LIVING SCHOOLYARD ACTIVITY GUIDE

UNITED STATES EDITION

green schoolyards america

greenschoolyards.org

In May each year, schools around the globe take their students outside to celebrate their grounds during International School Grounds Month. This event, coordinated by our colleagues at the International School Grounds Alliance, highlights the importance of outdoor learning and play at school for healthy development of children and youth, hands-on learning across the curricula, and daily access to nature for everyone in the school community.

School grounds should be places where young children can experiment with gravity by playing with water in their sandbox, use acorns to explore math concepts, build forts with friends, and engage all of their senses to explore their physical and natural surroundings. Older youth can use the school grounds to calculate sun angles, raise and prepare healthy foods in their school gardens, analyze stormwater as it flows across their school landscapes, and relax together for comfortable conversations under the shade of a tree. The possibilities for engaging children and youth with hands-on, place-based activities on school grounds are bounded only by imagination.

This *Living Schoolyard Activity Guide* contains over 130 activities for children and youth between the ages of 3-18 years old, written by 122 organizations from across the United States. Over 100 additional school ground activities can be found in the second book in our set, the *International School Grounds Month Activity Guide*, produced by our colleagues at the International School Grounds Alliance. These two books follow the same format, but include different activities. We encourage you to download both and use them together.

The activities in this set demonstrate the wide range of potential uses for school grounds—from providing spaces for place-based science and artistic expression to fostering imaginative play and community engagement. School ground activities can be implemented before, during, and after school, during class time or during free time. The *Activity Guides* also provide compelling arguments for including outdoor time in the school day, and shaping school grounds to facilitate the well-being of children and the environment.

We hope this *Activity Guide* set will encourage schools around the world to take their students outdoors in May and use their school grounds to their fullest year-round.

Visit greenschoolyards.org for free digital copies of both *Activity Guides*.

GREEN SCHOOLYARD AMERICA inspires and enables communities to enrich their school grounds and use them to improve children's well-being, learning, and play, while contributing to the ecological health and resilience of their cities. Our programs are designed to change the norm for school ground design and use, so that all children and youth will have access to the natural world, every day, right outside the classroom door.

LIVING SCHOOLYARD ACTIVITY GUIDE

United States Edition

This *Activity Guide* was published by Green Schoolyards America in honor of California's Living Schoolyard Month and the global celebration of International School Grounds Month, bold held in May. We regularly update the content and add new activity ideas. A digital copy is available free of charge on our website at: greenschoolyards.org.

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Green Schoolyards America greatly appreciates the collaboration of 122 author-organizations from across the USA and we extend our sincere and heartfelt thanks! Please see page 204 for a directory of contributing organizations and a map of their locations.

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Citations

Citations included throughout this book refer to the reference numbers listed below. Introductory article and chapter heading text © 2010–2018 Sharon Gamson Danks, adapted from materials previously published by this author.

1. Danks, Sharon Gamson. *Asphalt to Ecosystems: Design Ideas for Schoolyard Transformation*. Oakland, California, United States: New Village Press (November 2010).

2. ---. "The Green Schoolyard Movement." *The New Nature Movement: Guest Columns*, Children & Nature Network (February 6, 2014). Reprinted in this publication as "The School Grounds Movement," with author's permission.

3. ---. "The Power and Potential of Green Schoolyards." *The New Nature Movement: Guest Columns*, Children & Nature Network (February 7, 2014). Reprinted in this publication with author's permission.

4. International School Grounds Alliance: "Risk in Play & Learning: Ubud-Höör Declaration." International School Grounds Alliance (September 2017). internationalschoolgrounds.org/risk/

5. This section about "Self, Belonging, and Purpose" on page 69 was inspired by the Children's Wellbeing Initiative, a collaborative effort driven by a diverse network of change leaders, incubated by Ashoka, and supported by the Robert Wood Johnson Foundation. childrenswellbeing.com

Contents

INTRODUCTION

SCHOOL GROUND ACTIVITIES

APPENDICES

The Green Schoolyard Movement

When you think about typical school grounds, what image first comes to mind? For many people, school grounds are places covered by paved surfaces and manicured sports fields, adorned with a few, simple shrubs and trees, and one or two ordinary climbing structures. Most school grounds look the same, with very little variation to reflect unique aspects of each school community, the neighborhood's ecological or geographic context, or teachers' preferred curricula.

Children are masters at reading what Wendy Titman calls the "hidden curriculum" of school grounds, and understand the value adults place on them through the level of care given to their surroundings. The messages most traditional schoolyards send children about their place in the world is not reassuring—particularly in our cities where many school sites are paved and are home to very few living things.

Outside of school, spaces children can explore on their own have been shrinking over the last few generations, reducing children's domain from miles of free ranging territory to the limited zone between home and the end of the block. Schoolyards are now one of the only places many children are allowed to play outdoors on a daily basis, and they are increasingly important for fostering children's health and development. With this in mind, schools have a special responsibility to provide the next generation with outdoor experiences that help them develop their curiosity, their sense of adventure, a healthy lifestyle and a love of nature.

A green or "living" school ground movement is gaining momentum around the globe and has the potential to improve the lives of every child, every day. Schools are reshaping their conventional yards, designed for 1940s educational methods, and creating beautiful, ecologically diverse landscapes with an eye toward the future. School ground greening creates rich environments that connect nature and environmental sustainability with place-based learning, hands-on curricula, and imaginative play, while also building community.

The movement is growing around the world, and we invite you to join us in this vitally important work.

What are living school grounds?

"Living school grounds are richly layered outdoor environments that strengthen local ecological systems while providing place-based, hands-on learning resources for children and youth of all ages. They are child-centered places that foster empathy, exploration, adventure and a wide range of play and social opportunities, while enhancing health and well-being and engaging the community." *—Sharon Danks, Green Schoolyards America*

WHY ENRICH SCHOOL GROUNDS?

Teach place-based understanding. Living schoolyards provide opportunities for students to tune in to their surroundings and get hands-on experience with nature while gaining a better understanding of their own neighborhoods. They help children mark the seasons with changes in wildlife migrations, colorful leaves in autumn, and the length of shadows on the ground. They bring watershed education to life, as classes step outside when it rains to watch the rain flow off their school building, through a downspout, and out into the school's rain garden or cistern. Many excellent, low-cost educational resources sit right outside the classroom doors, waiting to be tapped.

Practice stewardship. Ecologically-rich schoolyards address important environmental issues in ways that even young children can participate in and understand. Students can identify place-based environmental concerns themselves and become empowered to repair them, enriching their own corner of the world with their ingenuity. While these individual actions may be small, together these projects can fundamentally improve the local environment and profoundly change the way that students understand their place in the world. This is an inspiring and optimistic way to approach the field of environmental education.

Foster adventure, wonder and health. Green school grounds foster children's social, physical and intellectual growth by providing settings for imagination, exploration, adventure and wonder, and serve as dynamic environments in which to run, hop, skip, jump, twirl, eat and play in active, challenging and creative ways. Enriched school grounds provide child-driven, play-based solutions to the obesity epidemic and can promote healthier lifestyles through increased physical activity and nutrition-oriented gardening and cooking programs.

Engage the community. Living schoolyards teach ecological literacy, invigorate children's bodies, open and inspire young minds, and knit our communities more closely together in the process. Successful green schoolyards are the product of many hands that harness the collaborative potential of their school communities. Like the barn raisings of previous generations, cooperation among community members reinforces interdependence, local self-reliance and a sense of community creating useful, beautiful places at low cost. When parents, teachers and students work together to improve their school and grounds, they foster closer relationships that in turn support student achievement and well-being. This movement shifts the way our society views these important, shared public spaces, and supports school district land management efforts with the energy of community partners.

The transition from a conventional, paved schoolyard to a living schoolyard can be dramatic and opens up a variety of opportunities for children to learn, play and explore.

MODEL THE FUTURE YOU WOULD LIKE TO SEE

Well-designed green schoolyards model the ecologically-rich cities we would like to inhabit, at a smaller scale, and teach the next generation how to live more lightly on the Earth—shaping places where urbanization and nature coexist and natural systems are prominent and visible, for all to enjoy.

They inspire students and their communities with organic food production, wildlife habitat, energy conservation and production, rainwater collection and management, sustainable design practices and creative artwork. By teaching students to explore their environment with their hands, hearts, and minds—whether they are climbing into a tree house or tackling the challenges of the surrounding world—living schoolyards help us to plant seeds that will blossom as children grow up and help to shape an ecologically literate society.

We are all important participants of the green schoolyard movement. You can help it reach its potential to touch children in every neighborhood—by starting with your own. Get a conversation going with your neighbors, the principal at your local school, and your school district administrators. Dream of the school environment you would like to see for our children, and then help to shape this reality at your local school. The schoolyards of tomorrow will be what you and your community make them.

Reference: This introduction by Sharon Danks was first published as an article entitled, "The Green Schoolyard Movement," in the Children & Nature Network's *The New Nature Movement: Guest Columns* blog, Feb. 6, 2014.

Environmental city planner Sharon Danks is CEO of Green Schoolyards America, based in Berkeley, California, USA. She is a co-founder of the International School Grounds Alliance and the author of the book, *Asphalt to Ecosystems: Design Ideas for Schoolyard Transformation.* Her work transforms school grounds into vibrant public spaces that reflect and enhance local ecology, engage the community, and nurture children as they learn and play.

The Power and Potential of Green Schoolyards

Public school districts are one of the largest landowners in almost every city and town across the United States and around the world. In the United States alone, over 98,000 public schools in nearly 13,500 school districts serve more than 50 million pre-kindergarten to 12th grade students each year.

Choices made by school districts about how they manage their landscapes profoundly impact their city and generations of local residents whose perspectives are shaped through daily, outdoor experiences at school. A movement to green school grounds and connect students to nature is gaining momentum in the United States and around the globe, weaving the ideas of urban sustainability and ecological design together with academic achievement, public health, children's wellbeing, sense of place, and community engagement.

Green schoolyards bring nature back to cities and suburbs by transforming barren asphalt and ordinary grass into vibrant environments for learning and play, set within the context of the rich, local ecosystems that nurture wildlife and the natural processes that underlie and sustain our urban infrastructure. Green schoolyards foster children's social, physical, and intellectual growth and health by providing settings for curiosity, collaboration, imagination, exploration, adventure, and wonder.

If, as a society, we can turn our attention and resources toward creating school district-wide, ecological systems-based improvements to school grounds, we will make significant progress in addressing complex inter-related problems. Large scale schoolyard greening efforts, if implemented across our cities, have the potential to provide:

ACCESS TO NATURE

Daily nature access. If green schoolyards can be built at every school, they will provide every child in every city with high quality access to nearby nature on a daily basis—democratizing nature access across socio-economic, racial and cultural lines.

Balance. Hands-on, daily access to nature on school grounds helps to balance real-world, sensory experiences with our increasingly digital world.

Sense of place. Green schoolyards, built with local, natural materials and native plants, are each unique, reflecting the geography, ecology, and culture of their community and building a sense of place for children and adults who spend time in them.

ECOLOGICAL INFRASTRUCTURE REPAIR

Water. School grounds designed to manage stormwater can be beautiful and educational while containing and conserving rainwater and purifying urban runoff.

Habitat. Schoolyard landscapes planted with native vegetation can complement local habitat conservation plans and add many additional acres to support wildlife.

Climate. Trees and shrubs can be placed to provide shade for children and school buildings, reducing sun exposure, urban heat island effects, and interior cooling costs for school buildings.

Energy. School grounds can host renewable energy demonstration systems that power decorative fountains—or the school—teaching children and their communities about clean energy.

Materials. Landscape features designed using sustainable, natural and recycled building materials demonstrate green building practices and reduce a school district's impact on landfills and other urban infrastructure.

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IMPROVED TEACHING AND LEARNING ENVIRONMENTS

Educational attainment. Studies show that many children learn better with hands-on experiences in the types of outdoor settings green schoolyards afford.

Improved teacher satisfaction. Outdoor teaching environments are also appreciated by teachers who benefit from abundant teaching resources, conveniently located near their classrooms, and the variety and diversity of experiences found in outside.

Reduced bullying. Green schoolyards promote imaginative play and provide variety and diversity in children's social and play environments, reducing boredom, shifting social leadership structures, and leading to fewer disciplinary problems such as playground bullying.

HEALTH AND WELL-BEING

Obesity prevention. Green schoolyard environments that provide opportunities for exploration and imagination offer child-driven, play-based solutions to the obesity epidemic.

Healthier lifestyles. Green schoolyards promote healthier lifestyles through increased physical activity and nutrition-oriented gardening and cooking programs. They are also settings for learning new skills that foster lifelong health, from balance to water safety and tool use.

Improved well-being. Green spaces of all types have therapeutic properties that lower our blood pressure, help us relax and provide other benefits that improve well-being of children, teachers, school administrators, and visitors.

COMMUNITY ENGAGEMENT

Empowerment. Green schoolyards are places where children of all ages can gain experience repairing their own local ecosystems and make a difference in our world. They are places where collaborative environmental action leads to clear, positive results that counter Ecophobia and build our confidence in the power of working together—sending messages of optimism and hope to children and adults alike.

Stewardship. By transforming the idea of schoolyard "maintenance" into the broader concept of "stewardship", school communities can become partners with their school districts and collaborate to reduce management costs while fostering increased parent involvement and community building.

THE TIME IS RIGHT

Green schoolyards are a central piece of a wider vision to restore our relationship with the natural world. The time is right to invest much more significantly in our school grounds across the country. The green schoolyard movement has the power to bring nature to every child, every day while improving our local ecosystems, learning environments, and health.

School grounds can foster active and imaginative play onsite using natural materials and vegetation and by installing thoughtfully designed play structures that offer open-ended play opportunities and frameworks for child-driven games.

Small scale green schoolyard projects now exist around the U.S., showing incredible promise but generally lacking the larger scale investments that can help them to reach their full potential.

This is a call to scale up our green schoolyard work from coast to coast, and empower school districts to lead this paradigm shift with increased support from their communities, public institutions, local utilities, healthcare institutions, and other like-minded organizations and partners.

Combining our resources in one place—school grounds—will multiply benefits for our cities and our children in the years to come. Is it hard? Yes, but we know where to start and together we can change our course.

Reference: This introduction by Sharon Danks was first published as an article entitled, "The Power and Potential of Green Schoolyards," in the Children & Nature Network's *The New Nature Movement: Guest Columns* blog, Feb. 7, 2014. Photographs and text © Sharon Gamson Danks, 2005-2018.

Progress: Schoolyard Policy in California

The movement to enrich outdoor learning environments on school grounds and connect children with nature took an important leap forward with the adoption of a California state resolution in 2014. The resolution encourages school districts across the state to design and construct schoolyard green spaces and use them to teach academic curricula outdoors. Authored by Assemblymember Phil Ting of San Francisco, the Living Schoolyard Month resolution (ACR-128), adopted on June 16, 2014, also established an annual state-wide celebration of school grounds to be held each May.

Support for vibrant outdoor classrooms has been gaining momentum over the last few decades in California, across the United States, and around the world. California has been a national leader in the school garden movement since 1995, when then-Superintendent of Public Instruction Delaine Eastin collaborated with chef Alice Waters to create the Garden in Every School initiative through the California Department of Education. In 1999, the state established the Instructional School Gardens Program (AB 1014) to support garden-based learning. Over the years, tens of thousands of children have enjoyed school gardens inspired by these efforts, and learned firsthand about horticulture, nutrition and a variety of academic disciplines. To promote continued growth of these programs, California passed legislation in 2006 (AB 1535) that provided a total of $15 million in school garden grant funds for equipment, supplies, and related professional development for 3,500 school sites.

The 2014 Living Schoolyard Month resolution is an important milestone in California's approach to promoting outdoor green spaces for all children in K-12 public schools and for the state's thriving green schoolyard movement. Building on the success of previous school garden programs, it expands the depth and breadth of outdoor education beyond horticulture and nutrition to connect schoolyard greening to the health of urban ecosystems, child development needs, and the quality of life for students and their school communities.

CONNECTION TO SCHOOLYARDS ABROAD

California's adoption of Living Schoolyard Month holds great promise for children throughout the state and is also significant for the wider, international green schoolyard movement because it highlights the ongoing dialogue between efforts in California and those in other states and countries.

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California's resolution was strongly influenced by the *Westerbeke Declaration on School Grounds* (http://bit.ly/ISGA-WestDec), produced by a global nonprofit organization called the International School Grounds Alliance (ISGA). Written collaboratively by leaders in the school ground field from thirty-one organizations in seven countries, the *Westerbeke Declaration* expresses a vision for using school grounds to improve children's well-being. The adoption of the Living Schoolyard Month Resolution (ACR-128) marks the first time the *Westerbeke Declaration* has inspired public policy, and it is hoped that the message it expresses will resonate with institutions in other states and countries in the years to come.

The annual celebration component of California's Living Schoolyard Month is also intentionally aligned with ISGA's annual May festival, International School Grounds Month, so students around the world will celebrate their school grounds simultaneously.

HOW CAN YOU GET INVOLVED?

Public support is very important to the success of green schoolyard programs. Whether or not you live in California, you can:

- Plan a project to enrich your schoolyard or assist a local school by volunteering on a schoolyard work day
- Organize events to celebrate and use your school's existing green space
- Spread the word about International School Grounds Month and Living Schoolyard Month
- Recommend that your city government include schoolyard ecology as a component of their green city plans
- Encourage your school district to support living schoolyards and outdoor classrooms that improve children's learning and play environments and enhance neighborhood ecology
- Put the activities in this Guide to good use with pre K-12 students at your local school
- Write about your May school ground celebrations and share them with us at info@greenschoolyards.org (See page 21 for details.)
- Join California's statewide Living Schoolyard Network by contacting Sharon Danks, CEO, Green Schoolyards America at info@greenschoolyards.org

With your help to spread the word in California and around the world, celebrations of Living Schoolyard Month and International School Grounds Month will bring the benefits of green schoolyards to an increasing number of schools, and thousands more children will go outside to learn, explore and discover the world just outside their classroom door.

Reference: Adapted from an article by Sharon Danks entitled "Living Schoolyards for California", published by Children & Nature Network in *The New Nature Movement: Guest Columns* blog, August 20, 2014. Photographs and text © Sharon Gamson Danks, 2005-2018.


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About this Guide

The *Living Schoolyard Activity Guide* is the result of a fruitful collaboration between Green Schoolyards America and our colleagues at 122 organizations across the United States. We hope this collection will inspire you to dream up outdoor activities for your own school, wherever you live.

This *Activity Guide* is divided into chapters that focus on a variety of themes that illustrate the ways that school grounds can be used before, during, and after school hours. Each chapter's introduction provides a broad overview and rationale for the theme, and describes the types of activities included in that chapter. Since many activities provide multiple benefits or have multiple uses, many chapters also reference activities found in other parts of this book.

There are 131 activities in this *Guide*. Each has its own page that contains all of the information needed to successfully complete the project, including directions and a list of any necessary materials. Each activity has a proposed age range, although activities can often be adapted to serve a broader range of students. Many of the projects can also be adapted for other age groups. A directory of the author-organizations that contributed their ideas to this book is included on page 204.

The *Living Schoolyard Activity Guide* is intended to be used with its companion, the *International School Grounds Month Activity Guide*, produced by our colleagues at the International School Grounds Alliance. For more information on how to download the second book with additional school ground activities, please see page 217.

Both of the school ground *Activity Guides* in this set are updated regularly with new activity ideas. Please visit our website to download a free copy: **greenschoolyards.org**

Green Schoolyards America inspires and enables communities to enrich their school grounds and use them to improve children's well-being, learning, and play while contributing to the ecological health and resilience of their cities. Our work includes:

- Research. We conduct research that connects children's well-being and academic achievement to the ecological health of their school ground and neighborhood environments.
- Policy. We advocate for policies that enable school grounds to become dynamic, multi-use, nature-filled public spaces that improve the well-being of children and the environment at the same time.
- Support. We partner with school districts, public agencies and other colleagues to develop city- and state-wide living school ground initiatives. We also offer public presentations, professional development, and publications.

Celebrate in May—and Year Round!

May is the annual, global celebration of International School Grounds Month, coordinated by our colleagues at the International School Grounds Alliance. The State of California has adopted this May event and also celebrates Living Schoolyard Month at this time. Green Schoolyards America's *Living Schoolyard Activity Guide* was created to encourage schools across the United States, and around the world, to take their students outside for these events and throughout the year, to celebrate their grounds and use them to their fullest.

There is no right or wrong way to take part in International School Grounds Month. You can take academic lessons into your grounds, promote play outside, camp out in the schoolyard, or invite parents to the school to watch a play outdoors.

Time spent outdoors could be an hour, a day, or even a week! It could be during class time, during free time, or before or after school. Consider involving parents, community members, and other school staff who do not typically interact with students. Use the ideas in this *Activity Guide* or create your own!

After you have participated in International School Grounds Month, please share your adventures with us by following the directions in the box to the right. Documenting your stories in this way will help us to raise the visibility of the green schoolyard movement and to advocate for more supportive public policies in the future. Be sure to visit our website during and after the month of May to read about other schools' outdoor activities, near and far:

greenschoolyards.org

Share Your Celebration

Please tell us about your school ground adventures by sending us the following information:

- Name of your school
- School's location: city, state, country
- A brief description of how you celebrated International School Grounds Month or Living Schoolyards Month (100-400 words)
- Photo(s) showing your activity in progress. Please confirm you have permission to use the images and to share them with the public in print and online.
- Contact name and email address
- Age range and number of participating students
- School or project website

Please submit this information by email to: **info@greenschoolyards.org** . We will share many of the activity reports we receive by posting them on our website and social networks! Thank you!

Art

Living school grounds provide settings and inspiration for creative projects ranging from writing assignments to drawing, painting, mosaic, nature art, sculpture, music, dance, and theater.

Creative Expression. Schools can diversify the recreational offerings they provide to students of all ages during their outdoor free time by including an array of inexpensive or natural visual arts materials among their supplies. Unstructured "art time" allows students to get their hands dirty and express themselves creatively in ways that are not always possible during the rest of the school day. Schools can also provide supplies and encourage students to use their free time for their own writing, music, dance, and theater projects.

Outdoor Studio. Students of all ages benefit from art studio spaces that allow creativity to blossom—and that are easy to clean, comfortable, inviting, and spacious. Enriched school grounds can include formal or informal outdoor art studios that increase teaching space and accommodate messier art forms that are more difficult to practice inside. Almost any outdoor space can be a "studio" for art-related projects. The environment that surrounds the chosen work space often inspires creative reflection that echoes in the artwork created there. Outdoor studios also sometimes provide natural materials that become components of the finished pieces.

Outdoor Exhibits. Outdoor art installations turn ordinary school grounds into beautiful, memorable places that delight the eye and speak to the heart, while also showing students the school community cares about their environment. Temporary and permanent schoolyard artwork can reflect local culture, highlight regional ecosystems, and instill school spirit.[1]

Chapter Notes. The art activities that follow are organized according to the types of materials they use and their mode of creation. All of the art activities in this collection foster creative expression and many can be adapted to become outdoor exhibits.

DRAWING AND PAINTING

SCULPTURE, TEXTILES, AND CARPENTRY

CREATIVE WRITING

OUTDOOR EXHIBITS AND TEMPORARY INSTALATIONS

RELATED ACTIVITIES IN OTHER CHAPTERS

SHADES OF GREEN

© HERB BRODA

AGES

6–12 years old

CONTRIBUTED BY

Dr. Herb Broda, Ashland University
Ashland, Ohio
movingtheclassroomoutdoors.com

This activity challenges students to discriminate among many shades of the same color and it also gets kids outside taking a very careful, micro look at their surroundings.

MATERIALS

- Strips of paper approximately 3 in wide and 18 in – 24 in long (Old manila file folders are great for this.)
- Masking tape

PREPARATION

It helps to use a paved area or outdoor tables as your home base for distributing the sticky materials. This activity also works best on a day when the wind is relatively calm.

DIRECTIONS

Working in pairs, students collect small samples (about thumbnail size) of differing shades of green they find in the schoolyard. Usually, I ask pairs to bring in twelve to fifteen samples. As the groups return, give each pair a cardboard strip that has a piece of masking tape fastened sticky side up along the entire length. The group's task then is to look carefully at the samples collected and arrange them from lightest to darkest on the cardboard strip. After the strips are completed, lay them on the ground to create a color gallery.

This activity is wonderful for developing an attention to detail and works especially well if you limit the "search area" to a small space. The nearest green space right outside the schoolhouse door works just fine. The grasses and weeds in an average lawn are great for this activity. Be sure to emphasize that only a sample the size of a thumbnail is needed. Help students see that many leaves have different shades of green on the top and bottom.

VARIATIONS

This activity can really be used at any time of year. Although the spring and summer months are ideal to search for green, the fall is great for orange or red. In winter, look for shades of brown.

NATURE'S WATERCOLORS

© AYESHA ERCELAWN

AGES

5–10 years old

CONTRIBUTED BY

Ayesha Ercelawn, La Scuola
San Francisco, California
lascuolasf.org

In this art activity, children grind leaves and flowers with mortars and pestles to extract their beautiful colors. They love the physical process of crushing plants and are intrigued to find that the shades of color emerging are not quite what they expected. This can also be a sensory activity if fragrant herbs are used, can connect to the botanical sciences in the classroom, be looked at through the lens of traditional art materials, or be used as an example of biodegradable and sustainable art materials.

MATERIALS

- Mortars and pestles (or small cups and sticks)
- Heavy paper such as construction or watercolor paper
- Paintbrushes
- Water in a small container
- Artist paint palettes
- Leaves and flowers

DIRECTIONS

Demonstrate how to use a mortar and pestle by grinding four or five leaves with a few teaspoons of water. (Try this beforehand since some leaves work better than others.)

Let the children gather leaves and flower petals from the schoolyard to try making their own colors. They can experiment with one plant material at a time or see what emerges when they combine different leaves or flowers. Try not to let them dump a lot of water in since the delicate colors will be too diluted.

Have small pieces of paper available for children to test their colors and see if they like the shade they created or if they want to keep grinding. Share all of the students' different colors by pouring a little bit of each child's watercolor into a communal artist's palette for all children to use, together.

Finally, pass out heavy duty paper and let the students start creating their paintings.

NOTES

To extend this activity, you can also provide strainers and containers to extract just the liquid color. These colors will keep for a few days in the refrigerator without spoiling, or you can study the process of spoiling (and discuss preservatives, refrigeration, etc.) by keeping them on a shelf to watch how the colors change with age. Many soils also make beautiful colors.

CREATIVE PAINTING WITH "GARDEN PAINTBRUSHES"

© BIANCA PISANO

AGES

3–18 years old

CONTRIBUTED BY

Explore Ecology
Santa Barbara, California
exploreecology.org

Students search the schoolyard garden for two natural items to use as paintbrushes. After finding their own place to sit in the garden, students paint a picture using their "brushes". Then all students come together, share their artwork, and discuss whether or not their paintbrush worked the way they thought it would and why.

MATERIALS

- Paper
- A variety of natural materials to use as paintbrushes
- Tempera paint
- Clipboards

DIRECTIONS

Instruct the students to search the garden for two twigs, leaves, fruits or other natural items to use as their paintbrushes (about 5 minutes).

After each student has found a paintbrush, give each person a clipboard, one or two pieces of paper and one or more cups with paint in them. Students can show each other their brushes while they wait for everyone to get settled.

Instruct the students to find a place by themselves where they can sit peacefully and undistracted. Once everyone has found a comfortable place, ask them to close their eyes and detect smells or sounds around them. (30 seconds)

Ask each student to create a painting inspired by their setting, or assign them to create a piece of art with a given natural theme. For example, ask them to draw their favorite place in nature. (10-20 minutes painting time, depending on age)

If some students finish early, they can sit in their special spot and continue to observe nature around them. When the time is up, ask the students to gather and share their artwork. It is nice to have each student stand up, present their work, and describe what they painted.

Complete the session with a discussion of the success or problems with the paintbrushes they chose. Explore why each paintbrush worked or didn't work as expected.

PAINTING THE SEASONS

© MAIA DANKS

AGES

4–18 years old

CONTRIBUTED BY

Green Schoolyards America
Berkeley, California
greenschoolyards.org

Students select a place in their schoolyard that they will visit once each season to draw or paint the plants and trees as they appear in that month, and then compare them to their drawings of the same place at other times of the year. Materials and techniques used can vary with the students' ages.

MATERIALS

- Watercolor paints and paint brushes, colored pencils, crayons or oil pastels
- Paper suitable for painting or drawing
- One clipboard per student

PREPARATION

Select a location in your schoolyard to act as a temporary art studio. Find a space large enough to seat the whole class on the ground, near plants with a variety of shapes, sizes, and textures. Look for an area that includes deciduous trees or perennial shrubs that lose their leaves in the winter, flower in the spring, leaf out in the summer, and/or change color in the fall.

DIRECTIONS

Bring the class outside to the selected "art studio" and ask each student to find a comfortable place on the ground, near a plant or tree that they find interesting.

Give each student a clipboard prepared with paper, and their own drawing or painting supplies.

Ask the students to draw what they see using whatever type of drawing or painting technique is appropriate for their age. Younger students can focus on the basics of drawing from life and capturing the colors of the season. Older students may work on more complex techniques such as detailed scientific illustrations, perspective drawings, or refined watercolor techniques.

Ask each student to create two drawings or paintings: one that focuses on a plant detail, such as a small group of leaves or flowers, and another picture that shows a wider view, with the whole plant or tree in the image. Students can also to try to represent the colors they see as accurately as possible.

Revisit the same site and use the same drawing or painting techniques twice more during the school year, to capture seasonal changes in color and form, as they occur.

When the third set of drawings and paintings are finished, display the artwork as an exhibit that illustrates the changing seasons on your school grounds.

ACT LIKE LEOPOLD

AGES

5–10 years old

CONTRIBUTED BY

Aldo Leopold Nature Center
Monona, Wisconsin
AldoLeopoldNatureCenter.org

Aldo Leopold was a famous naturalist and teacher. He is perhaps most well-known for his book of nature-based sketches, stories, and observations, *A Sand County Almanac*. This activity encourages children to do things like Leopold. You can simply examine the natural world and record what you see and hear, or add other activities inspired by Leopold's writing and philosophy.

MATERIALS

- Journal or notebook
- Pencils or colored pencils
- Other optional materials such as a bird call app called Identiflyer (http://bit.ly/1Vx0o8c), matte frames, and binoculars

PREPARATION

Leopold loved to sit or hike in nature and record his observations. His stories often include the sounds he heard and give life to what he imagined the animals were enacting. For example, in the July chapter of *A Sand County Almanac,* he writes about rising at 3:30 am to sit outside with his dog, a pot of coffee and a notebook to record each bird he hears as the morning progresses. "At 3:35," he writes, "the nearest field sparrow avows, in a clear tenor chant, that he holds the jack pine copse north to the riverbank, and south to the old wagon track." He then adds robin, indigo bunting, wren, warbler, and others to his list until his "ear can no longer filter out priorities."

As an optional preparation, you can use Identiflyer or another bird app to introduce children to the local bird sounds they may hear.

DIRECTIONS

Give each child a journal and set of pencils. Find an outdoor location where everyone can sit comfortably and spread out.

Warm up the children's listening skills by having them close their eyes and simply point to the sounds they hear—these may be natural or man-made sounds.

Give students 5–10 minutes (depending on age and ability) to sit and observe whatever is happening around them. They can write about, sketch, or list what they see and hear.

Complete this activity 2–6 times throughout the year and note how their observations change throughout the seasons. Talk about the study of Phenology.

Compile the students' notes and sketches into an "almanac" like Leopold's.

EXTENSIONS

Provide binoculars and instructions on how to use them; include tips on how to best spot birds and other wildlife.

Provide cardboard matte frames and allow children to place them around an image or area they want to focus on. For example, they may lay it on the ground and focus on the plants and insects or, they may hold it at arm's length to frame a scene or landscape they want to focus on.

TREE WONDER

© SHARI WILSON

AGES

5–9 years old

CONTRIBUTED BY

Project Central
Kansas City, Kansas
projcentral.co

What's going on with trees in winter? This activity teaches your students about geometry, shapes, scale, and nature. You may also add a journaling or drawing component. The activity is ideal for going outside, even if for a short period of time, and is best done in winter months so tree branches can be seen. The activity can be adjusted for the age or grade level of your students.

MATERIALS

- Paper or notebooks
- Writing or drawing materials
- Protractors for older students
- Optional: blankets to sit on

BACKGROUND

Winter is the perfect time to observe trees without leaves, and appreciate their stark beauty. It is also easier to observe bird and squirrel nests, as well as the difference in the shape, size, and scale of branches.

DIRECTIONS

Take a few moments before going outside to talk with your students about the life cycle of trees and the winter season. What is the difference between deciduous trees and evergreen trees? Deciduous trees lose their leaves in winter, because they need sunlight and warmth to grow. In winter, with less sunshine and colder days, deciduous trees "hibernate" until springtime warmer weather causes them to sprout new leaves.

Bundle up and take along a blanket to sit on, if you like. Find an area with at least one tree, and ask the students to sit down a little distance away and observe the tree quietly.

What do they notice? Are there any nests in the tree? Any leaves left on the branches? Were there any birds or other animals in or around the tree? Ask them to look at the size and shape of the branches, and note how they get progressively smaller.

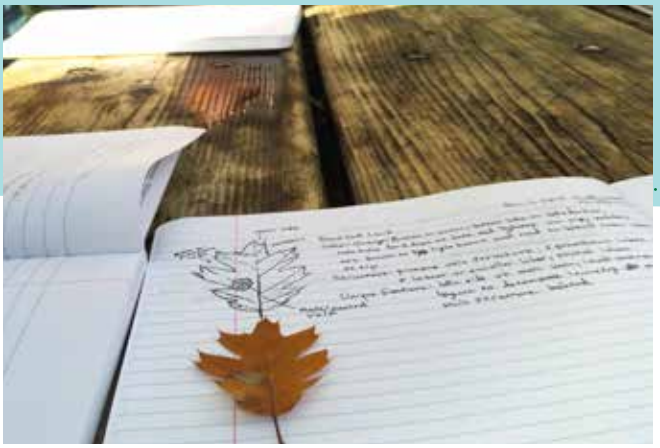
After a few minutes, ask the students to move closer to the tree and touch its trunk. What does it feel like? Is it different than other trees in the area? What is on the ground around the tree?

Ask the students to write or draw pictures about their observations. For older students, ask them to draw the branches of the tree so they can measure the angles with a protractor later. This part of the activity can be done in as little as 10–15 minutes.

Ask students to form small groups and share their observations. Depending on their age, students may write or draw a story about the tree.

© SHARON DANKS

OBJECT MATCH CHALLENGE



AGES

9–18 years old

CONTRIBUTED BY

California Native Plant Society
Sacramento, California
cnps.org

This is a great, hands-on, introductory activity for biology classes that can be done with students in a schoolyard. The goal of this exercise is to help students learn to provide sustained, focused attention on the details of a plant (or object) they choose, and to learn to describe and record what they see, in detail. This activity is a natural fit for lessons about herbivore predation, adaptations, photosynthesis, diversity, cells, respiration, and other biological topics.

MATERIALS

- Hard writing surface for each student (e.g. clipboard)
- Piece of paper and a pencil (or colored pencils) for each student
- Plant materials and other natural objects found in the schoolyard or local neighborhood. Fallen leaves work best, but a single leaf taken from a plant is also a good subject for study.

DIRECTIONS

Set the challenge for the students. Give them a few minutes to find a natural object in the schoolyard to study during this exercise (a biological focus). Once they find their object, they will draw it using the entire sheet of paper. Their drawings should be:

A = Accurate

B = Big

C = Clear

D = Detailed

E = Explained

These standards will set the tone for the students and allow their work to be compared to others in the class during a "match up" challenge at the end of the lesson.

Ask students to take their time and capture as much detail from their objects as possible.

As the students are working, the teacher should review their progress and encourage them to add more detail, explanations, colors, dimensions, and other subtleties of their object. This will help them to meet the "Explained" portion of the standard.

When the students have finished their drawings in an allotted amount of time (20–30 minutes), gather the group back together in a central location.

Ask the students place their papers in a circle on the ground, or on the perimeter of a table. Ask them to put their objects in the middle of the circle, but not near their own drawing.

Once all of the students have added their papers and objects to the circle, ask the entire class to work together to match each object with the corresponding drawing.

Debrief the class about which objects were the easiest to identify and match, and which ones were more difficult. What clues helped the students match their objects?

Use the drawing standard to guide the discussion. Ask broad questions to bring out their curiosity about the focus topic. The discussion may also continue in the classroom.

Reference: Adapted by San Francisco Unified School District from: California Native Plant Society, *Opening the World Through Nature Journaling*, Version 2.1, John Muir Laws. Used with permission. **http://bit.ly/22BgVq3**

BIRD HOUSE BUILDING

© WALDORF SCHOOL OF THE PENINSULA

AGES

8–18 years old

CONTRIBUTED BY

Waldorf School of the Peninsula
Los Altos, California
waldorfpeninsula.org

Building a birdhouse (or bat house) is a great project. At Waldorf School of the Peninsula, students build a birdhouse in Grade 4 during the winter months. This activity helps develop coordination and introduces bird ecology.

MATERIALS

- Redwood fence boards, 1 in × 6 in (2.5 cm x 15.25 cm), and 6 ft – 8 ft long (1.8 m – 2.5 m long), for a total of 4.5 linear feet (1.4 m) per bird house. Boards should be green and lightweight (not heartwood) with few knots and blemishes. It is best to use a wood that does not require treatment, including stains and oil.
- Small scrap wood to protect the birdhouse from clamps
- Nails: "5 Penny d" nails
- Hand-turned drills (two or three for the class), with bits for making the birdhouse hole and bits for the latch nail. The larger drills for making the birdhouse holes are more durable and the drill bits are larger and stronger.
- One per student: metal T-square rulers, small wood handled saw (the type that cuts on the push and pull stroke), lightweight hammer, metal clamp, pencil
- Sawhorses, 1 per three or four students
- Safety goggles, 1 per student

DIRECTIONS

Each type of bird requires a different type of house, with specific dimensions. Begin by researching what kind of birds you are hoping to house in order to select a species that lives in your area and to understand its needs.

At our school, students are given one full class day to practice measuring, sawing, and hammering on scrap wood before they begin. An alternative is to bring several adults for assistance.

There are many good plans for birdhouses. Here is a link to the plans we use: **http://bit.ly/1Ntow2X.** At our school, the teacher learns to build the birdhouse and uses the plans for reference. We do not provide the students with copies of the directions but instead show them a finished birdhouse and ask them to deconstruct it in their minds. When helping a student with the next step, other students watch and see if they can then accomplish the task on their own.

In the plans, you are directed to cut some of the boards down to 4 in (10 cm) wide. Experienced students can cut the boards themselves if boards are first cut to the proper lengths.

On nailing and finish work: Instruct the students to pull out any nails that are not true. Nails must be "flush" with the boards and the boards must be "flush" with each other, not showing large air gaps and mistakes. Cuts that are not straight must be fixed. Birdhouses are rasped, sanded and holes are patched with wood putty. Cracks are fixed with wood glue. Our goal is to make them beautiful as well as functional.

Our students take the birdhouses home when everyone is finished, which encourages the students to support each other in finishing their work. If students finish early, they team up to build another one for the school garden.

Reference: Adapted from Carolyn Brown and Anastasia Sinclair, "Bird House Building: Grade 3-4+," *Waldorf School Gardens of the Bay Area and Beyond.*
waldorfschoolgardens.com/lesson-plans/bird-house-building

MANDALA SUNCATCHERS

© KATHERINE KNIGHT

AGES

3–13 years old

CONTRIBUTED BY

Chicago Botanic Garden
Glencoe, Illinois
chicagobotanic.org

Loosely translated to mean "circle", a mandala is a symbol that represents wholeness, reminding us of the connectivity of all things in the universe. The design is usually patterned levels around a central image, growing from the inside-out. For children it is a good exercise in conceptualizing the many levels of community (family, friends, school) and networks (neighborhood, city, world) around them, and how they are all interrelated.

MATERIALS

- Two pieces of square, plastic contact paper, per person
- Assorted pressed flowers and foliage
- Scotch tape
- Scissors and a hole-punch
- Ribbon or yarn

DIRECTIONS

Discuss traditional mandalas and suncatchers. Students forage for natural materials like flowers and leaves, aiming for about 30–40 pieces each, depending on size. If possible, dry and press these materials.

Students receive one piece of contact paper, for size reference. Before using the contact paper, students design a draft of their mandala using natural materials.

Next, students each receive tape and the second piece of contact paper. Students remove the protective sheet and place the contact paper sticky-side-up. Tape down the contact paper corners to ensure it stays in place.

Students transfer materials from their drafts onto the sticky contact paper, then remove the tape from the corners.

Starting from one side, slowly lay the remaining contact paper sticky side down on top of the designs, smoothing and pressing out air bubbles. Our class partners up for this part to make sure the design comes out as intended.

Students cut off excess contact paper, staying about an inch away from their design.

Punch a hole at the top, thread a piece of yarn through, and tie it off so that the finished product can be hung up.

Students may want to hold their designs up to a bright light to show off their creations and describe the meaning behind their design or what their layers represent.

FABRIC SUN PRINTS

© ERIN MARTEAL

AGES

6–18 years old

CONTRIBUTED BY

Ithaca Children's Garden
Ithaca, New York
ithacachildrensgarden.org

Harness the power of the sun to create "photographs" of natural materials on fabric. Botanists in the 1800s utilized cyanotypes, an early photographic process, to capture the images of plant specimens. You can mimic that process using fabric paint, the natural materials found on your school grounds, and infrared light from the sun.

MATERIALS

- 100% cotton fabric (e.g. muslin), cut to fit on a clipboard
- Clipboards, 1 per child
- Masking tape
- Setacolor Transparent Paint in at least 3 colors (available online, e.g.: http://bit.ly/SetaColorPaint)
- Small cups and foam paint brushes
- Water
- Natural materials you collect such as flowers, petals, leaves, feathers, twigs, small rocks, and blades of grass

DIRECTIONS

Attach the fabric to the clipboards and add masking tape to secure the bottom corners. You'll need one per child. Pour small amounts paint into cups and dilute with a few drops of water. Stir to blend. Put one brush in each cup.

Let the children explore the environment, collecting natural materials such as flowers, petals, leaves, feathers, twigs, small rocks, and blades of grass. Show the children how to use a foam brush to paint the fabric with the diluted paint. Be sure to cover the entire piece of fabric. The colors will blend like watercolors.

Encourage the children to arrange the natural materials they collected on top of the painted fabric. Press flowers, petals, and leaves so they adhere to the damp fabric. Use pebbles to weigh down the corners of large leaves or any materials that are not flush with the fabric.

Place clipboards with attached fabric in the sun until they are dry. Drying takes 15–60 minutes, depending on how bright and warm the day is. Once dry, carefully remove the natural materials to reveal the prints on the fabric.

Use your sun prints as placemats, flags, or bandanas. String them together to make a banner. If you plan to wash the sun prints, iron the fabric to set the color.

HOW DOES IT WORK?

Water evaporates from the fabric exposed to sunlight faster than the fabric covered by the natural materials. As this happens, the drying fabric sucks the moisture, including the paint pigment, from the fabric covered by the natural materials. This leaves a shadow of faded color where the natural materials were covering the fabric. (On really hot, sunny days those areas will be white.) Although this is different than the chemical process used by botanists creating cyanotype prints on paper, the technique and results are similar.

USING IPADS TO TELL STUDENT-CREATED STORIESAGES

© SCOTT ASHMANN

AGES

4–8 years old

CONTRIBUTED BY

OAK Learning Center
at the Bay Beach Wildlife Sanctuary
Green Bay, Wisconsin
baybeachwildlife.com/kindergarten

Students tend to be curious about the environment. Part of this curiosity can be expressed through the development of stories about animals, plants, habitats, etc. In this activity, students take outdoor photos with an iPad, then use an app to create a story that includes both the photos and a corresponding audio file with a narrative. This works well with preschool students, since they do not write well enough yet to create a fluent written story.

MATERIALS

– iPad with an app such as StoryCreator

DIRECTIONS

Students use the iPad to take photos of interesting things outdoors, like a rabbit den or a squirrel nest.

At our school, the students were learning about what they need to survive—for example, food, water, shelter, and space—the basic elements of a habitat. They learn that animals need these same elements. Students describe their homes, and are then instructed to build a shelter for an animal, in this case a rabbit den.

Teacher and students discuss the shape and structure of the den, its size, any items to include, such as leaves for food or to act as bedding. Sand can be placed at the den's entrance to capture animal tracks to see if a rabbit (or other animal) uses this shelter when the students are not around. Students compare and contrast their home with the rabbit den, and then explore the homes of other animals "in the neighborhood," such as squirrel nests built high up in a tree.

Our students took more photos of "the neighborhood" where their rabbit den is located, such as the squirrel nest and a nearby pond.

We use an app called StoryCreator to upload the students' chosen photos. Each photo becomes a "page" in the storybook. There is room to type a caption for the photo.

If preschool students are using the app, there is a feature which allows them to audio record their thoughts about each individual page of their story. For example, they might talk about the rabbit, where he lives, adventures with his neighbor the squirrel, and how the rabbit likes to fish in the pond.

Many literacy skills are practiced in the use of descriptive words, identification of the setting, sequencing of events, separating fact (e.g. rabbits need shelter) from fiction (e.g. the rabbit fishes in the pond), character development, and plot creation.

In addition, the app allows the student's own voice to become part of the story. This is a great assessment tool for teachers and a wonderful artifact of student work that can be shared with parents and family.

BUBBLE POETRY

© SARAH AMADOR

AGES

6–18 years old

CONTRIBUTED BY

Evergreen Elementary School
Rohnert Park, California
crpusd.schoolwires.net/evergreen

The joy of blowing bubbles is timeless, felt immediately by people of all ages. The experience borders on the magical and whimsical. This English Language Arts activity allows students of all ages to access the power of metaphor and imagery by comparing their bubble to experiences, feelings, and the world around them.

MATERIALS

- Bubble solution
- Bubble makers (or wire hangers, anything that can make a closed shape)
- Bubble containers
- Journals and pencils

DIRECTIONS

What is metaphor? What is imagery? These are questions English teachers ask students every year. This Bubble Poetry lesson provides an easy, inexpensive and engaging way for students to apply these concepts to poetry.

I like to ask, "What does the bubble compare to? Is it the earth? A ball?" One of my first grade students is in love with monster trucks, so of course he imagines his bubble to be a monster truck wheel rolling across the sky. It's delightful to see students using their imaginations and being creative, not only with words but also with their bodies. Recently, my first grade students used their hands to make giant bubbles, quite successfully!

Invite four or five students to blow bubbles. Encourage the remaining students to run and pop as many bubbles as possible. That's the physical part of this lesson. If available, visit an adjoining park or run around a field. The more contact with nature, the better! Rotate the students who wish to blow bubbles, so that everyone gets a turn.

Direct students to write poetry about their bubble using metaphor, imagery, and adjectives. Encourage them to sit under a tree or find a quiet spot. A sentence frame for the first line might look like this, "My bubble is a [noun]."

I've taught this lesson to all ages, from seniors in high school to first graders. All of them find themselves able to access the power of metaphor and imagery, by simply comparing the bubble to experiences, feelings, and the physical world around them. Older students get to reconnect with their inner child, and witness the joyful laughter that bubbles spontaneously from the younger students.

Reference: Activity written by Sarah Amador.

POETRY IN THE GARDEN

© OPENLANDS

AGES

8–18 years old

CONTRIBUTED BY

Openlands
Chicago, Illinois
openlands.org

Students explore the garden independently and write poetry to communicate their observations and reactions to being in the garden. As a wrap up, students share their poems with each other, and nominate poems for a class-wide poetry slam.

MATERIALS

- Pencils
- Journal or sheets of paper
- Clipboards (optional)

PREPARATION

Walk through the garden space to ensure that it is ready for your students. Where will you be asking your students to go? Are there particular paths for them to stay on? Are there any defined borders?

You may want to involve students in a different grade. If you teach fourth grade, connect with a first grade class, and go outside to write poetry together.

DIRECTIONS

Explain that class will be held outside to write poetry.

Ask students what kind of poetry they have written before. Begin with three prompts for students to use when writing poems. "Write a poem about: something you observe in the garden; anything that crosses your mind while in the garden, or anything else you'd like."

Students should record the prompts in their journals or on their blank sheet of paper.

Poetry writing. Students bring writing materials outside with them. Students spend about 15 minutes writing their poems. Pick a meeting place for everyone to come back together when they are done.

Poetry slam. Gather students into groups of three to four people to share poems with each other. Bring the class back together after about 10 minutes. Students nominate classmates to read their poems aloud in a Poetry Slam. Perhaps your school garden has a space that could act as a stage for the poets.

PLACE-BASED ART INSPIRED BY ANDY GOLDSWORTHY

© SUSIE HOBART

AGES

6–18 years old

CONTRIBUTED BY

Lake View Elementary School
Madison, Wisconsin
lakeview.madison.k12.wi.us

Our students collect natural materials from the schoolyard to create temporary story sculptures and framed art, drawing upon the character of the school environment. A gallery walk allows students to observe the art, tell his/her story, and take photographs. Students return objects to the grounds and use the photographs to write a story. The stories and photos are displayed around the school or classroom.

MATERIALS

- Natural elements collected by students from the surrounding environment (leaves, rocks, branches, etc.)

BACKGROUND

British artist, Andy Goldsworthy, creates site-specific art using primarily natural materials. Goldsworthy notes, "Design implies a sense of mapping something out, and then you follow the plan; [but] these things grow, and the process of making it parallels that of growth. It's a lot more unpredictable, and with far more compromises with the day, the weather, the material."

This style of place-based nature art fits perfectly in the schoolyard. Students are growing and learning and will leave the school as they grow up. Their time in the school is temporary, and the art created in the environment, matches that idea: they are present today and can create from that mindset.

Students are often corralled into planning projects. In Andy Goldsworthy's style, going outside and free-forming creatively, students can go with their mood, use the objects that are available, and as they create the art, they can spin the story that goes with it.

We adapted the "nature frame art" from an educator's workshop at Community Groundworks, Madison, Wisconsin.

Reference: Activity written by Susan Hobart. An interview with Andy Goldsworthy can be found at: **http://n.pr/1VHB0rp**

DIRECTIONS

The art teacher presents Mr. Goldsworthy's works and highlights his biography as an artist. (Use books or online materials to inform the teacher's background.)

Students and their teacher go outside to collect materials. The students then build sculptures or 2D art in an empty frame using the materials they found.

When the pieces are complete, the students view each other's work on a gallery walk, share their stories and talk about their pieces. This builds oral literacy and community.

Students then discuss what exists in the schoolyard, making connections to natural systems and processes, and building environmental literacy. Next, the students photograph their art, for use in writing a story.

The photographs and accompanying stories may be displayed in an art exhibition at the school.

FROZEN SCHOOLYARD ART GALLERY

© SHARON DANKS

AGES

3–7 years old

CONTRIBUTED BY

Green Schoolyards America
Berkeley, California
greenschoolyards.org

When daytime temperatures in the winter fall below freezing, it's time to go outside and make some beautiful temporary artwork with young children. This art project uses natural, local materials to create an ephemeral schoolyard art gallery.

MATERIALS

- Reusable plastic lids with rims, saved from large yogurt or food storage containers (1 or 2 per child)
- Sticks, leaves, gravel, acorns, seeds, sand, and other natural materials gathered by the children from their school grounds and/or in their own backyards
- Other natural materials such as fresh flowers with brightly colored petals, dried flowers, or small seashells
- Empty egg cartons, muffin pans, or other containers for collecting and carrying small natural objects while hunting for them, outside (1 for each child, if possible)
- Water, a small watering can, and a wide bowl
- Food coloring (optional)
- Twine made from natural materials (e.g. jute, cotton, wool), cut into 6 in (15 cm) lengths, and knotted to form loops.
- Protected outdoor location to allow projects to freeze
- Several rimmed cookie sheets or trays to carry artwork

DIRECTIONS

Begin by bringing the children outside onto the school grounds on a crisp, clear winter day, when temperatures have been consistently below freezing. Ensure that each child is appropriately dressed for the weather.

Give the children containers and ask them to explore the yard for 5–10 minutes to find and collect small samples of natural materials they see on the ground. Examples: sticks, leaves, gravel, acorns, seeds, sand, etc.

Gather the children and their materials around an outdoor picnic table or a clear patch of level ground. Place the natural materials in the center, where everyone can reach them. Distribute one or two plastic lids to each child.

Ask the children to arrange the natural materials in their empty lid to create a composition they find pleasing. When their compositions are complete, collect the plastic lids on the shared trays. Bring the trays to a protected outdoor location where they will not be disturbed.

Guide the children in slowly pouring a small amount of water into their own lid, until it is filled at least 0.25 in (0.6 cm) deep. The water will slightly shift the lighter items. (Discuss which items float, which don't, and why.) Add a few drops of food coloring, if desired. Place the knotted end of a loop of twine into the water at the edge of each piece.

Allow the artwork to freeze, undisturbed. When the water is completely frozen, release the artwork from the lids by resting the bottom of each lid briefly in a warm pan of water. Hang the resulting frozen ornaments in the schoolyard to create a temporary outdoor art gallery.

WINTERBERRY WREATH

© PAUL SIMON

AGES

4–18 years old

CONTRIBUTED BY

KidsGardening
Burlington, Vermont
kidsgardening.org

The winterberry holly is native to eastern North America and grows throughout the USA in climate zones 4 to 9. Winterberry is deciduous, dropping all its leaves during the fall season to unveil a densely packed assortment of bright red berries along its bare branches. These berries persist well into winter and feed many different species of birds. Its showy fruits also make winterberry an ideal plant for nature-made winter decorations.

MATERIALS

- Local natural area with shrubs that include berries (preferably winterberry)
- Hand pruners, wire coat hangers, and floral tape
- Lightweight floral wire or thin aluminum wire
- Craft or masking tape

DIRECTIONS

Begin by taking students on a journey to find established winterberry plantings in an area where you are allowed to collect. Winterberry shrubs thrive in saturated soil conditions with full to partial sun, often found along the edges of lakes and ponds. Take only what you need and leave plenty for the birds.

After gathering your winterberry cuttings, prepare an outdoor area to assemble your wreaths.

Encourage students to prune winterberry cuttings to similar lengths, about 6 in – 8 in (15 cm – 20 cm).

Reshape the base of each coat hanger into a circular form. (Adults can complete this for young children.) Secure sharp coat hanger ends with craft tape. This will serve as the base structure.

Using lightweight floral or aluminum wire, secure the branches around the base hanger. As each branch is secured, overlap the next branch, tightly securing each branch to the base hanger. Keep adding stems until the hanger is fully covered.

You can also add decorations such as flowers, ribbons, leaves or other greenery.

Aside from making great wreaths, winterberry makes a bright addition to the winter landscape. If you're adding them to your school grounds for the winter berries, keep in mind that the plants are dioecious, so the plants may be male or female. Only the female plants produce berries, and at least one male plant is needed for pollination and fruit-set. The best way to ensure you are buying a male or female plant is to purchase shrubs when flowers or berries are present.

Play

Enriched school grounds encourage exploration, imagination, relaxation, and free choice among a variety of recreational options, from ball games and climbing equipment to informal play in bushes, trees, and flowers. They include space for traditional sports and games with rules created by adults, as well as places for children to dream up their own games without adult involvement.

Free Play. Rich, interesting, well-designed green schoolyard spaces invite children to climb and run and swing and balance, to dig and pretend and create. They lend themselves well to creative play with art materials, musical instruments and performing arts. Their planted areas invite kids to engage in open-ended "nature play", find the little creatures that live in the soil, and unwind and explore "far-away lands" with their best friend from the comfort of a cozy corner of the schoolyard.[1]

Risk-Taking. Risk-taking allows children and young people to learn vital lessons about themselves and their world. These are lessons that cannot be taught and can only be learned through experience. Caution, resilience, courage, knowledge about one's own abilities and limitations, and the self-confidence to reach beyond them are learned through self-chosen action.[4]

Loose Parts Play. Including movable materials in school grounds adds depth to children's play experiences and affords many more opportunities to engage their imagination compared to static play structures or manufactured toys. Loose parts can include natural materials, such as sticks, stones, sand, pine cones, leaves, and straw bales, and manufactured materials such as plastic crates, cloth sheets, rope, and cardboard tubes. It's helpful to provide dedicated outdoor storage spaces for extended use of loose materials, so children will know where to find them.

Games. Many places are lucky to have a rich collection of traditional childhood games, handed down through the generations, or shaped by local neighborhood culture and opportunities presented by the local environment. Ball games and sports also play a key role on most school grounds around the world, and often include dedicated play spaces with well-defined boundaries and rules of play.

Shared Use. School grounds can become shared community resources after hours, providing multi-use, public recreational spaces within walking distance of every neighborhood. They are often the sites of weekend or after school sporting events and community festivals, and can be used creatively outside of school hours.[1]

IMAGINATIVE PLAY WITH LOOSE PARTS

GAMES

RELATED ACTIVITIES IN OTHER CHAPTERS

THE NATURE SWAP

© NATURE KIDS INSTITUTE

AGES

2–8 years old

CONTRIBUTED BY

Nature Kids Institute
Orangeville, California
naturekidsinstitute.org

Transform your plastic and unimaginative playthings into unbridled creativity by replacing play accessories with nature's loose parts!

MATERIALS

- Leaves, sticks, pine cones, rocks, acorns, pine needles, seashells, flowers, seed pods, and other natural materials.

DIRECTIONS

This activity restores a child's right to imagine and create their own fun! Does your play space for young children contain a play kitchen with plastic food? How about a toy barn full of animals, a doll house with dolls, or even a painting easel with brushes? If so, it's time to let nature shake things up!

Leave the play kitchen but remove the food, leave the barn but remove the animals, leave the doll house but remove the dolls, and (our absolute favorite) leave the painting easel but remove the paintbrushes.

Challenge children to find their own "food", "animals", "dolls", and "paintbrushes" using natural elements found around the school or natural materials that you provide.

You will be amazed by how creative children can be when they are not limited by the manufactured toys we offer them. Suddenly, little chefs are able to cook up anything they want, unheard of animals move into the barn, dolls become free to embody the full range of human diversity and behavior, and painting becomes a much more complex and tactile experience. In this play scenario, the creative decisions come from within the child instead of from without.

COLORED WATER EXPLORATION WITH RAMPS

© BETSY HEDGES

AGES

0–3 years old

CONTRIBUTED BY

Mills College Children's School
Oakland, California
millscollegechildrensschool.org

Water is often a pleasurable sensory experience for young children and provides unlimited opportunities for learning by supporting children's social-emotional growth, eye-had coordination, and language skills. This activity allows infants and toddlers to explore the various components of water that strengthen their cognitive and scientific understanding of gravity and color mixing. The children engage in both parallel and cooperative play as they explore how water moves through ramps.

MATERIALS

- 2–3 rain gutters, at least 4 ft – 5 ft (1.2 m – 1.5 m) long each
- Liquid watercolor paint and water
- Buckets, cups, and scoopers
- Sensory table and/or plastic bins
- Duct tape

DIRECTIONS

This activity is easy to set up and requires few materials. First, find a shady and spacious spot in the yard. Next, attach a long rain gutter to the edges of a sensory table or plastic bin using duct tape. Connect the other end of the gutter to a second plastic bin (preferably a clear one). Fill the inside of the sensory table and bins with water and add a different color of watercolor paint to each one. Select two colors that will blend well.

Our school finds it helpful to provide more than one gutter, as this allows the infants and toddlers more space to explore independently. Having multiple gutters also allows enough space for several children to comfortably access the materials, which reduces the potential for conflict. You can connect additional bins to the added gutters, or just allow them to rest on the ground.

Provide buckets, cups, or scoopers for the children to use to pour the water.

We often invite the children to help set up this activity. They enjoy choosing where the gutters should be taped and take turns holding the hose to fill up the water table and bins. When the children are involved in the set up of a curriculum project, they often take pride and ownership of the activity.

When the activity set up is complete, ask a teacher to model how the colors can be mixed by scooping water from the sensory table and pouring it into the gutter connected to the bin with the second color. Highlight what changes when the colors are mixed. (Example: "When I poured the red water into the blue water, it turned purple!") This is a great opportunity for providing descriptive language for the children.

After modeling how the water can be poured into the gutters, step back and allow the children to explore, carefully observing their discoveries as they unfold.

Reference: Activity created by Betsy Hedges and Seferina Rivera.

"EVERYBODY'S IT" TAG

© PLAYWORKS

AGES

4–10 years old

CONTRIBUTED BY

Playworks
Oakland, California
playworks.org

This twist on a classic game of tag will get kids moving and help develop their hand-eye coordination and spatial awareness. This activity is best for a large group of kids (ten or more).

© LISA HOWARD

MATERIALS

No materials are necessary for this activity, but adult leaders should establish boundaries in a relatively small, safe area so that constant motion is encouraged.

PREPARATION

Demonstrate safe tagging: light touch, like a butterfly's wings, on the shoulder

Explain and avoid unsafe tagging: hard contact that might cause the person being tagged to fall

Review the boundaries and the consequences for going outside them. Students who go out of bounds will have their count started over from zero and will need to perform ten jumping jacks to get back into the game.

DIRECTIONS

The object is for players to tag other players and keep a running count of everyone they touch in three minutes.

No one person is "it" and no one stops playing or "freezes" when tagged.

VARIATIONS

- Adjusting the length of the game and the location of the boundaries, between rounds, can add fun and variety.
- If someone is tagged, they must subtract one from their running tag count.

JUMP THE RIVER

© PLAYWORKS

AGES

4–7 years old

CONTRIBUTED BY

Playworks
Oakland, California
playworks.org

This fun jumping game brings play into the classroom. Teachers can integrate this game into lessons about rivers or ways people travel. During the activity, children learn and practice different jumping skills. The game can also be adapted for indoor use.

MATERIALS

- Jump ropes and chalk
- Optional: hula hoops, small logs or "found objects"

PREPARATION

Arrange "obstacles" like sticks or small logs on the ground, or use jump ropes arranged in two lines, to create "terrain" for players to jump over. Obstacles can also be represented by chalked lines on the pavement. If you have an actual stream in the area you are using, that works well, too!

© SHARON DANKS

DIRECTIONS

Explain to the children that they are taking a walk in the woods and may need to cross a stream or river. Ask the children to walk throughout the prepared space and when they come to a "river" (the objects or chalk lines on the ground) they need to jump over it without getting their feet wet. Children should work independently.

When landing, children should land on two feet, spreading their feet about shoulder width apart so they have a wide base of support when they land. After landing, children should proceed to and jump over the next river. Emphasis should be placed on landing on both feet at the same time without falling over.

Indoor version. Ask children to draw or paint their own rivers on large sheets of paper. Securely tape children's drawings to the floor and pretend that the class is going on a trip. When children reach the different rivers scattered throughout the room they must swing their arms and jump over the river, landing on the other side without falling over.

BIRDS AND WORMS: CAMOUFLAGE RELAY

AGES

3–10 years old

CONTRIBUTED BY

Michigan Project Learning Tree
Traverse City, Michigan
michiganplt.org

Students participate in a relay race while learning how animals use camouflage skills for protection and survival to hide from predators or to sneak up on their prey. This can serve as the basis for further investigations into animal adaptations.

MATERIALS

- About 60 small objects in at least three assorted colors—biodegradable items such as pasta, dry beans, breakfast cereal, small pieces of yarn, or colored paper—to represent worms and bugs.
- Large flip chart paper and markers to track results
- Photos of various animals camouflaged by their habitat

PREPARATION

Find a large open area outside and scout the site ahead of time to ensure there are no safety hazards or poisonous plants. Designate a relay space appropriate for the age group. Scatter equal numbers of each color of "worms and bugs" throughout the relay space ahead of time. Make sure to choose one color that is similar to the playing surface (green for grass, grey for asphalt, etc.).

DISCUSSION

Ask students to name advantages of why frogs are green and snowshoe hares are white (to blend in with surroundings, such as leaves and snow). Ask if they know what this is called (camouflage).

Have a discussion about why animals are able to hide from their predators (survival) or for predators to hide from their prey (element of surprise).

Ask students if some animals change color in different environments or seasons. Give examples of this that are specific to your area. For example, a snow-shoe hare is white in the winter but turns brown once the snow melts.

DIRECTIONS

Split students up in two to four equal-numbered teams and have them line up, relay style.

Let students know that they are hungry birds and there are tasty treats scattered throughout the playing field. Describe what the "worms and bugs" look like (noodles, yarn, etc.) and ask them to predict what the best color will be for the environment they are in.

When the teacher says "go" the first round of birds pick up the first worm or bug they see. When they return, the next person on their team does the same. Once the entire team has collected food, they all sit down. The first team to sit down wins that round.

Next, teams place their "worms and bugs" on a large white paper and sort them by color. Students discuss what they found (mostly bright colors).

After each relay, a record keeper tracks the colors collected and the amount of time it takes for each team to sit down. Conduct relay rounds until all small objects are found and track each time. Students repeat the sorting and recording process. During each consecutive round, it should take longer to find "worms and bugs".

What happened? Ask the record keeper to chart which colors were collected each time.

Watch the activity demonstrated here: **http://bit.ly/Birdwm**

Reference: © American Forest Foundation. Adapted from Activity 25: Birds and Worms from Project Learning Tree's PreK-8 Environmental Education Activity Guide. Michigan educators can receive the complete guide by attending a PLT workshop.

YOU "CAN" CAST

© PROJECT F.I.S.H.

AGES

8–18 years old

CONTRIBUTED BY

Project F.I.S.H.
East Lansing, Michigan
projectfish.org

In many areas of the world, people do not have access to rods and reels. They fish using a hand line where line is spooled in their hand and the line is cast by tossing the hook and bait out into the water. Once a fish is on the line, they just pull the line in with their hands. "Can casting" is a similar technique and a few people in the U.S. use this technique to fish.

MATERIALS

- Aluminum pop/soda cans rinsed out, 1 per student
- Monofilament line (8–10 pound test)
- Practice casting plugs (or rubber erasers)
- Casting targets, e.g. cardboard, rope, or buckets
- Duct tape
- Safety glasses, 1 per student
- Rope or chalk to mark a casting line on the ground
- Optional: *Backyard Bass* casting game

PREPARATION

Find an open area, at least 12 ft x 12 ft (3.6 m x 3.6 m). Students bring in their own cleaned can. Designate the area with a line on the ground that is not to be crossed. This will prevent participants from moving in front of other casters. If an item gets stuck in the "casting area", nearby participants will stop to allow safe retrieval.

DIRECTIONS

Ask students to attach fishing line to their can by tying or taping it to the can's tab. The line's length shouldn't be longer than the space available, about 10 ft – 12 ft (3 m x 3.6 m). Students wind the line around the can and attach a casting plug to the loose end of the fishing line.

Demonstrate how to hold the can by grasping the can in your hand below the wound line. A finger or a thumb can be used to stop the line from unwinding. Be sure the participants do not have their hand covering the line because it will stop it from unwinding. Allow the casting plug to hang freely an inch or two from the can.

Demonstrate the motion that you would use to throw a ball underhand, let the line spool off the end of the can while you continue to hold onto the can. Set out large targets and pass out safety glasses to all who are going to cast. Targets should be close at first, then after some practice, targets are moved farther and made smaller. Another technique is to throw the plug out. Practice hitting different targets, using different techniques and positions.

Once students have practiced, they count how many targets they hit after ten casts. The ten casts are not intended to be competition, but a self-evaluation.

Fishing can start discussions about history, ecology and pollution, nutrition or other topics.

Reference: Adapted by Mary Riley MSU 4-H youth development programs from the National 4-H Sportfishing Curriculum. Developed by Sharon Rushton, SR Enterprises.


© SHARON DANKS

Health

Enhanced school grounds foster children's mental and physical health and well-being by providing settings for social engagement, curiosity, imagination, exploration, wonder, and adventure.

Improved Well-Being. Studies have shown that many types of green spaces have therapeutic properties that lower blood pressure, reduce stress, and provide other benefits that improve the mental health and well-being of children, teachers, school administrators, and visitors.

Sensory Exploration. Living schoolyards stimulate our senses and provide opportunities to engage the whole body to develop children's sense of balance and coordination, and reinforce sensory integration. This is helpful for all children, and can be particularly useful for children with special needs. Enriched school grounds are also a "feast" for the eyes, ears, nose, and (sometimes) mouth, and provide endless textures for curious fingers to explore.

Physical Activity. School grounds that encourage children to run and jump and climb offer child-driven, play-based opportunities to improve motor skills and increase heart rate, to build and maintain physical health, and to fight obesity. Green school grounds also provide places for students to be physically active during physical education classes and while participating in sports and other organized fitness games.

Skills for Lifelong Health. Green schoolyards can promote healthier lifestyle choices by providing space for nutrition-oriented gardening and cooking programs. They are also places to learn new outdoor skills such as how to properly use tools, how to manage a campfire, and how to act responsibly at the water's edge. These lessons build lifelong health by giving children and youth important skills for safely navigating the world.

Beneficial Risk. Risk-taking opportunities are an essential component of a well-functioning school ground, and a key ingredient in fostering lifelong health. Educators are responsible for providing children and young people with opportunities to develop competencies such as common sense, problem solving, and confidence. Those who plan, design, manage, supervise, and maintain school environments should be encouraged to take benefits of risk into account. School grounds should not be as safe as possible, but as safe as necessary.[4]

For more information about the benefits of risk for healthy child development, see the International School Grounds Alliance's, *Risk in Play and Learning: Ubud-Höör Declaration*: **internationalschoolgrounds.org/risk/**

SENSORY EXPLORATION

PHYSICAL ACTIVITY

SKILLS FOR LIFELONG HEALTH

RELATED ACTIVITIES IN OTHER CHAPTERS

MULTISENSORY GARDEN TOUR

© GISELA LOPEZ

AGES

4–8 years old

CONTRIBUTED BY

Chino Basin Water Conservation District
Montclair, California
cbwcd.org

No matter our age, gardens innately awaken our senses. They provide the perfect setting to engage students' senses and subsequently build a sense of place, mindfulness, and connection to the outdoors. This loosely structured sensory activity allows students to use their power of observation to explore and play in their schoolyard garden. In the Multisensory Garden Tour, children will actively engage with their schoolyards as scientists, stopping at predetermined areas to record and discuss observations using each of their senses.

MATERIALS

- 1 per student: Clipboard, pencil, worksheet with five sections (one section for each sense)

DIRECTIONS

Review or teach the five senses to students, emphasizing that scientists use all senses when developing an understanding of the world around them. Instruct children not to pick anything from the garden without asking, especially not for eating.

Sight. Ask students guiding questions such as, "What is the furthest thing you can see? What's the closet thing you can see? What might the garden look like from the eyes of squirrel, a butterfly, an ant…?" Provide time for students to write or draw observations of the garden. Challenge them to draw what the garden may have looked like 500 years ago or 500 years in the future.

Listening. Instruct students to sit silently for 10–20 seconds with both arms in the air, listening carefully to the sounds of garden. Ask them to count each garden sound they hear by raising a finger. When they open their eyes, ask them to compare and share their observations with their neighbor. What sounds were distracting? Which were caused by wind? Water? Animals?

Taste. Remind students not to taste anything unless it's a good choice for your class. Provide an opportunity for students to explore the schoolyard and list, draw, or discuss which plants they think may be tasty or edible. Introduce guiding questions such as: "How is taste a helpful sense?" Challenge students to find evidence of foraging or grazing and hypothesize what the consumer might have been.

Touch. Ask the students to find two contrasting plants that are distinctive to the touch. A soft lamb's ear compared to a succulent provides excellent contrast and offers an opportunity to discuss plant adaptations. Compare and contrast how the plants feel and why certain plants have different textures.

Smell. Prompt the students to find their favorite fragrance in the garden. Then have the students pair up, show, and discuss their favorite scented plant. Provide guiding questions about why different scents may help a plant.

EXTENSION

Ask students to draw a picture or write a creative story about their schoolyard garden from the sensory perspective of a small creature or insect.

HERB BUNDLES

© SHARON DANKS

AGES

5–12 years old

CONTRIBUTED BY

San Francisco Botanical Garden
San Francisco, California
sfbotanicalgarden.org

Children explore using their senses and create a scented herb bundle to remember their discoveries.

MATERIALS

- For each child: provide a piece of fabric cut into 4 in – 5 in (10 cm – 12 cm) squares and a rubber band
- Activity requires an area containing plants with fragrant leaves which children can collect

© ANNETTE HUDDLE

DIRECTIONS

Review the five senses. Explain to the children that they will explore the leaves in the area using their senses.

Discuss: "How might we explore this space with our senses? Which sense might we not use today?" The sense of taste, unless an adult says we can.

Take a moment to observe leaf shapes and colors and to notice sounds in the area. Then demonstrate how children can carefully touch the leaves to feel the leaves' textures and then smell their hands to experience each plant's scent.

Allow children to explore the area for a few minutes, then ask them each to find one plant whose scent they like and stand next to it. Help each child carefully collect two to three leaves from the plant, using one hand to support the stem while carefully pinching off the leaf with the other.

Gather the children in a circle and distribute the fabric. Have children place their leaves in the center of their square and then wrap the fabric around the leaves, pressing the leaves into the center. Distribute the rubber bands and help children wrap the rubber band to close the bundle.

Ask the children to offer one word to describe the scent of their bundle. If there is a good variety of plants, have children trade with a partner, smell the bundle and then try to find the plant whose leaves are inside. Remind them that gently squeezing the bundle will help release the scent of the plant even after the leaves have dried.

"SENSE-SATIONAL" TREE TOUR

© CANOPY

AGES

5–8 years old

CONTRIBUTED BY

Canopy
Palo Alto, California
canopy.org

Engaging and fun, this fresh-air tour of schoolyard trees engages students through their senses to observe trees up close and view trees in new ways. Students then use their observations to describe the similarities and differences among the trees at their school.

MATERIALS

- Bags for students to collect tree items
- Paper and clipboard
- Colored crayons or pencils
- Fruit from trees, to share with the class (optional)

PREPARATION

Select and identify four or five trees at your school that satisfy the five senses. For example, trees with leaves of interesting shapes or colors, leaves that are fragrant, textured tree bark, or fruit trees.

Gather samples from trees such as leaves, fruits, or seeds.

Find out a few facts about each tree to share with students.

DIRECTIONS

Review the five senses with students.

Ask students what they have noticed about the trees at their school. Let students know that they will visit some of the trees at school and will observe them using their senses.

Review instructions for how to observe a tree gently. If students will collect samples, remind them to only pick up items from the ground.

Go outside on the school grounds with the class. At the first tree, review the main tree parts and why each of these parts is important.

At each tree, ask the students to explore and experience the tree with the appropriate sense(s):

Sight. Students stand around the tree and look up and down. What colors and shapes do they see?

Touch. Invite students to gently touch the tree bark and leaves. How do they feel?

Smell. Pass around leaf samples for students to smell. How does it smell? (If there are no fragrant trees on campus, teachers can bring in samples from other trees. For example: bay, camphor, citrus.)

Hearing. Ask students to listen to the tree. What do they hear? Ask students what sounds they might hear from animals living in or around trees. If students hear human activity, talk about how people live among trees and that we are part of nature. Ask students why they think humans need trees.

Taste. Engage students in a discussion about which foods come from trees. Bring in fruit from trees, to share, or distribute the school's fruit snack.

After the tour, students may share the similarities and differences among the trees they observed and discuss which tree(s) is their favorite and why.

Ask students to draw one of the trees they observed, label the tree's parts, and write a paragraph describing the tree and what they appreciate about the tree. Or, if students collected samples, they can create an art piece with the tree parts they collected.

OUTDOOR SENSORY ACTIVITIES

© MARY MICHAUD

AGES

3–14 years old

CONTRIBUTED BY

Mary Michaud
Van Hise Elementary School Outdoor Classroom
Madison, Wisconsin
vhgarden.wordpress.com

Humans learn by using our senses, but as children, we all have distinct abilities to integrate sensory input. Children with Autism Spectrum Disorders, ADHD, and many other children with no diagnoses commonly experience these differences. This set of activities is designed for all children to better integrate sensory input. These movements are especially useful for children with sensory integration differences.

BACKGROUND

Because of sensory integration challenges, some children actually avoid the discomfort of crossing their midlines. You might notice that they "get stuck" in mid-reach for something and switch hands to continue what they are doing. They might also move their whole trunk toward the opposite side rather than crossing over or reaching with one arm. How can this impact learning? Children with poor mid-line crossing sometimes avoid tracking their eyes as they read from the left to right. They may also shift their whole body or the paper instead of writing across their midlines. Practice crossing the midline can actually help develop neurological pathways to make it more comfortable for kids.

DIRECTIONS

Watering and water play. Holding a heavy watering can or a hose with two hands will make children cross the midline. "Painting" with water on a sidewalk or brick wall can also help kids cross the midline. It's also helpful to ask kids to paint on vertical surfaces.

Raking. Ask kids to rake leaves or soil, alternating using their dominant and non-dominant hands. Raking usually requires pulling the rake across one's midline.

Shoveling. Shoveling, too, requires pulling one's arms across the midline. Ask kids to shovel, then ask them to switch how they might normally shovel, using their non-dominant hands to lift the shovel rather than guide it, or whatever seems less "comfortable". This stimulates the brain to practice integrating input.

Climbing. Kids generally cross their midlines while climbing, and trees are the perfect platform to get that integration going. Climbing walls or playground structures will work, too, but trees offer more random spacing of hand and foot holds, and kids benefit from the visual and tactile variety of trees' irregular textures. Watch how kids climb trees: How often do they have to use a right hand to cross over to a branch on their left? How often do they bring their left foot across the midline to step on a branch on the right?

Sand play. For pre-K children, simple tasks like using their hands to draw a big infinity sign in the sand can help them to cross the midline. Driving cars around a large, lateral figure-eight path works, too. For older children, digging and piling sand will most likely involve a lot of crossing over the midline. Set up a treasure hunt where children lie on their stomachs and uncover items have been buried in the sand. Make sure they have to reach across to the opposite side to uncover the treasure.

Some of these activities may feel uncomfortable to kids with sensory differences. While any of these activities are happening, remind kids to take big, deep breaths. Teach them to use their breathing to gauge how they feel, stopping when needed to take a deep breath and center themselves.

HERBAL TEA BAGS

AGES

7–18+ years old

CONTRIBUTED BY

Ithaca Children's Garden
Ithaca, New York
ithacachildrensgarden.org

Herbs are such versatile and useful plants. They make their way into our everyday lives through the foods we eat and drink, the medicines we use, and the bouquets and fragrances we enjoy. Even if you don't grow fresh herbs, their tastes and aromas can be explored in their dried form. A great hands-on way to experience herbs with all your senses is through herbal teas.

MATERIALS

- Coffee filters
- Scissors and staplers
- Baker's twine or string
- Card stock scraps and markers or colored pencils
- Dried herbs such as: chamomile, nettle, catnip, anise, cinnamon, mint, bee balm, rose hips, lavender, lemon balm, blackberry leaf, or other herbs you enjoy
- Bowls and spoons
- Hot water and mugs, or teacups
- Optional: freshly picked herbs, twist-ties, mesh produce bags, or paper bags

DIRECTIONS

Pour dried herbs into bowls. Set a spoon next to each. Write the name of each herb on a scrap of card stock and place it underneath the bowl so it is out of sight.

Ask the children to use their senses to explore the herbs. Smell, taste, touch. Ask if they can identify any by sight, smell, or taste. What happens when you smell two herbs mixed together?

Reveal the herbs' names and place the labels next to each bowl. Encourage the children to design a blend of herbs that appeals to them. They can use the scrap paper to record their ingredients.

Flatten out a coffee filter and use scissors to cut 0.5 in – 1 in (1.25 cm – 2.5 cm) from each side, turning the circle into a rectangle. Add about a tablespoon of your blend of dried herbs to the middle of the coffee filter. Fold the long sides in so they overlap and cover the herbs in the center of the filter. Fold it in half, bringing the long ends together. Tap gently so the herbs settle to the bottom. Fold the open top down two times and use a stapler to secure it.

Cut a length of baker's twine. Staple it to the top of the tea bag. Use scrap card stock and markers or colored pencils to design a tag for your tea bag and give it a name. Use a stapler to attach the tag to the end of the string.

Repeat until each child has made at least a few different tea bags, so they'll have one to taste and one or more to share. Now enjoy the tea! Steep the tea bags in mugs of hot water for 3–5 minutes. Let it cool and sip away.

EXTENSION

Dry your own herbs. If your school grows herbs, ask permission to harvest some for drying. Harvest mid-morning after the dew has dispersed and before the sun evaporates all the newly formed essential oils.

Bundle the herb stems loosely with twist-ties. Using twist-ties allows you to tighten the bunch easily as it dries and shrinks. Hang the bundles upside down in a dry place.

Wrap a mesh produce bag or a paper bag with some holes punched in it around the herbs once they begin to dry, to catch any dried leaves that fall from the stems. Use the herbs for the activity above when they are completely dry.

SOUND MAPS

© LIFE LAB

AGES

8–12 years old

CONTRIBUTED BY

Life Lab
Santa Cruz, California
lifelab.org

Students listen to the world around them and map the sounds they hear to help them develop their sense of hearing and awareness of their surrounding garden space.

MATERIALS

- A simple, blank map of your school garden or grounds, 1 copy per child
- Drawing materials for each child
- Clipboards, to facilitate drawing outside (optional)

DIRECTIONS

Take the class outside to your school garden, or another quiet/reflective space on the school grounds. Gather the group in a circle and ask everyone to be quiet for a few moments. Begin the activity by asking: "Does anyone hear a sound they can't identify? Any guesses about what might be making that sound?"

Select a special word that the teacher/leader will use as a trigger for the activity. When students hear this word, instruct them to fall silent for five minutes, or another length of time that is age appropriate.

Ask each student to pick a "Magic Spot" to sit alone or with one friend in the garden/grounds. Send them to their chosen spots and say the special word to begin a short period of silent reflection.

While they are sitting silently, ask the students to listen for any sounds they hear, no matter how quiet. When they hear a sound, ask them to draw a picture or write a note on their map indicating where the sound came from and what they think it was.

After five minutes, gather the class back together and encourage students to share their maps. Ask questions like these to guide the discussion:

- Did any of you hear the same sound? Did you identify it as the same object, or did you have different ideas of what was making that sound?
- Did anyone see something making a sound?
- What was the loudest noise you heard? The quietest?
- How were the sounds different in the first minute and the last minute of our quiet time?

After the discussion, combine all of the students' observations on a large map of the school garden or grounds to create a sound map of your site.

JUMP ROPE ACTIVITIES

AGES

5–18 years old

CONTRIBUTED BY

American Heart Association
Los Angeles, California
heart.org

The American Heart Association is working to help kids, families, and communities live heart-healthy lives. Use this physical activity information to help students get active and stay active, for life.

MATERIALS

- Jump ropes
- Jump rope skill cards from *Jump Rope for Heart* (See: http://bit.ly/1QYWrSx)

BACKGROUND

For both children and adults, increased physical activity is associated with an increased life expectancy and decreased risk of cardiovascular disease. Physical activity produces overall physical, psychological, and social benefits.

Inactive children are likely to become inactive adults. Physical activity helps with controlling weight, reducing blood pressure, raising HDL ("good") cholesterol, reducing the risk of diabetes and some kinds of cancer, and improved psychological well-being, including gaining more self-confidence and higher self-esteem. Physical activity should be increased by reducing sedentary time. It should be fun for children and adolescents. Parents should try to be role models for active lifestyles and provide children with opportunities for increased physical activity.

DIRECTIONS

Included (left) are two jump rope activities for school children sourced from the American Heart Association's *Jump Rope For Heart*. Follow the directions on the cards to teach children a variety of jump roping patterns and games. This is a time when children can establish the foundation for movement skills. These are also the years when positive experiences can establish a positive attitude and appreciation for participating in daily physical activity for life.

Jump Rope for Heart promotes the value of physical activity to elementary school children while showing them they can contribute to their community's welfare.

ADVENTURE COURSE

© MONICA EDGERTON

AGES

3–7 years old

CONTRIBUTED BY

All Our Kin *and*
Felicitas' Family Child Care
New Haven, Connecticut
allourkin.org
facebook.com/felicitasfamilychildcare

Children use their focus, balance, and hand-eye coordination as they walk along a series of stepping stones, stumps, and a balance beam to the end where they can throw their ball into the goal. The Adventure Course can be done in warm or cold weather as it encourages children to be active.

MATERIALS

- 10 board segments, approx. 12 in x 6 in x 1 in (30 cm x 15 cm x 2.5 cm)
- 1 long board, 72 in x 6 in x 2 in (1.8 m x 15 cm x 5 cm)
- 8 tree stumps, approx. 18 in (46 cm) high
- Box to hold balls
- Tennis ball-sized balls, at least 1 per child
- Tarp
- Scissors
- Rope, 20 ft (6 m) long
- 2 places to tie the rope 6 ft (2 m) high (for example, 2 trees or a garage and a fence)
- Blue tarp (optional) to be the water under the balance beam "bridge"

SET UP

Place all board segments and seven stumps in a half-circle path that leads to where the long board is set on top of two stumps to create a balance beam. Cut four large holes in the middle of the tarp in the shapes of a triangle, circle, diamond, and square. About 10 ft (3 m) from the end of the balance beam, string the tarp between two sturdy objects (trees, fences) so it hangs down like a curtain. Place the box full of balls mid-way along the path. Children can help set up the activity, leading them to feel a sense of ownership.

DIRECTIONS

Children start at one end to walk along the path of boards and stumps. They can pick up a ball from the box and then proceed to walk across the long balance beam. After jumping down from the balance beam, they approach the tarp with the holes in it and toss their ball through one of the holes. They can repeat this process as many times as they would like. At some point, children can collect the balls from the other side of the tarp and refill the box. Observe how successful the children are feeling about the course and modify it to fit their needs.

Note about materials

The Adventure Course can be as long or short as you want it to be and adapted for the resources you have available. The materials listed above are the materials we used. Alternatives to the above materials include:

- Flat stones instead of board segments
- A sheet instead of a tarp
- If it is not possible to tie the tarp/sheet to anything, use a variety of buckets to throw the ball into

DANCING OUTSIDE

© MONICA EDGERTON

AGES

0–5 years old

CONTRIBUTED BY

All Our Kin *and*
Pili's Day Care
New Haven, Connecticut
allourkin.org
facebook.com/pilisdaycare

Small children have fun making music and dancing outside while exercising their gross motor skills and creativity, and letting excess energy out. This activity can be done in all types of weather, and it works well in colder weather because babies and toddlers can learn how to regulate their body temperature through movement.

MATERIALS

- Speakers, extension cord, CD player, and your favorite CD or Bluetooth speaker and phone (optional)
- Musical instrument for each child (small drums, two sticks, egg shakers, etc.)
- Scarves and ribbons, multi-colored, ideally with a variety of textures
- Water in cups or bottles to quench thirst
- Blankets for babies (optional)
- Coats, hats, mittens, boots, and snow pants for cold weather dancing
- Tissues for cold weather dancing

DIRECTIONS

If it is cold outside, help children put their coats, hats, scarves, mittens, and warm footwear on themselves. Ask children to help carry the instruments and scarves or ribbons outside.

If the weather is hot and sunny, make sure you pick a shaded area to do the activity.

Allow children to select one instrument or one scarf or ribbon. Adults can model how an instrument is played or how they like to dance with a scarf, and then let the children use their own creativity to dance and play the instruments.

The speakers and CD or Bluetooth sound system can be set up ahead of time, or children can start dancing on their own with the musical instruments while the sound system is being set up.

For babies, an adult can hold the baby and dance with him or her, or the baby can explore movement on his/her own on a blanket.

Don't forget to take a water break!

Learning benefits

In addition to creativity and gross motor skills, this activity is a great way to build pre-literacy skills. When children hear a song multiple times, they remember the words and can sing along or will sing it later even without the music. During colder weather when coats are required, children will build self-help skills and independence when they put on their outdoor clothes. At first they may need assistance, but over time they will feel successful when they can do it themselves.

OUTDOOR SURVIVAL

© ABBIE RAMEL

AGES

10–18 years old

CONTRIBUTED BY

Wisconsin Green Schools Network
Columbus, Wisconsin
wisconsingreenschoolsnetwork.org

Through inquiry and field investigation, students build outdoor survival skills. They learn how to start a fire using a magnesium fire starter and tinder, and about the importance of teamwork as they decide what fuel to use and how to structure their fire in order to increase their chance for success. Students are also given a scenario in which they must build a debris shelter, explain their shelter design, and reflect on what they have learned in the process.

MATERIALS

- For each student: Food, water bottle, weather-appropriate clothing and footwear
- For each group: First aid kit; kindling, tinder, logs found on-site; magnesium fire starters

PREPARATION

Divide students into groups of three to four people. Find a location in nearby woods. Review general field safety and weather appropriate field gear with students.

DIRECTIONS

Building a fire. Review general fire safety and discuss first aid. Provide students with a magnesium fire starter. Use an inquiry approach and ask how students can start a fire with the equipment available and the fuel types and sizes (tinder, kindling, logs) they need to keep it going. Ask students to design a structure to sustain their fire (examples: teepee or log cabin).

The instructor should visit each group to discuss fire safety, the use of a magnesium fire starter, and their fire structure plan. The instructor should approve plans before students attempt their campfire. Students should begin working on starting and keeping their fires going.

At the end of the activity, ask students to reflect on their fire structure and maintenance, and on teamwork. Be sure the fire is properly extinguished before leaving the site.

Debris shelter. Ask students about our basic needs for survival (food, water, shelter, and space). In a survival situation, it is important to prioritize their needs. Tell students to imagine that they are stranded in the woods, far from civilization without any means to contact others, and the weather is taking a turn for the worse. What should they do? Students realize that they need to build a shelter to protect them from the storm. Give students plenty of time to construct their shelters.

When all shelters are complete, tour all the shelters with the entire group. At each shelter, ask the team to explain their engineering and design rationale about location choice, materials, and architecture. After reviewing the shelters, ask students to meet in their small groups to debrief the experience, exploring questions of form and function, such as whether or not they felt their debris shelter would withstand the elements.

CONCLUSION

Transition to a discussion about how they built their fire and shelter and mention other things to consider when trying to survive in the wild. When might this skill come in handy? Ask them how their experience during this activity influences how they would build a shelter in the future? Emphasize the power of positive thinking and remaining calm in any emergency situation.

WHY EAT COLORFUL RAINBOW FOOD?

© JUDY SIMS

AGES

4–9 years old

CONTRIBUTED BY

Trinity Gardens
Santa Barbara, California
trinitygardenssb.org

Children learn about the nutritional benefits and tastes of colorful, fresh produce snack food through this activity. Together they build a food rainbow from fresh produce. They then taste a prepared rainbow food snack at a community table. The group may also be involved in planning, planting, and harvesting from a rainbow-shaped children's garden.

MATERIALS

- Large basket of colorful, whole produce; 1 per child
- Additional fresh produce, cut up for each child's finger food rainbow snack (Optional: hummus for dipping)
- Laminated food rainbow color word cards, in English and other languages, as desired
- California Department of Education's laminated food cards (or assorted seed packets, magazine or calendar pictures)
- Compostable paper plates, cups, and napkins
- Hand washing station
- Painter's canvas tarp or old sheet, with colored bands each 10 in – 12 in (25 cm – 30 cm) wide, to create a "food rainbow"

DIRECTIONS

Part I. Rainbow mat activities (about 20 minutes)

Ask students to sit around three sides of a rainbow painted floor mat; position teacher on the fourth side

Discuss: "Why eat a FOOD rainbow?" Use charts, books and/or a song to introduce and reinforce that each food color helps our bodies grow in special ways.

Students echo: "Red helps my heart", "Orange helps my vision", "Yellow helps my skin", "White supports my good health (immune system)", "Green gives me stronger bones and teeth". "Blue and purple help my brain to remember (memory)". (Note: see additional information online about the health benefits of vegetables and fruits.)

Distribute whole produce to each student. Invite those holding red vegetables or fruits to place them on the rainbow mat near the matching color word. Help students identify each type of produce and discuss how each color helps our bodies. Repeat for each color.

Review and summarize: "What have we learned about the importance of eating different colors of fresh food?"

Part II. Eating the food rainbow (20–30 minutes)

Ask students to wash their hands, set the table and sit down to have a snack using the cut produce.

As they try each type of food, review healthy food concepts and discuss flavors. Encourage students to try foods for the first time. The teacher models by eating each item.

Compost leftover food and paper. Write in journals about food tasting experiences.

Contact Trinity Gardens for free seeds to plant a rainbow garden as a follow up project.

Optional resources

Books (ages 4–8): *I Can Eat a Rainbow* (Annabel Karmel); *Growing Colors* (Bruce McMillan); *Eating the Alphabet* (Lois Ehlert)

Books (ages 8–12): *Blue Potatoes, Orange Tomatoes* (Rosalind Creasy), *The Vegetables We Eat* (Gail Gibbons)


©SHARON DANKS

Social and Emotional Well-Being

Enriched school grounds are ideal places to foster positive, healthy relationships among children, between children and adults, and between people and the environment. Research tells us that nature has a therapeutic influence on our mental and physical health. An environment filled with trees, shrubs, flowers, and wildlife is a helpful starting point to set the stage for learning the social and emotional skills that lead to autonomy, confidence, and healthy relationships later in life.

Empathy. Living schoolyards, filled with trees, plants, and other living creatures help schools foster an atmosphere that emphasizes care for one another, care for all living things, and care for the Earth. Green school grounds provide settings that teachers can use for lessons that range from understanding one another's feelings, to valuing the great diversity of life that shares our world.

Collaboration. Nurturing a positive school environment, both among community members and on the grounds, is best accomplished through collaboration built on strong, positive relationships. Living schoolyard environments provide opportunities to practice and hone communication, teamwork, and stewardship skills, while providing balance for other aspects of school life that are more competitive.[1]

Self, Belonging, and Purpose.[5] Research suggests that feeling confident and connected plays an essential role in determining children's overall well-being.

- A strong sense of *self* includes identity and the ability to self-regulate and develop healthy coping mechanisms for experiences of trauma. School grounds can be ideal spaces for reflection and decompression, which nurture these skills and provide solace for children in times of need.
- Outdoor activities and environments that foster small group conversation also help children develop their *sense of belonging* within their school community, as they invent games together and build relationships with one another.
- Schools can also cultivate children's *changemaking* skills and sense of *purpose* through hands-on collaborative projects that improve the physical environment of their school grounds. Engaging actively in schoolyard design, construction, and planting helps children to feel that they have a valuable place in their community and that they have agency in their own lives.

EMPATHY

COLLABORATION

SENSE OF SELF, BELONGING, AND PURPOSE

RELATED ACTIVITIES IN OTHER CHAPTERS

THE TREE IS LIKE ME!

© SHARON DANKS

AGES

5–10 years old

CONTRIBUTED BY

TreePeople
Beverly Hills, California
treepeople.org

Comparing ourselves to trees might appear silly but if we take a look we find that we are quite similar. Bodies correlate to trunks, blood to sap, arms to branches; we begin to see a resemblance. What about our needs? Water to drink, air to breathe, food to eat; recognizing these similarities help us tune in to the natural world in a unique way. We will be able to see that "the tree is like me"!

MATERIALS

- Butcher paper or other mural size paper
- Crayons or markers
- Fallen tree leaves

© TREEPEOPLE

DIRECTIONS

Take students out to see a tree and ask,"What would it be like to be a tree?"

While laying underneath the tree, instruct the students to close their eyes. Lead them through a visualization that has them imagining their toes reaching down into the warm soil to become roots... their arms reaching up toward the sun to become branches... their hair and finger tips sprouting leaves... and their body strong and straight and covered with bark. Continue the visualization to imagine water soaking up through their roots; carbon dioxide coming into their leaves and releasing oxygen; birds landing on their branches; spreading their branches to create shade; and more.

Ask students to open their eyes and share experiences.

Next, have students lie down on a sheet of mural paper in the classroom or outside. Trace around their bodies, creating individual life-size images. Ask students to add their face to the drawing and then to make the rest of their body look like a tree: body=trunk, hands/arms=branches, skin=bark, hair/fingers=leaves, feet/toes=roots.

Invite students to draw animals on their Tree/Me image and glue fallen leaves on their branches.

Ask students, "What are the similarities between our bodies and the structure of a tree?" "What else do you think people have in common with trees?" (e.g. blood is like sap; similar needs for food, water, air, etc.)

LIGHTHOUSE

© JOHN FISHER

AGES

8–12 years old

CONTRIBUTED BY

Life Lab
Santa Cruz, California
lifelab.org

This activity asks one student (the lighthouse) to verbally lead another blindfolded student (the boat) through a maze of people. This pairs well with class discussions around communication and cooperation skills.

MATERIALS

- Blindfolds

DIRECTIONS

Ask a student who feels that he or she can communicate clearly to be the lighthouse.

Ask another student who considers himself or herself to be a good listener to be the boat. Blindfold this student.

The remaining students will become obstacles in a bay. They can be bridges, logs and so on. It is important that they are quiet and do not move during the activity.

Situate the lighthouse at one end of the playing area.

© LIFE LAB

Place the boat at the other end.

The remaining students can take their places between the boat and the lighthouse as obstacles in the bay.

The task of the lighthouse is to verbally lead the blindfolded boat through the obstacles. The lighthouse should remain stationary. The lighthouse should give the boat explicit directions so that it will avoid the obstacles. It may help to have the boat keep a hand raised to assist in determining left from right.

The task is completed when the boat safely arrives at the lighthouse. If the boat hits an obstacle and sinks, choose another student to be blindfolded, rearrange the obstacles and begin again. The obstacles should remain still and silent.

Possible discussion topics after this activity:

- How did it feel to be the boat?
- What did the boat have to do to stay afloat and reach the lighthouse?
- How did it feel to be the lighthouse?
- What did the lighthouse have to do to bring the boat in safely?
- What does “concentration” mean?
- What does “communication” mean?

TEAM BUILDING: THE AMAZING WINTER RACE!

© MATT MCKAY

AGES

10–18+ years old

CONTRIBUTED BY

Wisconsin Green Schools Network
Columbus, Wisconsin
wisconsingreenschoolsnetwork.org

Students work on team cooperation as well as fuel their competitive spirit as they race through challenges during the winter season! Winters can be long in Wisconsin, but there is never a shortage of great opportunities within a short distance of the school doors.

MATERIALS

- Large open area, markers, flags, and GPS units
- Stopwatches, clipboards, data recording forms, utensils
- First aid kit and drinking water
- 30 ft (9 m) of rope, two buckets, and a sled
- Board snowshoes: Two 8 ft (2.4 m) long wooden 2x4 boards per team

PREPARATION

Create teams of five students each. Prepare a written overview of the team challenges and where each event will take place. Give stopwatches, clipboards, and data recording forms to each of the event judges. The goal is for a group to have the lowest overall time while working effectively as a team.

Students can help make board snowshoes by drilling five holes in each board about 18 inches apart, along the center. Pull 36 inches of string or rope through each hole and tie large knots on the bottom side.

DIRECTIONS

Sled pull. Every teammate must take a turn pulling a single member of their team in a sled down the course and around a cone placed about 55 yards (50 m) away. Repeat the activity until each member of the team has taken a turn pulling their teammates and being pulled across the finish/start line.

Five-man snowshoe walk. The "Five-Man Snowshoe Walk" uses board snowshoes. The challenge is for the group to create a method to successfully move their team from the start line to the finish line in the most efficient way possible.

GPS sprint. Locate spots on the school campus where you can send students to look for hidden flags. Use the GPS to mark the "waypoint" at each spot and record those coordinates. With the marker and flagging, give that site a number and then hide the flag so it cannot be seen from far away. Give students a GPS and set of coordinates. Ask them to enter the coordinates into a GPS unit, and use the "where/go to" feature to assist them in finding and returning the hidden flag to the starting line.

Snowball throw. The object of this challenge is to have each member of the team make a snowball and throw it into two buckets that are placed 10 ft (3 m) away. If snow is not available, use marshmallows as a substitute.

The team that has the fastest overall time and best teamwork for all events is your winning team!

CONCLUSION

Engage teams in a discussion to reflect on these events. What worked well and didn't work well? What led to a team experiencing success and what detracted from success? How was effective leadership demonstrated? When was successful follower-ship demonstrated? How does this activity relate to other activities?

Reference: Written by Matt McKay

MODULAR OBSTACLE COURSE

© GOLESTAN COLAB

AGES

2–12 years old

CONTRIBUTED BY

Golestan Colab
Berkeley, California
golestankids.com/colab

In this activity students create their own modular obstacle course with a versatile set of materials. This activity is completely child-directed, never teacher-directed. By creating an obstacle course out of heavy movable parts, students develop core strength, agility, and balance, while also learning to collaborate and create as a team. This further helps them develop executive functioning, social emotional, and problem solving skills. The obstacle course particularly helps students that are disregulated or struggle with sensory integration issues by providing a lot of opportunities for proprioceptive input from moving heavy things and participating in the course when it's completed.

MATERIALS

- Any combination of: tires, straw bales, used large wire spools, ropes, cardboard boxes, hula hoops, trampoline, large wood slices, long 2x4 wood pieces, and/or tree stumps

DIRECTIONS

Set materials out in the schoolyard. The larger, heavier to move items can be piled in a corner. Other items like the ropes and wood pieces can have a designated bin to which they will be returned after the activity.

Explain to the students that they are going to be creating an obstacle course with the materials provided. Show them the materials they can use and allow them to examine them. Students can be encouraged to play around with the materials before they start making the obstacle course.

Older students can plan the obstacle course collectively, maybe even map it out on paper. Good questions to ask to help guide the process are: "What are the skills you want to test: Height? Balance? Speed? Coordination? Who are you designing the course for? How long is the course?"

After the kids have become familiar with the materials, they can create their own obstacle course. The role of the teacher is to give gentle guidance when needed. The teachers should not tell kids what to do or share ideas with them, rather help them to explore and find solutions.

There is no "right" way to use any of the materials—the more creative and unconventional, the better. You can lend a helping hand when asked, but do not move heavy items for the students. This is a time to encourage teamwork and problem solving. For example, if a child is having a hard time moving a straw bale, you can suggest that she/he solicit the help of other children. If they still have a hard time moving it, you can initiate finding a solution by asking questions that will enable the children to problem-solve such as: "What can we use to move it?"

Once the obstacle course is complete, the students can test it out and play in it. This is a good time for teachers to encourage trial and error to see how they can improve their obstacle course.

FIND YOURSELF IN THE DIVERSITY OF NATURE

© ELYSE RYLANDER

AGES

5–18 years old

CONTRIBUTED BY

OUT There Adventures
Seattle, Washington
outthereadventures.org

Sometimes it can feel like we are "different" from our friends, family, and community. However, if we look, we can see things "like us" all around, especially in the natural world. By taking time to look closely, reflect, and make connections, we can find replications of our identities in our backyards, our parks, and beyond. That difference is not only good, but necessary for healthy and thriving ecosystems! In this activity students will explore the diversity of forms, relationships, and processes in nature, while drawing parallels to their own unique identities and lived experiences.

MATERIALS

- *Walk Cards*
- Paper and pencils (if you want the students to record the experience)

DIRECTIONS

Create *Walk Cards*. (See examples, below.)

Explain to the students that much of the diversity we find in nature, we can also find in our human-created spaces, communities, and in ourselves. Provide a brief explanation of the various facets of identity, such as race, ethnicity, gender, age, ability, class, etc. (The leader can dig deeper for older youth.)

Select an outdoor area large enough for students to walk slowly around it and have some space between them. A quiet path is ideal. Place cards along the path (or in a line, creating a path) with about 30 ft (9 m) between them.

One at a time, send the students out to walk along path, stopping to read the cards as they go. Wait a few minutes between students to give them each time with the cards. Remind them to go slowly and respect the space of other participants. When all students complete the walk, gather as a group for the debrief.

DEBRIEF

Depending on the age group and your goals, the debrief can be facilitated as a large group, in smaller groups, or individually through journal keeping or silent self-reflection. Example questions include: "What was your favorite card and why? Which was your least favorite and why? How did we learn more about our own identities? Where did you see yourself reflected most in the natural world? How did that feel? What did it make you think about yourself and how you relate to the world?"

Facilitators may consider providing a personal example to spur conversation, for example, "As an LGBTQ person, it was amazing for me to learn about the ways in which a clam's sex is fluid over the course of its life." or "As a person whose family migrated to this area from another country, it was empowering for me to learn about the Arctic Tern and their global migration, because it reminded me of the experiences my family had traveling far from where I was born."

Walk Card themes

Community: Symbiotic relationships

LGBTQ Identities: Certain species have more than two sexes and some organisms can alter their state of being or have identities that are fluid

Colonialism: Impact of invasive organisms

Immigration: Species migrate across continents

Environmental Refugees: Migration as a result of environmental change

FINDING YOUR PLACE IN THE WORLD

© THE PRESIDIO TRUST

AGES

3–18 years old

CONTRIBUTED BY

The Presidio Trust
San Francisco, California
presidio.gov

This "activity" is remarkably simple yet potentially profound, and gets more valuable if it can become a regular part of a weekly or monthly routine. The power of observation relies on the conditions of settling the mind, tuning the senses and sparking curiosity. By giving each student their own space (or "place in the world") and singular task to simply notice what is happening, students develop a practice they can bring with them anywhere they go outdoors.

MATERIALS

- No materials are necessary for this activity, however it lends itself to on-going field journaling practice (drawing and writing observations, questions, musings, etc.)

DIRECTIONS

Identify an outdoor area that is large enough for students to have a personal sitting space at least 10 ft (3 m) from other students. This can be an area that is new to them or one that they are already familiar with. (If the latter, this can be presented as a challenge for them to notice something new that they had been previously unaware of.) Ideally students will be invited to find their own sitting spot, with the understanding that this is not a talking activity.

The initial length of time for their observations can be as short as 3–5 minutes. If this activity becomes a regular part of a weekly routine, its duration can be increased in response to students' capacities and interests. There is value in returning to the same sitting spot over time so that phenological changes can be noticed (changes in natural phenomena, e.g. the changing growth phases of a plant). Afterwards, invite students to share their insights and surprises. This discussion with an interested adult adds a vital component to their connection with the natural world.

There are many activities teachers can do with their students to extend this activity such as:

- Make a sound map of the area around each student.
- Engage a "See-Think-Wonder" inquiry: Focus on one thing that interests students. Encourage them to write about it and pose related questions.
- Write a poem (haiku or cinquain)
- Ask students to write a letter to themselves from the perspective of a plant or animal in their space.
- For older students, ask the following questions related to values in decision-making about human impacts on a place: "What has happened here? What is happening here? What should happen here?"

If journaling, invite students to "dialogue journal" with a partner to share questions and observations. Alternatively, invite students to bring their journal home so their parents can engage in the dialogue with their own questions.

EXPLORING OUR RELATIONSHIP TO PLACE

© SASHWA BURROUS

AGES

9–18+ years old

CONTRIBUTED BY

Occidental Arts and Ecology Center
Occidental, California
oaec.org

This activity examines our relationships with place, people, all living beings, and the "things" we interact with each day, building and re-learning ecological literacy. "Eco" comes from the Greek word *oikos* which means home. Ecology is the study of home. Economy is the management of home. Ecosystems are the web of connections at home. This place-making activity sets the stage for long-term observations of the ways in which we are in a relationship with home.

DIRECTIONS

Stand in a circle in the schoolyard. The facilitator supports participants in establishing the cardinal directions by instructing, "on the count of three, point to where the sun rose this morning". Ask participants to hold their pointing arms still while they look around at the varied responses. Ask two or three people to provide an explanation of why they are pointing in the direction they chose, highlighting observation, memory, and gut feeling as common responses.

Without revealing the answer, use the participants' co-created knowledge to establish the cardinal directions. Once group has established N/S/E/W, "create" (or imagine) an oriented, flat map on the ground with clear boundaries, an equator, and a center point. You may draw a line in the dirt, use chalk on asphalt, or use reference points to establish boundaries.

Participants will soon physically place themselves on the map according to their personal responses to the facilitator's prompts. Acknowledge that scale will vary depending on the question. After each prompt is (silently) responded to through physical motion, ask three to five participants to tell the group where they are. Set the pattern by asking students to introduce themselves and share their response with a brief story, if appropriate. The student sharing their response then calls on the next student. The facilitator monitors the discussion and prompts with the additional questions.

Sample prompts for this mapping activity include: "Place yourself on the map where you call *home*. Place yourself on the map where—to the best of your knowledge—your mother's ancestors are from. Place yourself on the map where—to the best of your knowledge—your father's ancestors are from. Place yourself on the map where you first felt a connection to the natural world. Place yourself on the map where some of the materials in your cell phone were extracted. Place yourself on the map where your shirt was made. (Ask a partner for some help in reading the tag.) Place yourself on the map where your favorite food is from. Place yourself on the map where you would like to travel one day." Design your own prompts in order to meet the needs of your community.

To debrief, stand in a circle. Raise your hand if you: liked that exercise; were ever confused during that exercise; learned something about yourself/the group during that exercise; had to travel during that exercise; felt heard during that exercise; have more stories to share.

Discussion prompts. "What came up for you? What did you learn about your community? Surprises? Similarities? Differences? How are we all connected? To each other? To land? To food? To water? What networks did you observe? What systems connect us?"

Summary. This activity is about building community amongst participants (unexpected commonalities and differences) and rooting our personal experiences in deeper relationship with place in order to better understand *home*. We are global citizens.

TOWARDS DEFINING RESILIENCE WITH Y-PLAN

© AMANDA EPPLEY

AGES

13–18+ years old

CONTRIBUTED BY

Center for Cities + Schools
University of California, Berkeley
Berkeley, California
y-plan.berkeley.edu

What does resilience mean to you? Psychologists, ecologists, and economists, cities, schools and businesses, and individuals all over the world have developed their own definitions. Increasingly, these once disparate uses of resilience are converging into a cohesive system; ultimately shaping the society our children will inherit. This lesson allows adults to work toward a new, comprehensive understanding of the term resilience for and with young people.

MATERIALS

– Pen, paper, and clipboard for each student

DIRECTIONS

Take students on a tour through the school and its grounds. As you walk, ask them to list evidence of "resilience" or lack of resilience. This evidence could be about the physical space, the school community, or even themselves.

Sample prompt for students include:

Physical. "Are there recent improvements to buildings or grounds that you see? Are there murals or student work in the halls? Things that used to be broken? Things that have been broken for too long?"

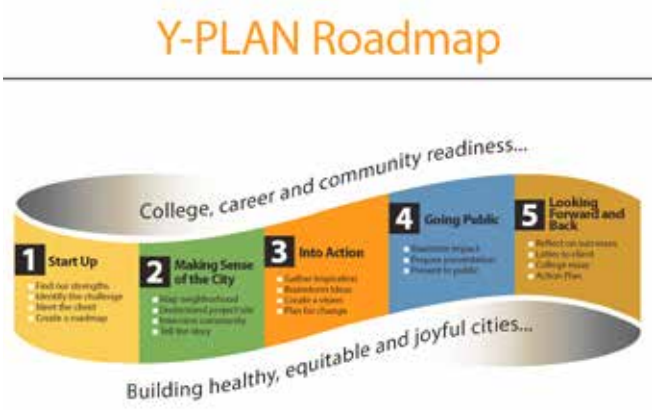
Social. "Whether and how do clubs or groups at your school support students or overcome issues at the school? Does Student Council improve the school? If so, how? What sports teams or clubs create a supportive environment for members?"

Personal. "Does walking through the lunch room or a particular spot on the yard remind you of a time you or a peer were able to overcome a bully? Does walking past an old classroom remind you of failing a test? Did you improve your grades? Do you have friends at school who support you?"

End your tour outside the school, and discuss what students have noted as physical, social, and personal resilience. Are there particular spaces that they see as more or less resilient, or make them feel personally more or less resilient?

Now focus on the outdoor space. Let students go to their favorite part of the grounds. While they are there, they should list evidence of resilience and lack of resilience. Is the grass beaten back into a natural trail? Are tree roots breaking a concrete path? What plants, animals, or insects are here, and how well are they thriving? Is a creek allowed to run through the property or is it underground? What evidence of resilience do you see in the natural world around you? What impact are people having on it? Note examples of both resilience and things that are not resilient.

Bring students back together. Ask if they think their school is resilient? How could it be more resilient? Allow time for a discussion. Finish by asking each student to write a working definition of resilience that includes the factors they saw today.



APPRECIATION CIRCLE

© ANNIE SCHULER

AGES

7–18 years old

CONTRIBUTED BY

NatureBridge
San Francisco, California
naturebridge.org

In this highly adaptable activity, students practice social and emotional skills by anonymously giving compliments and recognizing their peers in a structured environment. A guided discussion afterwards helps students learn about themselves and others, strengthen social bonds, and build positive group culture. The Appreciation Circle works particularly well as a closing activity. This activity is known to circulate through and around outdoor education programs, and its origins are uncertain.

MATERIALS

- List of Appreciation Statements (See examples, at right.)

DIRECTIONS

Bring your students to a comfortable outdoor space and ask them to sit in a circle. If desired, use a brief sensory activity to focus and quiet students, such as listening for bird calls. Next, instruct your students to close their eyes, and to keep them closed until you ask them to stand up.

Tap several students on the shoulder (for a group of 30, select 6 students; adjust numbers as needed depending on group size) and quietly ask them to open their eyes and stand in the middle of the circle.

Tell the whole group that you are now going to read a few statements, for example, "Someone who had a great idea this week". With each statement, the students in the middle of the circle can move around and tap the shoulder of anyone they think the statement applies to—as many people as they want!

Once you've read 2–4 statements, ask the standing students to sit back down and close their eyes. Quietly invite the next group of students to enter the circle, and read a new set of statements. The instructor can also participate to make sure everyone gets recognized. Continue until all students have been inside the circle.

Examples of appreciation statements

Someone who:

- Volunteered to help the group
- Shared a great idea
- Became a new friend
- Was a good discussion partner
- Showed leadership skills
- Taught you something new
- Cheered you up
- Made you smile
- Showed courage
- Had a positive attitude
- Was a respectful listener

Be creative! Adapt these statements and write new ones to meet the needs of your students and program.

Discuss this activity with your students. Example discussion questions: "How did it feel to be recognized by someone, especially since you didn't know who it was? What did you learn about yourself while doing this activity? How might this change the way we interact as a group? How can we apply what we learned about kindness today to other parts of our life?"

Recognize that these conversations aren't always easy; thank your students for participating!

Schoolyard Agriculture and Food

In our increasingly urban society, people of all ages have become disconnected from the natural and agricultural environments that sustain us. Starting a school garden is one way to reconnect students and school communities with local agricultural and ecological systems and to create new, vibrant, hands-on learning environments at the same time.

Horticulture. Culinary gardens are cost-effective, hands-on learning spaces for studying natural science, botany, and horticultural techniques. Gardens are commonly used to teach lessons on topics such as soil, weather, plant growth, insect life cycles, and decomposition. At many schools, children help to build and maintain their gardens by planning and constructing garden beds. They may also design and assemble trellises and other garden infrastructure, and raise and tend plants from seed to seed, to better understand growth cycles and seasonal change. School gardens are also places to practice and study composting techniques using materials from the schoolyard landscape.

Animal Husbandry. School gardens can provide an opportunity to introduce children to farm animals on a daily basis. Chickens are the most common, but some schools also raise bees, ducks, rabbits, sheep, goats, ponies, and other animals. The animals provide opportunities for children to practice stewardship and empathy, improve their nutrition, and help to enrich garden soil.

Sharing Food. Edible gardens give students of all ages insight into where their food comes from, what it takes to produce it, and the art of bringing it to the table in an enjoyable manner. Preparing and sharing food in the schoolyard is easier to do if schools build informal outdoor kitchen spaces with ovens, campfires or barbecues, sinks, and picnic tables. School garden harvests range from simple salads of freshly harvested lettuce to more complex cooking competitions with a wide range of ingredients and techniques.

Curriculum Connections. School gardens can also be springboards for topics in many disciplines. They help to bring social studies and history lessons to life, and provide engaging settings for teaching arithmetic and geometry, health and nutrition, art and music, reading and foreign languages.[1]

HORTICULTURAL SKILLS

SHARING FOOD

CURRICULUM CONNECTIONS

RELATED ACTIVITIES IN OTHER CHAPTERS

SEED SAVING WITH CHILDREN

© BENJAMIN EICHORN

AGES

4–18 years old

CONTRIBUTED BY

Grow Your Lunch, LLC
San Francisco, California
growyourlunch.com

Saving seeds preserves genetic diversity for generations to come and completes the life cycle of school garden plants. Keep in mind that not all plants in the garden will produce viable seeds, as many are hybrids whose offspring will not exhibit the same traits as the parent plant. The basic principle to successfully saving seeds is to let the seeds dry completely (or "senesce") on the plant before trying to save them. If the seeds are not completely dry, they will be prone to rot once stored. If you want to learn more about seed saving, read Suzanne Ashworth's book *Seed to Seed*.

MATERIALS

- A screened drying rack or stainless steel cookie sheet
- Stainless steel bowls
- Mason jars with holes punched in the tops
- Sticky labels

Easy seeds to save

- Herbs: parsley, dill, fennel, cilantro/coriander
- Lettuce
- Legumes: beans, peas
- Grains: wheat, barley, oats, quinoa, amaranth
- Annual flowers: sunflowers, poppies, hollyhocks

DIRECTIONS

Before you begin, identify the plants in the garden that are ready to have their seeds saved. The seeds will be dry and ready to fall to the ground. Select plants that have not cross-pollinated with others, unless you are trying to save hybridized seeds. Refer to *Seed to Seed* for more detailed seed saving guidelines.

Pick the pod, seed head or other part of the plant that contains dry seeds and place them in stainless steel bowls.

Find a comfortable place to sit and "thresh" the seeds. (Rub the seeds out of the other plant material, or "chaff".) Remove any remaining plant material by blowing over the seeds. (This is called "winnowing".)

If the seeds are completely dry, place them in the mason jar and label it with the date the seeds were saved, the name of the crop and the variety. Store in a cool, dark, dry place.

If the seeds are not completely dry, spread them out on the drying rack and place it in a well-ventilated area, out of the sunlight, where it will be safe from animals until the seeds are ready for storage.

GROW HEIRLOOM WHEAT: SEED TO FEED

© TIMOTHY TEAGUE PHOTOGRAPHY

AGES

4–12 years old

CONTRIBUTED BY

Trinity Gardens *and*
Center for Regenerative Agriculture
Santa Barbara *and* Ojai, California
trinitygardenssb.org *and* ojaicra.org

While learning where their food comes from, students use simple approaches to grow, harvest, thresh, winnow, and grind wheat into flour. This can be used to make bread, tortillas, muffins, or pancakes. Ideally, fresh produce grown in the school or community garden accompanies this activity for a well-rounded meal. Young children are introduced to the curriculum through the classic story, *The Little Red Hen*. Kids also plant seeds for the next wheat crop.

MATERIALS

- Hand grain mill (suggestion: Victorio Deluxe Grain Mill)
- *The Little Red Hen*, any version that suits the student group
- Wheat seed (suggestion: heirloom White Sonoran wheat from Native Seeds)
- Small, dark paper or plastic plates, 1 per child
- Recipe, ingredients, and equipment for cooking with flour
- *Bread Comes to Life*, by George Levenson, optional
- Red Hen puppet, Folkmanis, optional
- Smooth pebble for each child, about 2.5 in (6 cm), optional

DIRECTIONS

Arrange a schoolyard growing space. Use *The Little Red Hen* book to introduce the "Seed to Feed" wheat growing project if you are working with young children. Young children become excited when asked, "Would you like to help the Little Red Hen with her wheat?" Older students can learn about grain by doing research, to gain historical perspective and scientific knowledge. Examples of grain varieties may be obtained from a local garden or farm, and grain seeds can be found in bulk bins at a health food store or acquired at a local seed bank, seed swap or nursery.

Plant wheat seeds in a weed-free, prepared garden space and cover with approximately 0.3 in (0.8 cm) soil in rows about 6 in (15 cm) apart, with 2 in – 3 in (5 cm – 7.5 cm) spacing. After growing into 6 in (15 cm) tall clumps of grass, thin the plants to about 6 in (15 cm) spacing. Students delight when discovering the first seed heads, and then observe the maturing plants changing to a lighter green, then golden brown. Hand water the wheat, or use drip irrigation. Stop watering when the wheat begins to turn light brown.

Thresh the wheat when it is fully mature. First, dry the seed heads, cut them off with scissors, and place them into harvest baskets. The seeds can then be separated from the seed heads in several ways: 1) stomp on a pillowcase full of seed heads; 2) smash an individual seed head with a smooth rock; 3) winnow the seeds by hand. To winnow seeds, students blow the chaff away from a plate containing smashed seed heads. This leaves just the seeds which can then be poured into the mill. After the wheat is milled, it becomes flour and can be used in a cooking project. Set some seeds aside for planting the next wheat crop.

MORE VEGGIES FOR ME... LESS FOR THE PESTS!

© SHARON DANKS

AGES

8–18 years old

CONTRIBUTED BY

Kansas Association for Conservation and Environmental Education (KACEE)
Manhattan, Kansas
kansasgreenschools.org/green-schools-garden-gate

Insects are an integral part of every garden. In vegetable gardens, beneficial insects (bees, ladybugs, etc.) benefit the garden by pollinating plants and eating insect pests. Harmful insects (squash bugs, aphids, etc.) may cause damage to crops if left unchecked. This lesson will help to determine the difference between those insects that are deemed harmful or beneficial, and experiment with ways to encourage beneficial insects and control pests.

MATERIALS

- Insect net
- Glass jars covered with holes in lid and/or mesh fabric
- Small sponge soaked in water (if overnighting insects)
- Cubed white bread
- Choose 5 or more pest control options: cayenne pepper, vinegar, lemon juice, garlic, marigolds boiled in water, organic insecticide, biological controls (lady bugs, etc.)
- Online field guide about insects

PREPARATION

Ask students what they think makes a fruit or a vegetable organic. Guide students to understanding that organic fruits and vegetables are those raised without the use of human-made or synthetic processes, like pesticides.

Ask students to think about what some of the challenges might be in raising organic fruits and vegetables. Explain that one of the biggest challenges is managing pests that consume or destroy produce. They will test some natural pesticides to see what would be best for controlling pests in their garden. Students choose between the natural options, placing the test ingredient on a bread cube and sealing it in a jar full of insects.

Choose a pest problem in your school garden. Describe the pest control methods available to the students for testing (lemon juice, cayenne, praying mantis, etc.). Take students outside to collect insects that harm the garden.

DIRECTIONS

Hypothesis. Divide students into groups, assign each group an organic pest control method. Challenge them to write a hypothesis on their own, using an "If, Then, Because" statement about how the control method might work and why.

Method. Have students test their hypothesis. Instruct students to write out their methodology. This includes all the materials necessary to conduct their experiment, a control (cube of bread) and specific step by step procedures that could be followed by someone else.

Analysis. Record experiment results. Students should produce at least one chart and show how they will determine the success of their hypothesis. (e.g. number of insects on the bread, insect death, avoidance, etc).

Conclusion. What did students learn about pest control?

Application. Have students examine all the results. Ask students which method they think might work best on a larger scale in the garden? Ask students to identify their rationale for their recommendation. Apply the chosen control method to the garden and monitor results.

Follow up. A week or two later, complete the scavenger hunt again. Has the chosen pest control method been effective?

Reference: Written by Mandy Kern

BUILDING A HOOP HOUSE

© DR. DAVID RONGEY

AGES

8–12 years old

CONTRIBUTED BY

The Organic Gardener Ltd.
Highland Park, Illinois
theorganicgardener.net

Do you think plants can grow in the winter? Students will explore this question as they construct a hoop house in their garden and investigate the interactions between the hoop house, plants, sun, and the growing environment. A hoop house will extend your growing season by allowing you to plant earlier in the spring and grow longer into the fall and winter.

MATERIALS

- 2 pieces of rebar per PVC pipe, 2 ft (61 cm) lengths
- 10 ft (3 m) of 0.5 in (1.3 cm) PVC pipes or cut hula hoops
- Roll of greenhouse plastic or any clear plastic
- Weed blocking fabric or cardboard
- Tape measure, scissors, gloves
- Zip ties to attach greenhouse plastic to PVC pipe
- Mallets

© SHARON DANKS

Finished hoop houses, without their plastic covers.

PREPARATION

Lead the class in a discussion about greenhouses and how they work. Guiding question: "What differences can be observed between plants growing inside and outside of the hoops house?"

DIRECTIONS

Divide the class into two groups and perform half of the work at a time.

Measure the garden or raised bed to see how large the hoop house will be.

Lay down the weed barrier fabric, or cardboard so that it extends past the edges of the house by at least 1 ft (30 cm). (This step is not necessary with a raised bed garden.)

Ask students to stand on the edges of the fabric to hold it taut and in place while using fabric stables to secure the cloth to the ground.

Use your feet to measure two paces on the perimeter of the garden bed and mark the spot by cutting a hole in the fabric/cardboard with scissors. Lay the rebar in these spots.

Show students how to use mallets to pound the rebar half way into the ground, vertically.

Slip each end of the PVC pipes over the rebar to create "hoops".

Cover the resulting rounded frames with clear greenhouse plastic when the weather is cool. Note: Remove the plastic covering when the weather is warm, so the plants inside do not overheat.

BUILDING SUB-IRRIGATED PLANTERS

© SARAH KARLSON

AGES

11–18 years old

CONTRIBUTED BY

Community GroundWorks
Madison, Wisconsin
communitygroundworks.org

Building sub-irrigated planters is a great activity to teach about winter indoor container growing with a focus on water conservation and capillary action, the forces of adhesion and cohesion that allow water to move "up" against gravity via wicking. Students also learn life skills like how to use tools (drills and hand-saws), the benefits of building with up-cycled materials, and end up with a planter full of fresh produce!

MATERIALS

- Two 5 gallon (19 L) buckets
- 18 in (46 cm) piece of 0.75 in (2 cm) PVC
- 8 oz (o.25 L) styrofoam cup
- Drill
- Hand saw
- 3/8 in (1 cm) drill bit
- Spade bits (optional)
- 2/3 cubic foot (0.02 m3) of potting soil

DIRECTIONS

Top bucket (holds soil and plants). Create a hole for the wicking basket: Trace lip of styrofoam cup onto bottom center of the top bucket. Cut hole with spade bit, or multiple holes very close together with 3/8 in (1 cm) drill bit, and remove this circle.

Create a hole for the PVC watering pipe: Trace the circumference of the PVC pipe on the bottom of the top bucket, to the side of the center hole you just cut. Proceed as above to make the hole. The PVC pipe goes from the top of the top bucket, through this hole, into the bottom bucket.

Create drainage holes: Drill multiple holes in the bottom of the top bucket for drainage.

Bottom Bucket (water reservoir). Make overflow holes: Nest the top and bottom buckets together. Hold them in front of light source until you can see the bottom of the top bucket.

Drill a hole on either side of the bottom bucket, just below the bottom of the top bucket. Overflow holes ensure air space between the water and soil.

PVC watering tube. Cut an 18 in (46 cm) piece of 0.75 in (2 cm) PVC, with a roughly 45 degree angle at one end. The angled side goes through the hole in the bottom of the top bucket, to rest on the bottom of the bottom bucket. To water your planter, pour water into the PVC pipe until water starts to come out of the overflow holes in the bottom bucket.

Wicking basket. Make multiple slits with scissors in the bottom and sides of the styrofoam cup (this is the wicking basket). Place cup in the hole you made for the wicking basket.

Top covering (optional). Cover the soil with the bucket lid or black plastic and cut holes for planting to further prevent evaporation.

Assemble planter. Fill the wicking basket and top bucket with moist potting soil. Plant seeds or starts. Pour water through the PVC pipe until it comes out overflow holes to water. Check weekly.

MATH AND BUSINESS SKILLS IN A YOUTH FARM STAND

© CRISTIE SHELL

AGES

11–17 years old

CONTRIBUTED BY

Calypso Farm and Ecology Center
Fairbanks, Alaska
calypsofarm.org

Calypso's School Garden Initiative programs connect youth to their food source and teach gardening skills. Actively engaging youth in the basic business of running a farm stand empowers them to build confidence, a sense of responsibility, and teamwork in the garden. Through this activity, youth sharpen math skills, set sales goals, plan the harvest, record inventory, and evaluate market success.

MATERIALS

Instructors should create a Harvest Inventory Sheet, with the following column headings:

Crop Name, Crop Unit Price, Units Harvested (bunches/heads), Crop Value (Unit Price x Units Harvested), Units Remaining After Market, Crop Sales ((Units Harvested – Units Remaining) x Unit Price)

DIRECTIONS

Walk through the garden and ask youth what is ready for harvest this week, what needs more time to grow, and how much they think they can sell. Answers will vary by crop. For example, mature root crops store in the ground and can be left for future harvests, while broccoli must be harvested when mature. Encourage students to choose a variety of crops for customers to choose from.

Set a sales goal by asking youth how much they want to make this week. Consider past sales and the possibility of increasing, within a realistic scope.

Use the Harvest Inventory Sheet to plan the number of Crop Units to harvest and determine their Total Value (see below).

Crop Unit Price x Units Harvested = Crop Value

Sales Goal x 25% = Total Value of Crops Harvested

This value should equal 25% more than the Sales Goal, which may require some adjusting of crop units. For example, if the sales goal is $200 for the market, plan to harvest $250 worth of produce. Explain that an aesthetic of "fullness" is known to increase sales, and harvesting extra can ensure the Sales Goal is met. After harvest, students should verify that the crop inventory is accurate.

After the farm stand, have students record the number of units of each remaining crop on the Harvest Inventory Sheet. Use the formulas provided to calculate individual Crop Sales. Add together all Crop Sales for the Total Market Sales value.

Units Harvested – Units Remaining = Units Sold

Units Sold x Unit Price = Total Crop Sales

MARKET REFLECTIONS

Ask youth if the sales goal was met. Discuss the factors that may have had a role in the result, such as: number of customers, display, attainable goals, weather, farm stand outreach, etc. Brainstorm ways to grow by asking youth what worked well and what they can improve.

SCIENCE COMES TO TEA

© AYESHA ERCELAWN

AGES

7–10 years old

CONTRIBUTED BY

Ayesha Ercelawn
La Scuola International School
San Francisco, California
lascuolasf.org

A garden tea party, fun for everyone, can also be an excellent format for including some science. Our garden class incorporated tea making into the third grade classroom's unit on States of Matter. Evaporation and condensation, changes in temperature, thermometer reading and recording skills, conducting, and insulating—these ideas can all be pulled into making a lovely pot of tea!

MATERIALS

- 2 – 4 teapots (clear glass teapots are great visuals)
- Fresh herbs from the garden or purchased
- Hot water thermos or kettle
- Honey
- Spoons, 1 per teapot
- Cooking thermometers, 1 per teapot
- Clear glass or plastic cups, 1 per teapot
- Baskets for gathering herbs

DIRECTIONS

Children gather herbs, such as mint, from the school garden. Small teams harvest and prepare the herbs, remove the stems, tear leaves in half and place them in empty teapots. Plan to steep the tea for at least 10 minutes.

Review or introduce thermometer use and observe the current air temperature.

Place a thermometer into each teapot, and slowly start to pour hot water. Once the temperature stabilizes, a student from each group records the temperature. As the tea steeps, students periodically record the change in temperature.

Discuss what will happen when you take off the teapot's lid, as part of a conversation about evaporation, water vapor, and the gas phase of water. Show clear cups and ask children how they could capture some of that water vapor. Give each team a cup to place on or above the teapot and watch steam condensing.

Show honey and discuss whether students think it is a solid or liquid. Each team stirs honey into their tea and observes the process of dissolving/mixing. Pour and drink!

EXTENSIONS

Science extension. After a discussion of recorded temperatures and the cooling observed, make a plan for insulation vs. conduction experiments. What materials could we try using to keep the tea as hot as possible?

Cultural extension. Invite students' families to share a favorite tea or tea drinking customs, including medicinal values for these herbs.

Botany extension. Make teas out of different plant parts. For example, chamomile flowers, licorice roots, mint leaves, rooibos twigs or cinnamon bark.

Math extension. After tasting different teas, children record their preferences and analyze this data.

EDIBLE BOUQUETS

© JENNICA SKOUG

AGES

8–12 years old

CONTRIBUTED BY

Community GroundWorks *and*
Public Health Madison and Dane County
Madison, Wisconsin
communitygroundworks.org

In this activity, students create edible bouquets with the guidance of a garden leader. Their bouquets may include greens, herbs, and edible flowers, and may be made as part of a garden walk or from pre-harvested materials. Students learn the names of the plants in their bouquet, as well as basic nutrition information, and how food impacts health. The bouquets may be eaten on the spot, taken home by students, or used as part of an optional cooking activity.

MATERIALS

- Twine or rubber bands and scissors
- Edible bouquet components: kale, Swiss chard, salad mix, herbs, pea shoots, edible flowers (nasturtiums, violets, borage, calendula, daylilies), and other favorites!

PREPARATION

Begin by walking around the garden before students arrive, making a list of different plants they may be able to harvest for their bouquets. If needed, research basic nutritional information or an interesting fact about each plant you would like to include, e.g. "One cup of kale has more Vitamin C than a glass of orange juice!"

DIRECTIONS

This activity works best with a small group of students—about 10–12 students per adult is a good ratio. Adults can help younger students as needed with harvesting, and at the end with tying their bouquets together.

Gather students in a circle. Tell them they will be making bouquets, but unlike most flower bouquets, everything in their bouquet will be edible. If needed, define the words "edible" and "bouquet" with the group. Tell students they will be allowed to pick one thing at each place you visit together in the garden, but they must wait for instructions before picking.

Lead students in a walk around the garden with 4–6 stops along the way. At each stop, introduce students to the plant they will harvest: its name, one fact about that plant, how they should harvest it, and how many pieces they may harvest. Help students collect all their materials together to form bouquet. At the end of your walk, assist students in tying their bouquets with a rubber band or piece of string.

Review what students learned by asking them to identify the different plants in their bouquet and what they know about each one. Also encourage them to talk about the nutritional benefits of each component in their bouquet and how specific foods can impact our health (e.g. greens are great for digestion, Vitamin D is great for our bones, Vitamin K is great for our eyes).

You may wish to allow students to eat pieces of their bouquet immediately following the activity (or taste test along the way), put bouquets aside to take home, or use the bouquets as part of a cooking activity together.

EXTENSION

Cooking with bouquets. Cooking with youth is an excellent way to make them feel connected to their food and empowered in their cooking skills. Select bouquet components that can be used as part of a recipe. After making bouquets, disassemble them and use the components to cook a recipe together.

Weed bouquets. Make a bouquet out of weeds growing in the garden! Talk about what it mean to be a "weed", adaptations of different weeds, and how we decide if a plant is beautiful or not. (Don't eat weeds unless edible!)

PLANT ROOT EXPLORATIONS

© SHARON DANKS

AGES

6–10 years old

CONTRIBUTED BY

Hidden Villa
Los Altos Hills, California
hiddenvilla.org

In this two-part activity, students will study roots in the schoolyard and make a viewing box to study roots over time. Plant roots absorb water and nutrients and anchor the plant in the ground. Roots are typically found below the ground, but sometimes grow above ground to absorb water and nutrients from the air. There are many different types of roots including taproots, fibrous roots, cauline roots, and tubercular roots. A taproot is a long central root that stores energy while firmly anchoring the plant. Fibrous root systems usually grow less deep but can extend a great distance to allow plants to find water and nutrients in a wider area. Cauline roots spread easily and help a plant cover a wide area (e.g. ivy). Tubercular roots, found on plants such as the sweet potato, grow out of the stem, branch, leaves, or old woody root.

PART 1: EXPLORE ROOTS IN THE SCHOOLYARD

MATERIALS

- Garden trowels and gardening gloves (optional)
- 1 milk container (school lunch size) for each student

DIRECTIONS

A great way to encourage students to explore different kinds of roots is to have them weed a portion of the schoolyard such as a garden pathway or other weedy playground space. Select a large, well-defined area to work on that does not contain any plants you want to keep. Clearly mark the boundaries of this selected area before you begin.

Bring students outside and explain the activity. Demonstrate how to pull the weed by the stem base, as close to the ground as possible, so that the roots come up cleanly and remain intact. Use trowels as needed to loosen the soil.

After students remove the plants from the ground, they should gently shake off the extra dirt and observe the roots they have in hand. Designate a space for students to put the weeds they find. Discuss the range of root types the class discovered.

References: Jenny Strehle and Jessica Zuckerman, "The Root Show," Hidden Villa Garden Curriculum 2008, Hidden Villa. Adapted excerpt used with permission.

PART 2: CREATE ROOT VIEWING BOXES

MATERIALS

- 1 clear plastic square 1.5 in x 1.5 in (3.8 cm x 3.8 cm) for each student, cut from transparency sheets or similar sturdy, clear plastic
- Scissors, tape, drawing paper, pencils
- Soil, seeds (e.g. sugar snap peas or radish), water

DIRECTIONS

Preparation: Wash the milk cartons and open the flaps. Mark a 1 in x 1 in (2.5 cm x 2.5 cm) square on each container to show students where to cut.

Ask students to cut a 1 in x 1 in (2.5 cm x 2.5 cm) square in the side of their carton, following the marked outlines, and then tape a 1.5 in x 1.5 in (3.8 cm x 3.8 cm) piece of plastic across the hole. (Tape the plastic on both sides, inside and outside the container.)

Fill each milk carton with soil and plant a radish or pea seed. Be sure students place their seeds near the side with the viewing square. (If planted too far back, students will not see the roots growing.) Place near a classroom window or outside in a protected area.

Water the plants regularly and observe them weekly after the seeds sprout. Ask students to discuss and record their observations once a week for four weeks.

HOW MANY HONEY BEES?

© DANA BIEDERMAN

AGES

5–13 years old

CONTRIBUTED BY

Slide Ranch
Muir Beach, California
slideranch.org

Do people need bees? Do bees need people? How many honey bees do you think live in a hive? The average number of bees in a medium sized colony is 42,000. By acting out the process of gathering nectar, students gain a larger understanding and appreciation for bees, the process of making honey, and how bees impact the food we eat.

MATERIALS

- Jars (one large, several small)
- Spoons
- Water
- Optional: yellow food coloring for water (to make it look more like nectar), markers, and paper.

DIRECTIONS

Spread out jars filled with water in an outdoor area.

If possible, position jars near actual flowering plants, or ask students to draw flowers and then instruct the students to place the drawings under the jars. The jars can be far apart or close together depending on the space available.

Give each student a spoon and explain that they are going to use the spoon like a bee uses its "proboscis" (straw-like tongue) to collect the nectar from the jars.

Students will deposit the "nectar" they collected into one centrally located jar representing the hive.

After five minutes, look to see how much "honey" is in the "hive."

Debrief: A bee typically makes 40 trips from the hive to flowers and back in a day. In its whole life a honey bee makes about 0.5 tsp (0.25 cL) of honey.

Ask: "How many honey bees do you think work together to make one jar of honey? How about one gallon of honey? What about all of the honey in the supermarket? How did it feel to be a bee?"

PUMPKIN MATH

© ANDI COOPER

AGES

5–11 years old

CONTRIBUTED BY

Lombard School District 44
Hammerschmidt Elementary, Learn + Play Gardens
Lombard, Illinois
whslearnandplaygardens.org

Pumpkins can be studied for their many properties including weight, circumference, number of seeds, number of ridges, and whether they sink or float. Using a fall pumpkin harvest, this math lesson can be taught school-wide or within a single classroom. In a garden's first year, growing pumpkins is a manageable project for teachers to take on without feeling pressure to have a "green thumb". The resulting graphs provide visuals to enhance a garden bulletin board.

MATERIALS

- Pumpkins, 1 per group
- Scale
- Tape measure
- Large bowl or a sink filled with water
- Knife, spoon, and sheet pan
- Salt and cooking oil
- Oven

DIRECTIONS

Explain the goal of the Pumpkin Math activity to the students: to use estimation and fact checking to learn about the properties of pumpkins.

Divide students into groups of three or four. Distribute a pumpkin to each group, or ask students to gather in one large group to discuss the properties of the pumpkin.

Start by asking students if they think the pumpkin will sink or float. Demonstrate by setting the pumpkin in a bowl of water. Discuss what happens and why.

Next, ask students to estimate the pumpkin's weight, circumference, number of ridges, and the number of seeds inside the pumpkin. Fact check the estimates by asking the groups of students to measure and record their pumpkins' actual weight and circumference and to count the number of ridges.

Cut the pumpkins open and remove all the seeds. Ask the students to clean the seeds and count them using various strategies, like counting them in groups of ten. Discuss the results. Were their estimates correct? Were they over or under the actual number? Discuss.

Ask students to graph their results. This can be done with one graph comparing all the pumpkins that were studied at the school. For example, place the number of ridges, the weight, the circumference, or number of seeds along the y-axis and the various group names along the x-axis.

Combine seeds with cooking oil and salt in a pan. Roast them in the oven and enjoy them with the students as a healthy snack.

The colorful charts produced for the Pumpkin Math activity can be used to decorate a garden bulletin board.

Place-Based Understanding

Living schoolyards, built with local, natural materials and native plants, are each unique; reflecting the geography, ecology, and culture of their community. This makes school grounds special and memorable for the children, youth, and adults who spend time in them by building a "sense of place" and feelings of connection, belonging, shared ownership, and care.

School Ground Exploration. Many children today spend the majority of their outdoor time on school grounds, making these landscapes centrally important for shaping their experience of the world around them. As they attend school, children and youth visit the same outdoor environment day after day, and year after year, which gives them a nuanced and intimate understanding of the microclimates, wind patterns, rainwater flows, landforms, and communities of creatures, big and small, that share their landscape.

Schools can ensure that children of all ages develop a relationship with and understanding of place by giving them the time they need to explore their grounds every day, on their own. They can also foster outdoor learning that helps students weave their first-hand experiences of the grounds into a sophisticated understanding of the natural and human systems around them. Map-making is one way to harness students' knowledge of their grounds and solidify their spatial understanding, while connecting concepts taught in the classroom with hands-on fieldwork.

Natural Context. By exploring their own surroundings, children build a connection to and affinity for these outdoor spaces and the living things that inhabit them. Green schoolyards can also showcase local ecosystems and species, helping children to build scientific understanding and an awareness of human impacts—inspiring stewardship and further academic inquiry.

Geographic Context. Large painted or three dimensional maps of many types can be added to schoolyards to illustrate the school's location in the world, the country, the state, the city, the neighborhood, or even their watershed.

Cultural Context. Many school communities have incredibly rich cultural diversity which can be celebrated in their schoolyards with art, events, and activities that reflect the school's population and context.

Historical Context. Every school site and surrounding neighborhood has its own history, whether it is newly built or has stood for hundreds of years. Curricula about local history can be connected to the unique patch of ground managed by your school, and the results may be displayed creatively outdoors, for everyone to enjoy.

SCHOOL GROUND EXPLORATION

NATURAL CONTEXT

GEOGRAPHIC CONTEXT

CULTURAL AND HISTORICAL CONTEXT

RELATED ACTIVITIES IN OTHER CHAPTERS

GARDEN SCAVENGER HUNT RELAY

© ACACIA VANEPS

AGES

8–15 years old

CONTRIBUTED BY

Boise Urban Garden School
Boise, Idaho
boiseurbangardenschool.org

The goal of this activity is to get students moving, exploring, and searching within the garden space. They will need to rely on teamwork to successfully complete the challenge. A group consensus will be required before each item is checked of the scavenger hunt list. By breaking the scavenger hunt into several distinct parts, students will see the garden as more than just a bunch of plants.

MATERIALS

- Structure Lists (shed, bathroom, greenhouse, etc.), 1 per group
- Plant Lists - 1 per group
- Critter List (pillbug, earth worm, etc.), 1 for teacher
- Washable/dry erase markers
- Clipboards
- Butterfly net and/or bug catcher

DIRECTIONS

Prepare by creating and laminating lists of the structures and plants that can be found in and around the garden.

Divide the students into groups. (We recommend no more than the number of critters you have on your critter list.) Tell the students that they will be completing a scavenger hunt and will have to work as a team to do so.

The scavenger hunt will operate like a relay. Once a team has all of the items on their first list checked off, they will return the list to the teacher in exchange for the next one.

Each group will start with a clipboard, a marker, and either a structure or plant list. (Tip: Starting everyone with the Structure List allows the students to get the wiggles out while they run from structure to structure.) For the team to be allowed to check the structure or plant off their list, they all must see the item in question. Once that list is complete, they will return to the teacher and exchange it for the other of the two lists.

Upon completing the second list, the team will turn in their clipboard, marker, and list in exchange for a butterfly net and/or a bug catching container. (Tip: For the sake of the bugs, please give a demo how to properly catch bugs with the equipment prior to the activity.)

The teacher will then assign only one critter at a time for the group to go collect. The team will head back to the garden in search of the assigned critter. Once they catch the assigned specimen, the team must show the teacher to have it checked off their list. (The teacher should keep a running list of what bug each group has caught. Older students may be able to do this themselves.) The team will then release the specimen and the teacher will assign a new critter to find. Make sure to have the students trade off the bug catching equipment after each successful collection so that everyone in the group gets a turn!

SCHOOLYARD INVESTIGATIONS USING TOOLS

© JOEY LEHNHARD

AGES

4–8 years old

CONTRIBUTED BY

Monterey Bay Aquarium
Monterey, California
montereybayaquarium.org

Young children can use observation and measurement to find out more about an environment using simple tools that extend human senses and make the data collected more precise and scientific. In this activity, students take a closer look at a small part of their schoolyard and use scientific tools to observe and explore what they see!

MATERIALS

- Magnifier, thermometer, 1 m (3 ft) long piece of string
- Science notebook, pencil, clear tape

DIRECTIONS

Select an area of your schoolyard that has both sunny and shady areas. Explain to students that today they are going to do what scientists do—collect data—about their schoolyard. Show them the place in their science notebooks where they will record their findings.

Ask students to:

- Make a string circle, lay it on the ground and observe what you find inside of it.
- Collect a soil sample from your circle and tape it into your notebook.
- Use the thermometer to take the surface temperature inside your circle.
- Count the number of insects you find in your circle.

After students spend time collecting data, return to the classroom and graph and analyze or discuss what they found. Record students' questions on a chart or Question Wall for further investigation. Help them think about their data by asking the following questions:

- Look at your soil samples. What do you see? Now look again with the magnifier. How are the two samples the same? How are they different? Could you find some soil that looks different from your samples? Where would you look?
- Which area was warmer, sun or shade? Do you think we could find the very *warmest* place in our schoolyard? Where would you look? Do you think the temperature stays the same in those areas all day? How can we find out?
- How many insects did you find? Where could you look for more? Do you think you would find the same number if you went back another day? How can we find out? Can you find a place with more insects in the schoolyard? Where might you find more insects, in the sun or in the shade?
- What did you find in the sun that you didn't find in the shade? What did you find in the shade that you didn't find in the sun?
- What interesting thing did you find? Was it in the sun or shade? What makes it interesting to you? Can you describe it?

Scientists must look more than once at their study areas to begin to answer questions. Ideally, take the children out again to answer these and other questions.

SENSES AND SORTING NATURE EXPLORATION

© AMY LEAMON

AGES

3–6 years old

CONTRIBUTED BY

Lake Erie Nature and Science Center
Bay Village, Ohio
LENSC.org

Help very young children explore their place within nature by leading them in this quick and easy sensory activity. This exploration uses the five senses to encourage mindfulness in nature, reinforce counting and sorting, and introduce children to native animals. Use this exercise on a nature hike or on a "field trip from the sidewalk" in any season.

MATERIALS

- Outdoor area with some natural elements, such as leaves, acorns or rocks, that can be counted

DIRECTIONS

Lead your students outdoors to the most "natural" area available. A wooded area is ideal but any area near where animals may live is appropriate.

Tell students that today they are going to use their senses to explore the world around them. The first sense they will use is sight. Ask students to point to the part of their body that they see with. Ask the following questions and allow time for responses:

- "Look up, what do you see?"
- "Look down, what do you see?"
- "Look right, what do you see?"
- "Look left, what do you see?"

Repeat the step above for hearing, smelling, and touching.

Guide students in listening for natural sounds, identifying colors such as the color of the sky, trees, grass, and rocks. Point out any native animals or plants that you are knowledgeable about. Encourage students to close their eyes and touch nature (grass, rocks, tree, plants) and describe how they feel. Remind students not to taste anything in nature unless their parents instruct them to.

If the season and area allows, encourage children to collect acorn tops and bottoms. Show them how the top fits with the bottom and ask them what animals live here that might eat acorns. Encourage students to leave the acorns for the squirrels, leaving nature the way we found it. Include a focus on math by counting the acorns as they pile them up.

Repeat this activity at different times of the year so that students can see the changes that occur in nature with the change of seasons. You can also invite students to collect rocks and acorns for a sorting exercise, which can be used to introduce the idea of living versus nonliving things for older students.

© SHARON DANKS

I SPY A...
TREE! PLANT! BUG!

© SHARON DANKS

AGES

5–10 years old

CONTRIBUTED BY

Sandi Snyder
Big Pool, Maryland

The future of our Earth relies upon the environmental education of our students today. Incorporating environmental issues into our science programs is of utmost importance. The activity begins with an outdoor game for children that helps them to learn about the local environment, and to identify beneficial insects, plants, and trees. It can also be used as a science teaching tool and a starting point for discussions about local environmental wisdom in the community.

MATERIALS

- Gardening gloves
- Small magnifying glasses
- Small cups or receptacles with a lid for collecting bugs
- A tongue depressor or a stable stick to pick up bugs
- Cameras and/or drawing paper and writing tools

DIRECTIONS

This game is very simple to play but has many horticulture and science lessons embedded in it, so it can be used as an assignment for home or school. One of the goals of this project is to teach students the importance and necessity of identification, prevention or encouragement of the "good" and "bad" bugs, plants, and trees we find in our local environment.

Based on the game "I Spy", give students the names, descriptions, and identifying "personalities" of specific trees, plants, and/or bugs found in your region.

Allow students to explore a natural area of your school grounds or a park in your neighborhood. Give them 15–30 minutes for this exploration.

Ask the students to take pictures, draw pictures, and/or give a detailed description of what they find.

When they are back in the classroom, give the students additional time to research more information about the trees, plants, and insects they encountered. Through their hands-on field work and independent research, students will learn how to identify local organisms and what their roles are in the ecosystem. Hold a class discussion to share the research findings and drawings.

The class can also discuss the impact of each of these organisms on humans. Some of the insects, trees, and plants are useful to us. Others make it more difficult to grow our agricultural crops or present other issues for our communities. Class discussion can include information about how to encourage plants, trees, and insects that help us and how to discourage the ones that eat our crops or cause other problems for people.

If there are parents in your community who work as organic farmers, invite them in to talk about beneficial insects and the other management practices they use to keep their crops healthy without chemicals.

This activity can also be linked to a discussion of edible and medicinal plants that are found in your local area. Ask students to interview their parents or grandparents to find out if they know how to make any home remedies or special edible treats using local plants. Review the recipes students bring in (check for safety) and share them with the class.

NATURE PASSPORT

© ALDO LEOPOLD NATURE CENTER

AGES

4–10 years old

CONTRIBUTED BY

Nature Net
Madison, Wisconsin
naturenet.org

Nature Net is known for its summer activity booklet, *Nature Passport*, which encourages learning and exploration throughout the summer at each of the Nature Net member sites in south central Wisconsin. In this activity, students create their own passport and travel itinerary around their own schoolyard. How many destinations can they traverse and learn about? This activity will encourage students to look for nature everywhere they go.

MATERIALS

- Journal, notebook, or design your own passport booklet (leave space on each page for journal entries)
- Stamp pad and stamps

PREPARATION

Survey your school grounds for various areas that differ from one another. Examples might include woods, short grass, tall grass, shady and sunny areas, blacktop, playground, vegetable garden, hilly and flat areas, and busy or quiet zones. You can map these out or simply plan in your mind where you would like to visit, and which locations would be best for observing natural phenomena.

DIRECTIONS

Give each child a passport journal and a writing utensil.

Discuss with students how travel takes us to new lands and gives us a new perspective on the world around us. Encourage children to think about and examine the places they visit as if they've never been there before. What new things might they see? What kinds of nature may exist? What might they see if they are quiet or if they look closely?

Visit each site as a class, encouraging students to explore, listen, get down low, use their sense of smell, or quietly observe. Ask students to take notes in their passports about what they see in each new place: different types of plants, animals, scenery, sights, and sounds. Their notes can be in the form of drawings or writing.

Ask students to think about what they would put in a postcard to their families or friends back "home" to best describe their travels.

Stamp their passports to signify they've visited each site.

The class might visit several locations in one day or throughout the year. Note (or make predictions about) how places change through the seasons. Which animals do you see or not see? What textures and smells are different? Does the wind move or sound distinct in each season or location?

EXTENSIONS

Add photos or other keepsakes to your passport. Consider setting up a class photo album, Instagram, or Siftr account to record your memories and "travels".

Use the same passport for field trips off site as well. Send it home at the end of the year as a reminder of all the travel adventures around the school and "abroad".

Send students home with a Nature Net *Nature Passport* at the end of the year to encourage them to continue their exploration. Contact Nature Net to order a classroom set.

YOUR SPECIAL PATH

© MING CHOU

AGES

2–18+ years old

CONTRIBUTED BY

Nature Explore
Lincoln, Nebraska
natureexplore.org

Take a walk in nature with children. Explore and let your senses go to work. Make mental notes of things most interesting to you. Later you will make a "map" of your special path. This activity supports a wide range of ages, interests, and abilities. Children are able to develop skills and understandings in many areas of development at the same time as they engage in personally meaningful explorations of the world around them.

MATERIALS

- Clipboards
- Writing and drawing materials
- Books and resources such as atlases and maps can be used to spur interest in this topic.

PREPARATION

Identify a good location for a walk in nature with students. This could be somewhere on your own school site, or nearby in the neighborhood. Areas that have a variety of terrain features are useful for this activity. Look for a place that has hills, some vegetation for cover, and different surfaces like grass, rocks, water, or bridges or other structures. Easily recognizable landmarks are helpful, such as a unique tree or a pond.

DIRECTIONS

Bring the class to the natural area and introduce the activity to find and explore their own special path. Remind children that the path they create should not disturb the natural area. (e.g. avoid breaking branches, etc.)

© SHARON DANKS

Allow the children to take a walk and hunt for interesting things. As the group explores, ask them to let their senses go to work. Listen, look, smell, and feel this environment! Encourage them to make mental notes of things that interest them. Observe the details. Try a variety of perspectives… climb a tree or pretend to be a bug on the ground.

Bring the group back together and ask the students if anything they touched or smelled reminded them of another time or place they have been outdoors? Hold a discussion with the group about what they experienced.

Now, give the children some drawing materials and ask them to make a map that is representative of their walk and the things they experienced along the way. The map may have symbols or lines representing a path, or landmarks drawn on it. It can convey a sense of the physical place as well as their feelings about their experiences there.

EXTENSIONS

Remember that this type of walk in a natural area does not have to be strenuous, just interesting. Find a natural area that is wheelchair accessible and lead this activity with children or adults who have mobility differences.

Try making different types of "maps" on repeated trips. Children can convey their experiences along their path using descriptive words and poems, or they can describe their journey with movements that they act out.

REFLECTION WRITING IN YOUR GREEN SCHOOLYARD

© NATURE'S VOICES

AGES

7–18 years old

CONTRIBUTED BY

Nature's Voices, Green Schools Initiative
Berkeley, California
naturesvoices.org

This activity links to the Language Arts Common Core Standards by asking students to reflect upon why green schoolyards are important to their school. Students choose their favorite spot in the schoolyard, then use a prompt to write about the benefits of green schoolyards for themselves and their school. These essays can be published on the Nature's Voices website and on other community platforms to showcase student stories about green schoolyards.

MATERIALS

- Pen, paper, and clipboard for each student
- Computer access to publish the stories on the Nature's Voices website, listed above.

DIRECTIONS

Tell the class that May is Living Schoolyard Month in California (and International School Grounds Month around the world), and they will be brainstorming, writing about, and then publishing stories about the many reasons why their green schoolyard is so important to them.

Begin by taking students on a tour of the schoolyard, stopping at all of the students' favorite spots and reflecting on why these places are special. The teacher can designate a note-taker to record comments during the walk.

Gather the class and lead a discussion to reflect on the site tour. The discussion might include questions like this:

- "Name some of your favorite places on the school grounds and tell us why they are so special to you?"
- "What are some of the benefits of green schoolyards?" Students might say: nature calms them down; they love that their school is protecting the environment; or they have fun playing in nature at school.
- "How does the green schoolyard help the community?" Ideas might include that the school is saving water, growing food, or planting trees.
- "Should other schools have green schoolyards like the one at your school? If so, why?"
- "Are there other elements that students would like their schoolyard to include, to make it even greener?"

Teachers continue the lesson by giving each student a clipboard to write an essay that summarizes what they were thinking about during the discussion. Students choose their favorite place in the schoolyard, sit down there and write for 15–20 minutes. The general writing prompt might be: "Why I love my green schoolyard" or "What my green schoolyard means to me."

After students have completed the first draft of their essays outside, the teacher can later use them to teach or practice the writing process by creating edited revisions. Students may also illustrate their writing with photographs or drawings.

With their teachers' assistance, students can publish their completed stories and images on the Nature's Voices website. This website, listed above, is a storybank of written work, photographs, and videos from and about youth, who share their thoughts related to their environmental and outdoor experiences.

Students and teachers can also brainstorm other ways to share their stories, from publishing their essays in the school or community newspaper to sharing them on the school's website.

DOCUMENTING BIODIVERSITY IN YOUR SCHOOLYARD

© KAIT SHORROCK

AGES

9–18 years old

CONTRIBUTED BY

California Academy of Sciences
San Francisco, California
calacademy.org/educators

Using simple tools and technology, develop and carry out an original scientific investigation about biodiversity on your school campus. Use iNaturalist to conduct a biological survey, get help with species identification and connect with a global network of naturalists. Then, analyze your data, draw conclusions, and share your findings to inspire environmental stewardship in your community.

MATERIALS

- Mobile device with iNaturalist app downloaded, 1 per group of 2–5 students
- Science notebook, 1 per student

PREPARATION

- Review the iNaturalist mobile app, website, and Teacher's Guide: http://bit.ly/1W5dxDG
- Setup login: http://bit.ly/1RZMRmB
- Select your schoolyard study site as your "place"

DIRECTIONS

Lead a short discussion accessing prior knowledge about schoolyard biodiversity. Ask the students: "Which species (large or small) have you seen on your school grounds?"

Show students the iNaturalist website and app and, if applicable, show any data that already exist near your schoolyard. Ask students: "Which of these species are unfamiliar to you? Who collected these data?"

Explain that today students will be collecting data using iNaturalist to document the species they can find in their schoolyard.

Ask students to log onto iNaturalist on the mobile devices. Model how to take a photo of an individual organism and sync to iNaturalist. Give students time to practice.

Ask students to create a preliminary inventory by using a mobile device to take photos of individual organisms. Divide responsibilities so that everyone has a chance to take photos, sync to iNaturalist, identify species and complete online entries. (Use the online tutorials to practice this process before teaching the students.)

Facilitate a discussion about what the students observed. Ask: "What kinds of organisms did you observe? What did you see that you didn't expect?"

After students have a sense of local biodiversity, have them work in small groups to examine the data, compare their schoolyard to a nature preserve and discuss.

Then ask students to answer questions in their science notebooks: "What kinds of organisms are abundant near your school? What is rare? Why do you think that is? How did the organisms near your school get to be there? What do they need to survive? Does anything seem strange, confusing or interesting to you about what lives in your environment?" Record all questions in science notebooks.

RECOMMENDED EXTENSION

Continue students' background research on local environmental issues by investigating local news and interviewing community members. Ask students to develop their own research questions, gather more data on the schoolyard, analyze results, and share them with their community. More information is available from: http://bit.ly/1Tag0dA

GUIDEBOOK: NATIVE PLANTS IN THE SCHOOLYARD

© ELAINE THOLEN

AGES

9–18 years old

CONTRIBUTED BY

NoVA Outside
Arlington, Virginia
novaoutside.org

This activity produces a schoolyard habitat guidebook that is specific to your own school site, and is useful for students and visitors. Working on the guidebook—and selecting native plants for the habitat or studying those already there—helps students feel a sense of ownership for habitat plants on your grounds. This is also a great way to integrate technology use with hands-on, outdoor studies.

MATERIALS

- Access to computers and the Internet
- A list of native plants in your locality or a list of the plants that are already in your school ground habitat
- A template for a final presentation (e.g. slides or written)

DIRECTIONS

Ask the students to select a native plant whose name they like or randomly distribute names of local plants. Give students both the common and the Latin name.

Students can work individually or in groups depending on the number of plants you'd like them to research. Ask students to conduct some research online or in the library to find out more about their plant. Students should gather: a description of their plant, including size and identifying characteristics; the plant's needs for survival; a list of wildlife this plant will attract; human uses for the plant; and other fun facts. Ask the student to also look for pictures of their plant during each of the seasons.

If the class will be choosing plants for your school ground habitat, ask the students to recommend whether or not the plant they researched should be placed in the habitat. (Some may need more or less sunlight, or may be too big or too small for the intended space.)

Ask the students to give oral presentations to a panel of plant experts or to a small group. Laminate the presentation materials for each plant that will be placed or exists in your school ground habitat, to create a new guidebook to your native garden.

EXTENSION

Ask the students to:

- Write a blog post about their plant and its attributes
- Take a video of themselves talking about their plant and share it online
- Make a QR code to post near their plant in the garden, and link it to their video or research narrative
- Design garden signs for their plant
- Talk with local plant experts about their plant research

Plant websites for students:

- USDA **plants.usda.gov**
- LBJ Wildflower Center **wildflower.org**

SIX OF ONE, HALF DOZEN OF THE OTHER

© JOHN FISHER

AGES

7–18 years old

CONTRIBUTED BY

Life Lab
Santa Cruz, California
lifelab.org

In this activity, groups of students will search for objects in the garden that have a specific quality and those that have the opposite quality. Students use multiple senses to find and classify contrasting objects in the natural environment.

MATERIALS

– 1 egg carton per group of 3 students

PREPARATION

On the bottom of each egg carton write two words. One should be a likely quality of a garden object, such as "wet". The other should be its opposite ("dry"). Use words that will encourage students to use their senses, such as dark/light, rough/smooth, dull/colorful, scented/unscented, scratchy/soft, etc. Label each carton with different opposites. To discourage unsupervised tasting, avoid opposites that refer to taste.

DIRECTIONS

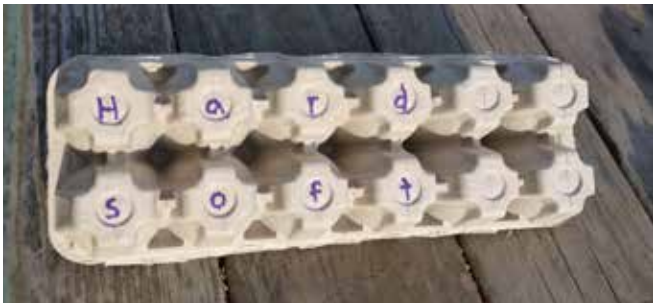
Divide the class into groups of three. Tell the class that each group will get a special collecting container in which to collect 12 items. They shouldn't let any other group see the secret information on the bottom of the carton.

Distribute the cartons and demonstrate to each group how the opposites should be placed, with six of each category in a long row. On the bottom of the carton are secret words that tell what category of objects to collect. Every group will be collecting different opposites.

Remind students to handle everything gently and to take only small specimens. Allow enough time for students to explore the site and gather the items they need.

When the groups are finished, have them each exchange cartons and try to determine which opposite categories the other group collected, without looking on the bottom of their carton.

Discuss strategies that the groups used for identifying the other group's classifications.



BUTTERFLY HABITAT HUNT

© ELIZABETH SOPER

AGES

5–12 years old

CONTRIBUTED BY

National Wildlife Federation, Schoolyard Habitats®
Midpines, California
nwf.org/california

Students will explore what butterflies need in order to survive and will investigate their own school grounds for butterfly habitat.

MATERIALS

- Pictures of local butterflies, and research or articles on butterfly habitat and host plants for your geographic area
- Magnifying glasses
- Nature journals

DIRECTIONS

Explore the concept of wildlife habitat with your students. Ask them what they think wildlife need in order to survive.

In order for an animal to survive, it must be able to find adequate habitat that provides food, water, cover, and a safe place to raise young. The amount and quality of these needs varies a great deal from species to species.

Now have students think specifically about butterflies. Where do they tend to see butterflies? What do they think butterflies eat? Where do they think butterflies find cover and raise their young?

© SHARON DANKS

Many butterflies require specific plants in order to survive. These plants are called "Host Plants". For example, Monarch butterflies require milkweed in order to survive. Ask students to research which butterflies are present in their local community and which habitat and host plants they may require.

Next, take your students outside to your own schoolyard and have them explore the grounds for butterflies and plants. Younger students can draw what they see in their journals or you can also cut out squares of construction paper of different colors. Hand out one or more (depending on level of students) squares of several different colors and have them look for butterflies or flowers that include that color. Ask students to observe these animals/plants carefully and draw them in their journals. For older students, take them outside for a butterfly/plant hunt. As a group, search for the butterflies and plants they identified in their research.

Alternatively, divide students into groups and ask each group to look for one specific type of butterfly or plant. Depending on the time of year, students can also look for butterflies and draw what they see in a nature journal or on a sheet of paper.

When you return to the classroom, examine your results. Make a list (or simple sketches) of the plants and/or butterflies you found. Could you add any plants to make the schoolyard a better place for butterflies?

Note: Consider planting or starting a butterfly garden as part of a Schoolyard Habitats® site. Visit our website for more information: **http://bit.ly/1ScGx7H**

ADOPT-A-TREE

© NAOMI HERSHISER

AGES

5–8 years old

CONTRIBUTED BY

Prairie Crossing Charter School
Grayslake, Illinois
prairiecrossingcharterschool.org

Introduce students to the field of phenology (the study of nature's seasonal changes through the year) by adopting a class tree. Classes choose a tree that they will visit and observe throughout the year, looking for changes over time. By adding complexity in the recording tasks, this activity can be appropriate for a range of ages.

MATERIALS

- Recording tools (nature journal or paper and a clipboard, pencils or colored pencils), 1 per student

DIRECTIONS

Choose a tree to adopt. The best trees to select are accessible to the classroom, change throughout the year, and exhibit their important phenophases (flowering, leafing out, seed formation, color change, leaf loss, and dormancy) while school is in session.

Introduce the class to the tree at the beginning of the school year as a member of the class. On the first visit to the tree, guide students to look at the tree's different parts very carefully. Ask them to describe the leaf's shape and color, the feel of the bark. Have them look at the tree from far away to get its overall shape, as well as close up. Look for evidence of animals interacting with the tree, such as chewed leaves, nests or spiderwebs in the branches.

Ask students to draw the tree. Remind them that this drawing is supposed to be a realistic drawing, and they are trying to show what the tree looks like to someone who can't see it. (Depending on student level, they can label their drawings or describe the tree in words.)

Take a photograph of the class with the tree. This, and subsequent photos, can be displayed in the classroom or used in digital displays.

Keep students' tree photos on hand, so that each visit pictures can be added to the previous and create a complete picture of the tree through the seasons.

Visit the tree every couple of weeks. In winter, when there are fewer changes, visit less frequently, but rapid change in spring and fall may merit more frequent visits.

Start each subsequent visit by having students look for differences between this visit and last time. A review of the photos or drawings can help jog their memories.

At each visit, ask students to draw the tree, and take a photo from the same vantage point.

At the end of the year, review the data with the students. Ask them look at their own drawings as well as photos to determine how they've progressed. These also make great portfolio entries, showing students' academic growth through the year.

Enjoy getting to know your class tree. It can be the inspiration for art, writing, and scientific inquiry.

Reference: Written by Naomi Hershiser.

MEAN, MEDIAN, MODE — OH MY!

© LEAF

AGES

10–15 years old

CONTRIBUTED BY

LEAF - Wisconsin's K-12 Forestry Education Program
Stevens Point, Wisconsin
leafprogram.org

In this activity, students will measure the circumference of tree trunks to determine mean, median, mode, and range values for a group of trees. Students will work in small groups.

MATERIALS

- For each group of students: clipboard, paper, calculator, pen or pencil and a flexible tape measure (or string to fit around tree trunk and match circumference to ruler)

DIRECTIONS

Introduce the concepts of mean, median, mode, range, and circumference to students before going outside.

Go outside to an area with at least five trees.

Ask students to form small groups.

Each group should measure the circumference of five trees and record each tree's circumference in a table the students create on a blank piece of paper.

© SHARON DANKS

After all of the trees have been measured, ask students to calculate the mean, median, mode and range of the trees' circumferences.

Ask students to graph their results. If your site has multiple trees of different species, go more in depth with the following steps.

Encourage the students to collect the circumference measurements from multiple trees of the same species and enter them into a table. (One species per table; record at least two species.)

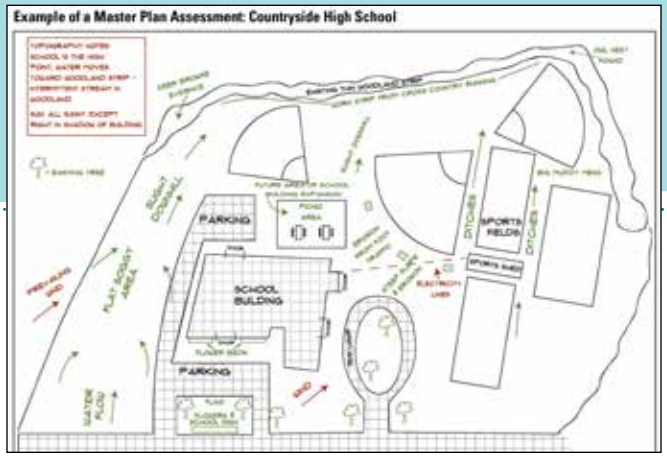
After the tables have been filled out, students should calculate the mean, median, mode, and range for each species and graph the results.

Ask each group to compare the data and results by having them write about the following:

- "Describe the similarities among the tree species that were measured."
- "Describe the differences among the tree species that were measured."
- "Compare just the circumference measurements taken from the trees in one species. Were the measurements all the same?" Ask students to explain and analyze their results.

Discuss with the class why different trees may have different size trunks based on the data collected. Include a discussion of the age of the tree, light and water requirements, growing conditions, and species growth patterns.

CREATE A SCHOOLYARD SITE SURVEY MAP



AGES

5–18 years old

CONTRIBUTED BY

U.S. Fish and Wildlife Service
Sacramento, California
fws.gov

A schoolyard site survey takes students on a journey around the campus to identify areas used by people, both formally and informally, physical features of the campus, and human-related and biological characteristics of the site.

MATERIALS

- U.S. Fish and Wildlife Service's Schoolyard Habitat Project Guide, see: http://1.usa.gov/1RZLep0
- All available maps and images of the school
- Camera
- Measuring tape
- Field guides
- Binoculars
- Pencils, markers, and graph paper

DIRECTIONS

Draw an outline of the school property, school buildings, and parking lots. This is your base map.

Walk the entire schoolyard.

Sketch on your base map all of the important physical, human related, and biological characteristics listed below. Create a legend and designate symbols to mark important characteristics.

Create a collective schoolyard site survey that includes observations from the whole class about the following features:

Topography. Identify high and low spots. Locate steep slopes.

Prevailing wind. Indicate prevailing wind direction.

Sunny and shady areas. Distinguish between areas that receive full sun, partial shade, and full shade.

Water. Designate any areas that are obvious drainage or waterways. Indicate direction of water runoff. Locate any areas where erosion is occurring. Locate spots that seem especially wet or dry.

Structures. Identify structures where students play or gather such as playground equipment, bike racks, signs, benches, picnic tables, and fences.

Fields. Identify the athletic fields and areas that are used for informal play either by the school or other members of the community. Identify where students gather for fire drills.

Accessibility. Identify areas that are accessible during a class period. Indicate formal and informal pathways. Identify spaces used by the public.

Utility features. Locate obvious utility lines above or below ground. Locate existing water or irrigation lines and accessible spigots.

Plants. Locate and identify trees, shrubs, and plants that provide food and cover for wildlife, both on and adjacent to the school grounds.

Wildlife. Locate and identify signs of wildlife on the school grounds.

Groundcover. Indicate different groundcovers such as grass, bare earth, pavement, woodland groundcovers, native plantings, or garden areas.

Discuss your observations and completed schoolyard map with the class and with the rest of the school.

BUILDING CONNECTION VIA ACTIVITY MAPPING

© REBECCA COLBERT

AGES

4–18+ years old

CONTRIBUTED BY

MIG, Inc.
Berkeley, California
migcom.com

The experiences children share at school can be just one facet of their "wild" lives outdoors. The goal of this three-step activity is to broaden students' awareness of the role of outdoor spaces in their lives, while at the same time increasing their understanding of the diverse interests and experiences of their peers.

MATERIALS

- Poster-size local map
- Dot stickers, about 1 in (2.5 cm) diameter
- Star-shaped stickers
- Sticky notes
- Blank paper to draw on
- Pens, pencils, colored pencils and markers

DIRECTIONS

Give each student a blank piece of paper and ask them to draw their favorite thing to do outdoors. Allow 10 minutes to complete the exercise (more if everyone seems focused and engaged). Ask each student to share what they drew. To help students share with open minds, start by asking everyone to pay attention to the presentation and ask themselves how the person presenting is like them. Try to find something that you can identify with in every presentation. Identify common themes, interests, and experiences across the activities.

Ask students to write their favorite outdoor activities on dot stickers (3–5 per student). Open the big map. Have students take turns placing a star-shaped sticker on their homes, and then placing their activity dots on the map where they usually do the activity. Encourage students to share with the group about their choices for activities and places. Again, look for themes and point out common interests between students.

Discuss where the activities take place, who they do the activity with, and how they usually get there. (If you want, you can help students to draw their route from home or school to the place where they do their favorite outdoor activity.) Are there common spaces that students visit or modes of transportation that they use (or don't use)? Discuss why this might be.

Do any of their favorite activities take place on the school grounds? Why or why not? Ask students to think about ways to incorporate favorite outdoor activities in the schoolyard. Use sticky notes to record comments and ideas, and place them on the map.

To close, choose one place students identified, or introduce them to a new one, and go for a walk together. Practice noticing small natural things around you, such as acorns, leaves, the sound the wind makes, etc. Discuss whether students visit this space on their own. If not, why not? Discuss ways to make accessing this space easier, safer, or more enjoyable.

Tip

When choosing a map, focus on an area that includes your school and is wide enough to cover several neighborhoods and local destinations. You can create one and print it at a local copy shop, or use a ready-made map. The map should be large enough for several students to gather around at the same time.

DECODING MIDWESTERN ROCKS AND MINERALS

© JENNIFER DAVIES

AGES

10–14 years old

CONTRIBUTED BY

Avon Outdoor Learning Center
Avon, Indiana
avon-schools.org

Students love rocks! Ask each student to bring in a sample, or collect a bucket full for students in the class to choose from. In this activity, students will use the same methods a geologist uses—the characteristics of minerals, such as cleavage, luster, hardness, and weathering—to identify the rocks they have found. Note: There will almost always be a sample that does not key out easily! If you end up with a 'mystery rock' encourage students to search online or reach out to local geologists—every state has them, usually working for your Department of Natural Resources.

MATERIALS

- Variety of rocks and minerals, at least 1 per group
- Steel nail
- Diluted Hydrochloric Acid (HCL, found at pool supply stores) or vinegar
- Paper towels

DIRECTIONS

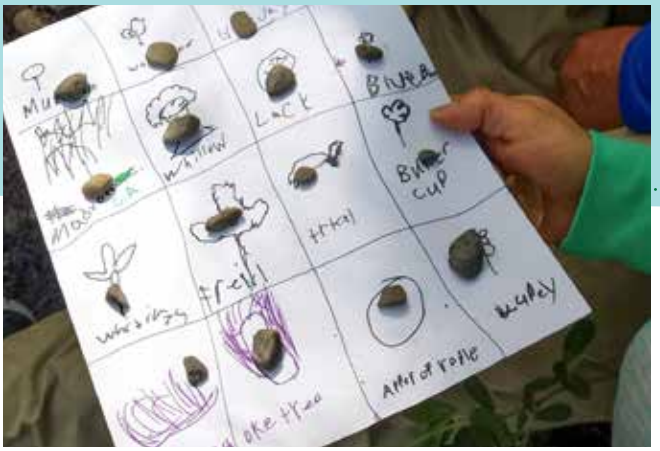
Use this dichotomous key and the scientific method to figure out which rock or mineral you have.

1. Scratch your rock with the steel nail. (You may have to scratch very hard and more than once!)
   - If your rock is easily scratched by the nail or it leaves a groove in the rock ..... **go to 2**
   - If your rock is not easily scratched by the nail, but the nail leaves a silver mark like a pencil ..... **go to 6**
2. Scratch your rock with your fingernail.
   - If your rock is easily scratched or broken by your fingernail, is black and lightweight, your rock is.... **COAL**
   - If your rock is not scratched by your fingernail....**go to 3**
3. If your rock is wet, dry with a paper towel. Put a small drop of HCL (or vinegar) on your rock and observe.
   - If your rock fizzes or bubbles ..... **go to 4**
   - If your rock does not fizz or bubble ..... **go to 5**
4. Look closely at your rock.
   - If your rock is yellowish, white or clear and has a square shape, your rock is the mineral ..... **CALCITE**
   - If your rock does not look square and is grey or tan, your rock is ..... **LIMESTONE**
5. Look closely at your rock and touch its surface.
   - If your rock is white, reddish-brown, golden-brown, feels sandy and rough like sand paper, your rock is .... **SANDSTONE**
6. Look closely at your rock and touch its surface.
   - If your rock is white, tan, grey, black, brown, pink or purple, feels smooth and glassy, and has sharp edges and points your rock is ..... **CHERT**
   - If your rock is grey, black or brown with some shiny green or blue, your rock is what is left over after burning coal ..... **CINDER**
   - If your rock is white or clear, may have sharp or rounded points, and sometimes looks like cauliflower or stacked pencils you have a mineral called.....**QUARTZ**

Additional resources

Paleontological Research Institute's *Geologic History of the Midwestern US*: **http://bit.ly/1QdxRwi**

SCHOOLYARD NATURE *LOTERÍA*



AGES

6–17 years old

CONTRIBUTED BY

Latino Outdoors
Capitola, California
latinooutdoors.org

Lotería **is a traditional game played in many Spanish speaking countries that is somewhat similar to bingo. Kids can make their own nature-themed *lotería* cards and *tablas* (game boards) using their schoolyard or backyard for inspiration. Teachers can help students to make a collaborative class set and/or personalized, nature-themed *lotería* games to take home.**

MATERIALS

- To make one *lotería* set for the class, you will need at least 2 blank index cards per child, of any size. You will also need 1 full sheet of card stock, 8.5 in x 11 in (A4 size) per child, to use for the tablas.
- Drawing and coloring materials and glue for each child
- A class set of counting chips, for use while playing the game. This can be anything from bottle caps to beans or a favorite type of dried seed found in your schoolyard.

DIRECTIONS

First, bring the class out into the schoolyard to explore, play and identify what they see! Ask the children: "What kinds of trees grow at your school? Which animals visit or live there? Which insects? What type of plants do you see? Do you see birds, a lizard or a cat walking by?" Ask students to make a list of everything they see, from the grass they can touch to the birds that fly away.

Second, ask the children to draw what they observed, and make colorful pictures of the plants and animals in your schoolyard. They can pick other favorite objects, too. Give each student two cards. Ask them to draw one animal, plant, or object per card and label each card with a descriptive name. If they know how to translate their label into Spanish, their cards can have both the English and Spanish words for the plant, animal or object they drew (e.g.: *El Gato*, The Cat). Ask Spanish-speaking parents or students to help with the translations. Visit the schoolyard as many times as needed to draw a full set of 54 cards (or more) with the class.

To create the *tablas* (game boards), make photo copies of the hand drawn cards at a reduced scale, 2 in x 2.5 in (5 cm x 6.5 cm), and ask children to paste the small versions of the drawings onto their 8.5 in x 11 in (A4) paper to create a grid of pictures, in random order, with four rows and four columns. (See photo) Each child will need sixteen small images for their *tabla*.

Next, play *lotería* in the classroom or outside in the schoolyard. To begin, the leader holds the deck of cards and picks one card at random from the stack. He or she calls out the name of the card (as written) and shows everyone the picture. Children playing the game place a counting chip on the matching space on their tabla if their *tabla* has that image. The first child to cover four squares on their *tabla* in a horizontal, vertical, or diagonal row (or fill four corners or a small square group of four) is the winner of the game and shouts "*¡Lotería!*" (Lottery!)

Students can also work in small groups to make their own full set of place-specific *lotería* cards and *tablas* and use them to play with their parents and other members of the community, reinforcing the identification of nature in the schoolyard while spending time together in an enjoyable social activity that connects generations.

For more about ***lotería*** see:

Wikipedia – *Lotería* – **http://bit.ly/1PSeyYH**

CIVILIZATIONS OF THE AMERICAS: AZTEC *ALEGRÍA*

© SHARON DANKS

AGES

5–11 years old

CONTRIBUTED BY

The Edible Schoolyard
Berkeley, California
edibleschoolyard.org

At the Edible Schoolyard in Berkeley, our students study ancient civilizations of the Americas, combining social studies lessons with related hands-on cooking and gardening projects. The activity below is a cooking project using a grain called amaranth, which was a staple food of the Aztec Empire and was considered sacred. In addition to growing amaranth, the Aztecs followed many of the Mayan agricultural traditions like growing cacao, harvesting honey and growing food on terraced hills. In later years, the Incas further developed terraces using stone walls and rigid geometric patterns. In our curriculum, we explore those agricultural practices and ideas by trying many of them with the students.

BACKGROUND

Amaranth has been a cultivated grain for thousands of years. The bright flowers can also be used for dying cloth and making pigment. When the Spanish conquered the Aztecs and saw how important the grain was for their culture, they banned it.

Mayans discovered chocolate before the Aztec civilization came about. Chocolate is made from cacao beans. The beans we eat are the seeds within the cacao pod, which grow on trees in the tropics. The cacao plant is native to Mexico. There is bountiful evidence that the Mayan civilization used cacao in their everyday life and valued it highly. We show our students images of Mayan hieroglyphic writing and explain that from writings such as the *Popol Vuh*, we know that the Maya had two main uses of cacao: as currency and as a special drink. The Maya believed the cacao bean had magical and divine properties and they prepared it in the form of a frothy drink that only nobility could consume.

The Maya were among the world's first beekeepers. They cultivated honey from a native stingless bee that resides within living trees in the tropical forests of Central America. Honey was harvested as part of a religious ceremony twice a year. Honey was used as a sweetener, an antibiotic, and as an ingredient in the Mayan version of mead, a fermented drink.

INGREDIENTS FOR AZTEC *ALEGRÍA*

- 0.33 cup (78 mL) brown rice syrup (or maple syrup or honey)
- 0.5 cup (177 mL) sunflower seeds
- 1 tsp (5 mL) ground cinnamon
- 1 cup (236 mL) amaranth, from the school garden or purchased
- 1 TBL (15 mL) honey

DIRECTIONS

Line a sheet pan with parchment paper. Place the jar of brown rice syrup into a pot of hot water. In a deep pan, pop the amaranth in small batches, setting the popped amaranth aside in a mixing bowl.

Lightly toast the sunflower seeds in a deep pan. Add the toasted sunflower seeds and cinnamon to the popped amaranth.

Slowly stir in the warmed brown rice syrup and honey. Mix well and pour *alegría* onto the sheet pan. Spread the *alegría* mixture evenly over the sheet pan and let it cool. Cut into 2 in (5 cm) squares or store it in an airtight container. Eat together in the school garden.

Reference: Adapted from Edible Schoolyard's, "Civilizations of the Americas" lesson by the Edible Schoolyard staff. Complete lesson can be found at: **https://edibleschoolyard.org/resource-search**

PROCESSING ACORNS

© VICKI MOORE

AGES

8–10 years old and up

CONTRIBUTED BY

Living Classroom
Los Altos, California
living-classroom.org

In this lesson, students will learn how the first California inhabitants relied on native plants for a wide range of essential needs including food, hunting, housing, baskets, medicine, and tools and how knowledge of these plants were crucial to their survival. Because the plants are grown in their school's own native habitat garden, students will not only learn to recognize these plants but will be able to connect the plants, through sensory observation, with how they were used. This lesson supports the California 4th grade Social Studies focus area of California history.

MATERIALS

- Bag of dried acorns (or gather with students)
- Tarp or terry cloths, mortar and pestle, bowls to collect shells and kernels, 20 pounding rocks

DIRECTIONS

Quickly introduce the importance of acorns: One of the mainstays of the diet for California Indians was the acorn which was used in soup, porridge, and bread from sixteen different species of oak trees. Because of the nutrition provided by acorns, the Native American people in California did not need agriculture. Acorns contributed to the fact that California peoples did not experience annual famine months. It is estimated that among one tribe, the Yokut, a typical family consumed 1,000 lbs – 2,000 lbs (454 kg – 908 kg) of acorns each year. Acorn meal is 21% fat, 5% protein, 62% carbohydrate, and 14% water, mineral, and fiber. Show photos of acorn meal, acorn mush, and acorn pancakes if you have them.

If there are acorns on campus, go with students to collect them. Otherwise include acorns in your activity kit.

Bring the acorns to the tarp and spread them out. Place the small terry cloth material on the tarp, one per student.

Show the students how to crack the acorns. Place one acorn on a rock and then use the other rock to smash the acorn between the two rocks. Once smashed, ask students to peel off the outer layer and put the acorn meat in one bowl and the shell in another.

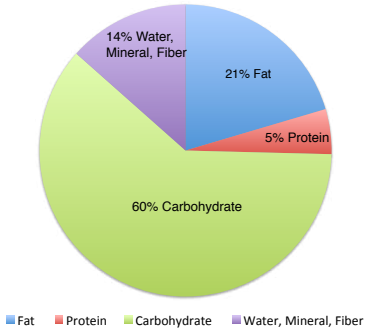
After enough acorn meat is obtained, allow students to take turns with the mortar and pestle to pound the acorn meat into acorn meal. (30 seconds per student, so it goes quickly.)

While the kids work, provide more information. In the fall, Indians would travel to special groves of oak trees that produced abundant crops to collect acorns. Acorns were a staple crop—something they ate on most days and it supplied a large portion of the calories in their diets.

Acorns take time to process. It is best done over the course of a semester or several weeks.

How to process acorns:

- Gather them, dry them, and remove the shells.
- Grind them with a mortar and pestle, then leach this flour with water to remove tannic acid (very bitter).
- Cook the acorn meal in a basket to make mush or toast it on hot stones to make pancakes.



TRADITIONAL USES OF CALIFORNIA NATIVE PLANTS

© VICKI MOORE

AGES

8–18 years old

CONTRIBUTED BY

Living Classroom
Los Altos, California
living-classroom.org

This lesson is intended to coincide with the 4th grade Social Studies topic of California Indians. Students will learn about various plants that the Indians used for housing, baskets, food, medicine, and tools. Students learn how plants were crucial to the survival of Native California Indians and can find many of the plants in their school's own native plant garden. Students will also gain hands-on experience with the plant material.

MATERIALS

- Laminated pictures of tule houses and tarweed gatherers
- 2 arrows, bow, arrowhead, cutting tool, dipping gourd, elderberry flute, or soap root brush (the more variety to demonstrate, the better)
- Tule basket or deer grass mat / basket
- Ethnobotany story handouts
  http://bit.ly/LC-ethnobotany

DIRECTIONS

Instructor: "How many stores did the California Indians have?" Answer: They had to find or make everything.

"Today we'll learn about plants they used and relied on for their survival. This is called ethnobotany (ethno = people and botany = plants), how plants are useful to people. How did they make their houses?" With poles and thatch from plants (show picture).

"What did they use for medicines?" Plants. "Today we still use plants for medicine like aspirin whose natural form is found in willow tree bark."

Some medicinal examples:

- Teas—from mint, sage, elderberry, rose petal—to drink for stomach aches, headaches, fevers, etc.
- Poultices made by grinding up plants—like yarrow, sage, lichen, buckeye—mixed with water or oil and applied to skin to heal wounds, bug bites, etc.
- Scattered plants as bug repellent in houses—like bay leaves to repel fleas.

"What did they eat?" Some meat, some fish, and clams, but lots of plants; much more variety than we eat today, including all kinds of berries, seeds, and roots.

"Their main winter food was acorns. Why?" They were abundant and could be stored.

Lastly, show the bow made from elderberry, the arrows with an obsidian tip and a glass tip, the skirt (Ohlone), elderberry flute and soap root brush, elderberry game of staves. (Soap root was used for soap, food, glue, medicine, poison, and more, all from a hairy, fist-sized underground bulb.)

Now, transition the students by telling them they are going to walk through the garden and look for the plants that they would use to complete their ethnobotany story. Assign pairs and hand out the ethnobotany story. Tell students that they are to read the story and look for the plant that would serve the needs described in the story. Ask them to include the name of the plant in their story. They should also read the plant sign (if the instructor has labeled it) for more information about the plant.

After this exploration in the garden, ask the students: "Are you ready to gather and live off native plants like the Native Americans did? How does California Indians' knowledge of plants compare with your own knowledge of plants?"

Wildlife and Habitat

Schoolyard wildlife sanctuaries and native habitat zones are important and engaging places that help students of all ages connect to the natural world. They illustrate that "the environment" is not just a far away place—it is something that surrounds us all in our local neighborhoods.

Wildlife sanctuaries and schoolyard ecosystems, large or small, enrich school curricula while providing refuges for a variety of species. They allow students to see that wildlife can exist in urban and suburban areas and even thrive with a little help. Wildlife areas and native plantings can be connected to the curriculum in countless ways, including nature observation in science classes, sketching practice in art classes, and population estimates and counts for math or science classes.

The strongest school ground wildlife projects provide well-rounded habitats that fulfill the basic needs of local creatures—consistent food sources, clean water, shelter, and areas where they can rear their offspring. Successful schoolyard wildlife sanctuaries also provide places for students to observe birds, animals, and insects while leaving the creatures relatively undisturbed. They are peaceful havens for quiet reflection where flora and fauna are nurtured, changes happen slowly following ecological cycles, and planting schemes highlight seasonal change and mimic natural patterns.[1]

School grounds can also be used to explore wildlife- and habitat-themed games and other hands-on lessons that foster a deeper understanding of the needs of local wildlife. Outdoor learning can also extend from the school grounds into the neighborhood to investigate the health of local ecosystems.

Chapter Notes. Some of the activities that follow focus on conveying a general understanding of ecosystems and their interconnections. Other parts of this chapter are organized by type of organism, to make it easy to find curriculum connections and to build teachable moments after seeing particular creatures or plants on the school grounds.

ECOSYSTEMS AND INTERCONNECTIVITY

ANALYZE AND IMPROVE SCHOOLYARD ECOLOGY

PLANTS

INSECTS

BIRDS

MAMMALS AND FISH

RELATED ACTIVITIES IN OTHER CHAPTERS

GARDEN-BASED LEARNING: INTERDEPENDENCE

AGES

7–10 years old

CONTRIBUTED BY

Berkeley Public School Gardening and Cooking Program
Berkeley, California
berkeleyschools.net/cgp

Students explore different environments within the school garden to identify various ways flora and fauna adapt to natural and non-natural environments. After this lesson, students will understand how plants and animals survive in their habitats and will have an emerging understanding of biodiversity and its importance in gardens of all types.

MATERIALS

- Garden journals and pencils
- Assorted garden tools
- Scavenger hunt cards that picture flora and fauna found in your school garden (make these ahead of time with your class)

DIRECTIONS

Bring the class outside into your school garden.

Distribute garden journals and scavenger hunt cards to teams of two. Discuss how plants have particular features that enable them to conserve water and absorb sunlight.

Instruct students to find a plant to describe that: has tiny leaves, a spine, uses stems to climb, is covered in tiny hairs, or has giant leaves. Have them find an animal or insect that: burrows under ground, sunbathes, eats garbage, or walks on two feet. Students document these findings in pairs as they explore the garden using their scavenger hunt cards.

Regroup students and discuss adaptation behaviors and physical features that help living things survive in their habitat. Students then share their observations and discuss how these characteristics could have adapted over time to fit their environment.

Ask students to discuss with their partner their knowledge of what plants and animals need to survive (nutrients, sunlight, water, shelter). Next, encourage the partner pairs to share their discussion with the group. Students can describe what they found during the scavenger hunt and share something about how it has adapted to its environment.

To provide ceremony to the closing of the lesson, offer students a seasonal snack or invite them to forage and taste something in the garden on their way out. Ask students to think about how that piece of fruit or vegetable has adapted to survive in its environment.

FOOD WEB TAG

© JAC KYLE

AGES

8–11 years old

CONTRIBUTED BY

The Greening of Detroit
Detroit, Michigan
greeningofdetroit.com

This version of tag is a fun and physical way to demonstrate how population dynamics within a food chain affect the sustainability of an ecosystem. Students act out the transfer of energy to different trophic levels by assuming roles as producers, herbivores, consumers, and decomposers. Each "round" can be altered to emphasize various environmental conditions. Food Web Tag takes active learning to a whole new level!

MATERIALS

- Green, tan, red, and white paper or cloth strips, twice as many as there are students
- Rubber bands

PREPARATION

Students create colored cards (or strips of cloth) for each of the four roles: green for "producers", tan for "herbivores", red for "carnivores", and white for "decomposers".

You will need twice as many cards as there are students. To get the total number of each card, use the following percentages: 70% producers, 20% herbivores, 5% carnivores, 5% decomposers. This ratio reflects the make up of real ecosystems.

DIRECTIONS

Identify a grassy area suitable for a game of tag, along with game boundaries. Introduce the four roles and their associated colors:

- Producers. Avoid herbivores and decomposers. They can't tag anyone.
- Herbivores. Collect as many producer cards as possible while avoiding carnivores and decomposers.
- Carnivores. Tag herbivores and collect their producer cards. They are chased by decomposers.
- Decomposers. No one chases the decomposers and they try to catch (decompose) all other students.

The teacher plays the role of the "sun". Rather than having a steadily growing pile of "dead" students, you can give students another card after they've been tagged.

Describe each role and the four card types to students, and emphasize that they must collect as many cards as possible to survive. When a student is tagged they give their card to the tagger and return to the "sun".

Give the producers a 10 second head start, followed by herbivores, carnivores, then decomposers.

At the end, ask the students to count their cards. Any surviving herbivore with less than five cards dies of starvation.

Experiment with the ecosystem in subsequent rounds. Increase the number of carnivores, remove decomposers, or alter the ratio of roles in another way.

Discuss with students what happens when the ratio changes, and what this means for ecosystems.

ADAPTATION TAG

© KIM GREEN

Example of what the front of the card sets can look like.

AGES

7–12 years old

CONTRIBUTED BY

Children's Forest of Central Oregon
Bend, Oregon
childrensforestco.org

This tag game introduces students to the concept of adaptations that help plants and animals to survive. Each student receives a character card of plant, prey, or predator. Students "eat" (tag) other students as appropriate for their character. On a second round, adaptations are introduced to help plants and prey survive longer.

MATERIALS

- Field or open space suitable for a tag game
- Card Set #1: Labeled "Plant", "Prey", or "Predator"
- Card Set #2: Also labeled "Plant", "Prey", or "Predator" on one side. On the back of most of the "Plant" and "Prey" cards, also list an adaptation to help them survive longer (could be created by students in advance).
- Bandanas to help identify character roles (optional)

DIRECTIONS

Gather students in a circle to introduce the game and explain how each type of character acts: Plants have roots and cannot run—your feet will be roots in the ground while you are a plant. Encourage students to take on a plant form with arms outstretched as branches, or a flower on their head. Plants don't "eat" (tag) any other characters. Prey "eat" (tag) plants, and are given a red bandana so they're easy to spot. Predators "eat" (tag) prey, but not plants. When a student is tagged they crouch down to show they've been eaten.

Distribute cards from Set #1 to students so that there are more plants than prey, and more prey than predators.

Release plants onto the field first to situate their roots. Next, send prey out to begin eating/tagging plants. Finally, release predators to begin eating prey. Let the round go until most students are crouching.

Bring everyone back together, collect the cards and bandanas, and facilitate a discussion about what happened in the game.

Introduce the concept of adaptations, and how not all plants and prey are eaten so easily. Give a few examples of common adaptations for survival.

This time, distribute cards from Set #2 (not everyone will have an adaptation). Play again. Wait a bit longer to end this round. You should start to see students acting out the effects of the adaptations!

Bring everyone back together again. This time ask students how they were able to survive.

Play another round as time permits.

Example of what the back of the cards in Set #2 can look like.

SCHOOLYARD HABITAT SURVEY

© SHARON DANKS

AGES

5–10 years old

CONTRIBUTED BY

CalRecycle
Sacramento, California
californiaeei.org

Students conduct a survey of their schoolyard to determine in what ways it is a habitat for plants and animals. They work in small groups to discuss and sketch their ideas on how to improve their schoolyard for plants and animals.

MATERIALS

- Piece of paper (and clipboards if feasible) for students to record their findings (written words or drawings) while they are outside studying schoolyard habitats.

DIRECTIONS

Put students in pairs. Assign each pair an adult helper/older student buddy, if available.

Explain to students that they are going out to the schoolyard to see which plants and animals they can find. They will use their paper to draw and write about some of the plants and animals they see and will note where they found them.

Lead them outside, talk about appropriate physical boundaries and the importance of not disturbing what they see (nests, flowers, etc.). Give them 15 minutes to walk around the schoolyard recording what they find.

Return to the classroom for a group discussion about the findings. Teachers may help the class organize and summarize their findings in columns, e.g. "What We Found" (animal or plant) and "Where We Found Them".

Finish the activity by having students write and draw about how people can help plants and animals survive in their habitats. Doing so will help teachers assess students' understanding. (e.g. We can plant trees to make a habitat for birds.)

Reference: Adapted from California Education and the Environment Initiative, *Surviving and Thriving.*
http://bit.ly/20Jt5hh

PASSIVE QUADRAT SAMPLING

© DENISE SCRIBNER

AGES

16–18 years old

CONTRIBUTED BY

Eisenhower High School
Goddard, Kansas
ehs.goddardusd.com

Quadrat sampling is a classic tool for the study of ecology, especially biodiversity. In general, a series of squares (quadrats) of a set size are placed in a habitat of interest and the species within those quadrants are identified and recorded.

MATERIALS

- Squares made from PVC pipe pieces and corner angles, measuring 1 m on each side
- Site map (Google Earth aerials are useful to draw on)
- Camera
- Clipboards and pencils

BACKGROUND

Passive quadrat sampling, done without removing the organisms found within a given quadrant, can be done by hand, with students carefully sorting through each individual quadrat or by photographing the quadrant for future analysis. Abundances of organisms found at the study site can be calculated using the number found per quadrant and the size of the quadrat area. This information can provide the school with a data set to track annual changes.

DIRECTIONS

Each group of students chooses an unpaved location to study, either in a natural or maintained outdoor area. A variety of locations may spur conversations about differences found. Each group has their own set of materials to conduct the quadrat sampling procedure.

Students prepare a site map of the physical features of the area. Students use a consistent set of symbols to represent the organisms on site. For example, green triangles represent trees, blue circles represent insects.

Toss a quadrat into the grass. Students survey the area within the quadrat and take a photo of the quadrat area.

Students draw symbols on the map to show the location and relative abundance of each type of organism. On a separate sheet of paper, students record any observations or organisms in their environment, and describe the physical characteristics of their study area:

Sunlight exposure. Full sun, partial sun or full shade?

Soil. Is the soil sandy, silt, clay, or organic matter?

Rain. When was the last rainfall recorded?

Maintenance. Is this area maintained?

Water drainage. Is the area well drained?

Vegetation cover. How much of the soil is covered with vegetation? How much soil is exposed?

Students use their hand lens to inspect the area, and record the insects they see, while being careful not to disturb the soil and the organisms that live in it.

Analysis. Return to the classroom and ask the students to display their maps. Students calculate the estimated population of a species for the sample area, using $T = NA$:

$$T = \text{total population estimate}$$

$$N = \frac{\text{total number of individuals counted}}{\text{number of quadrants}}$$

$$A = \frac{\text{total area}}{\text{area of quadrat}}$$

Conclusions. What are the differences between the areas that each group in the class studied? Are there any differences from previous year(s) results? What have the results revealed about the local ecosystem?

THROW AND GROW

© KATHLEEN SWENSON

AGES

9–13 years old

CONTRIBUTED BY

Mississippi National River and Recreation Area
St. Paul, Minnesota
nps.gov/miss

Students will discuss how prairie ecosystems benefit lakes, rivers, and wildlife. Instructors should customize this program for their specific region. Students should be able to list two characteristics of prairies and two ways prairies benefit rivers. In brief, the long roots of prairies stabilizes soil, decreases rain runoff, and recharges groundwater. After learning about prairies, students will make seed bombs, small balls of soil, compost, and prairie seed for distribution on school grounds or other location.

MATERIALS

- Two bags of top soil, 0.75 ft^3 size (0.02 m^3) (do not use soil with additives such as fertilizer, peat, vermiculite, etc.)
- 8 cups (1.9 L) of mushroom compost
- 8 cups (1.9 L) of playground sand
- Native prairie seeds, a mix of grasses and flowers
- 18 bowls, in 20 oz (60 cL) size, 1 per student
- 10 heavy weight plastic soup spoons
- Four plastic cups, 9 oz (27 cL) size
- Prairie root presentation and props

DIRECTIONS

This activity can begin to address processes and systems, relationships between humans and the environment, and constructing a product or system that addresses a problem.

Discuss characteristics and benefits of prairies, ideally using local examples. Compare prairie plant root length with that of turf grass.

Discuss how to make the seed bombs (also called mud marbles, seed balls, etc.) and where prairie plants should be distributed. In a bowl combine one cup of soil, three rounded spoonfuls of compost, three mounded spoonfuls of sand, three pinches of native seeds, and four spoonfuls of water. Mix them all together.

Take a small amount of this mixture; enough to make a 1 in (2.5 cm) ball. Squeeze it fifteen times. The mixture will begin to form a play-doh like consistency around squeeze number twelve. Do not make the balls too big or they won't break apart in the rain.

Let the balls dry for two or three days and then store them in a cool, dark, dry space.

Distribute seed balls at planting sites in late winter or early spring to allow the seed bombs to be outside in freezing temperatures for approximately four weeks. Alternately, store the seeds in the freezer for four weeks, and then make seed bombs.

Minneapolis Dept. of Natural Resources

- Prairie benefits information: **http://bit.ly/1UKTpEj**
- Minnesota historical prairie map: **http://bit.ly/1PURBe7**

PLANT A NATIVE HEDGEROW

© SHARON DANKS

AGES

8–18 years old

CONTRIBUTED BY

Collaborative for High Performance Schools (CHPS)
Sacramento, California
chps.net

A hedgerow is a linear arrangement of closely spaced shrubs and trees designed to create a fence-like border, serve as a barrier or mark a boundary. In a schoolyard context, a hedgerow can also act as a windbreak, create shade, and promote habitat for beneficial insects and birds. Plants in hedgerows can be chosen for a variety of services that support a nearby school garden, such as: masking crop plants from pests, deterring pests with their scent, enticing pests away from crops, and serving as nurse plants and food sources for beneficial insects that assist in the management of organic gardens.

MATERIALS

- Mixture of native hedge plants (mostly perennial shrubs)
- Well-rotted manure or peat-free compost
- Cardboard
- Shovels, trowels, spades, pruning shears, forks, and gloves
- Bark, mulch, straw or grass clippings
- Stakes or bamboo sticks

DIRECTIONS

Decide where the hedge is to be planted. Consider linear spaces around the perimeter of a school garden or other school ground boundary between adjacent uses.

Source native hedgerow plants from your local nursery.

Mark planting locations 1 ft (0.3 m) apart in the designated row using stakes or bamboo sticks. Double rows may be needed, or even triple rows, if your site is very exposed to the wind or if you would like to create a dense boundary. If you are planting more than one row, stagger the plants as in this diagram:

X X X X X X X X X X X X X X X

X X X X X X X X X X X X X X X

Dig holes approximately the same depth as the height of your plants' root balls, or as directed by your local nursery. Add a trowel full of compost or manure to each hole and mix with the native soil. Loosen the root ball of each plant slightly (so roots will not continue to grow in a circle in the ground) and place one plant into each hole. Fill the remainder of each hole with native soil and firm the soil around the plant to remove any air spaces. Water the new plants. Add a 1 ft (0.3 m) wide strip of cardboard to the soil's surface around the plants to deter weeds. Cover the cardboard with a thick layer of bark, mulch, grass clippings or straw.

Clip plants to 1 ft (0.3 m) high to encourage root development and new growth but leave a plant unclipped roughly every 10 ft – 12 ft (3 m – 3.7 m) to become a standard.

Versatile California Plant Families

- Sages (*Salvia spp.*)
- California lilac (*Ceanothus spp.*)
- Manzanita (*Arctostaphylos spp.*)

California Native Plant Resources

- CA Native Plant Society **http://bit.ly/1p5U3Sz**
- CA native plant lists by region **http://bit.ly/1Vr8cHW**
- Hedgerow species to consider **http://bit.ly/1MyUss4**

Reference: Inspired by Kourik, Robert. *Designing and Maintaining your Edible Landscape Naturally*. Vermont: Chelsea Green Publishing, 1986.

BUILD A WILDFLOWER HUGEL MOUND

© IESHA SILER

AGES

5–18+ years old

CONTRIBUTED BY

New Horizon School
Pasadena, California
newhorizonschool.org

A *hugelkultur* mound (or "hugel mound") is a no-irrigation raised-bed system created by stacking logs and mounding soil over them. The activity of building a hugel mound will provide a way to teach and learn about rainwater harvesting and the process of building healthy soil. This building project should be accompanied by a lesson on the importance of infiltrating rainwater on site, building soil fertility, and capturing moisture. This activity works well as part of a community work day, where parents, students, and community members come together to build this drought tolerant garden.

MATERIALS

- 20 bags of steer manure or compost (often free or available inexpensively from a local farm or ranch) and some top soil
- Wood chips or straw to use as mulch
- Local wildflower seeds such as: California poppies, white yarrow, collared annual lupine and purple needlegrass, or seeds appropriate for your own area. (Ask your local botanical garden for ideas.)
- Collect: fallen logs in 2 ft – 3 ft (0.6 m – 0.9 m) long segments that are manageable for two students, branches, twigs, fallen leaves, compostable food wastes

DIRECTIONS

Identify an area in your school that would be appropriate for local wildflowers and has good sun exposure. Try to place the garden beds in an area where the school community passes or congregates often, so that the blooms can be enjoyed by everyone. Select a location that is already unpaved (bare soil, grass, etc.) Consider the wind direction, too, as this will capture moisture from the air.

Lay the logs down as the first layer of the *hugelkulter* bed. Place the largest logs on the bottom, and smaller logs above them. Next, add a layer of branches and then a layer of small sticks and twigs. Water these materials until they are soaked.

Fill the spaces between the logs and branches with leaf litter and organic materials like food scraps. Top off the mound with 1 in – 2 in (2.5 cm – 5 cm) of soil and a 3 in (7.5 cm) layer of mulch. Sprinkle with native wildflower seeds.

Water generously upon completion and then water lightly once a week until the plants are established. (Plants usually take one month to become established.)

References: Leigh Adams, artist and sustainable agriculture consultant at the Los Angeles County Arboretum, taught this passive water harvesting technique at New Horizon's free community workshop series. The poster above was created by Zainab Eltaib, 8th grader at New Horizon.

PHOTOSYNTHESIS TAG

© SHARON DANKS

AGES

9–13 years old

CONTRIBUTED BY

Los Angeles Unified School District
Office of Outdoor and Environmental Education
Los Angeles, California
outdooreducation.org

In this activity, students learn about the components and process of photosynthesis while practicing cooperative learning skills and playing a game of tag. The game explains the ingredients necessary for plant survival. The object is for the "trees" to get everything they need in order to make glucose (earn a sweet treat) and survive.

MATERIALS

- Green, yellow, blue, brown, and red string
- Bag of small, sweet, edible treats

DIRECTIONS

Explain the concept of photosynthesis and the process by which leaves create energy for plants.

Show the students the collection of string and explain what each color stands for: yellow for the sun, blue for water, red for carbon dioxide (CO_2), and brown for nutrients. These are the components needed for a tree to survive.

Choose a few students to be the "trees" in this game of tag, so approximately one person in six is a "tree". Give each "tree" a green string to tie on their wrist in a manner that is easily released. The "trees" will be the only ones who can try to snatch the other students' strings.

Once the "trees" have been selected, have the other students choose which photosynthesis components they would like to be. Note: allow the students to choose whichever component they would like to be, even if all of them choose the same color. This can be discussed at the end of the game.

Ask the "components" to tuck their strings into their back pockets or the back waistband of their pants. They should not tie the string on their body in any way. The hanging strings will look like a tail. The object is for the "trees" to get everything they need in order to make glucose.

To play the game, the "trees" chase the "components" and try to snatch their "tails". Once a "tree" has everything needed to make glucose they take their catch to the leader and explain what they have collected. The students cannot just hand the strings to the leader. They must explain what each color represents. Once the student ("tree") has answered correctly, give them one treat. Round one should last about five minutes.

When the first round is over ask the students to sit down and discuss what happened in the game. Did one or more "trees" survive? Why or why not? (In order to survive, they must have had a least one treat.) If most students chose "water", discuss what happens during floods. Explain that if there is too much of something, like water, the trees cannot survive. Trees get uprooted, and nutrients get diluted or washed away.

Play a second round. Choose different students to be the "trees". During the second round, if a string gets taken, the student can get another string of any color and keep playing. As "trees" turn in their components, add another "tree". Do not tell the students at the beginning of the round that more trees will be added, they will begin to see what happens as "trees" turn in their components. This can be discussed during the wrap-up. This round should also only last five minutes.

At the end of round two discuss the results. What happened when there was an unlimited amount of components? How many trees survived? What would happen if the game continued?

PLANT PART RELAY RACE

© ERIN DERDEN-LITTLE

AGES

8–10 years old

CONTRIBUTED BY

Community Alliance with Family Farmers
Davis, California
caff.org

In this activity, students connect the foods they eat to the six parts of a plant while being physically active. It requires an open space with even ground for kids to run and can be adapted for a 15–25 minute time slot.

MATERIALS

- At least 50 cards printed with different types of produce
- 1 sign for each plant part: root, stem, leaf, flower, fruit, seed
- 6 containers
- Diagram showing all 6 parts of a plant

BACKGROUND

Plants have six primary plant parts: roots, stems, leaves, flowers, fruits, and seeds. The produce items we eat can be classified by plant part. For example, carrots are roots, spinach is a leaf, zucchini is a fruit, and a broccoli crown is made up of flower buds.

DIRECTIONS

The class will be divided into two to three teams, depending on the number of students. To set up the race, divide the cards evenly among the teams and place them at each team's starting line. Attach each plant part sign to a container and set them a good distance from the starting line.

Ask students to sit in a circle so they can all see the teacher. Display a diagram of a plant showing the six plant parts. Ask students to explain what each plant part does or why it is important. The discussion should include the following ideas:

Roots bring in water and nutrients from the soil and hold the plant firmly in the ground.

Stems act as an elevator for the nutrients/water and bring them to the rest of the plant (like our veins). Provide structure for the plant (like our skeleton).

Leaves gather sunlight for photosynthesis in order to create food for the plant.

Flowers contain the reproductive parts of the plant. Fruits and seeds are produced after flowers are fertilized through pollination. Some flowers rely on insects, animals, wind, or water for pollination. Bees are the pollinating insects we hear about the most. We wouldn't have many of the fruits we eat without the help of bees!

Fruits develop from fertilized flowers. Fruits are the outer covering that protect the seeds. They can be fleshy (like apples, and tomatoes) or sometimes dry or hard (walnut shell).

Seeds contain the embryo for a new plant and a food supply that the embryo uses to sprout.

Explain that the students' job is to think about which plant part we are eating when we eat a particular type of produce. For the relay race, they will sort cards displaying things we eat into the correct plant part category. Show the group a few examples to practice.

Divide the students into teams. Line them up and review the rules. The first person picks up a card and works with his/her team to decide which plant part it is. The person with the card skips or hops to the corresponding container, puts the card in the container, then skips or hops back to tag the next person in line. Keep playing until the cards run out.

Encourage the children to work with their teammates! Once finished, ask the students which cards were the hardest to sort. While they watch, go through a few cards in each container and discuss whether each item fits or whether it should be placed under a different plant part category.

ROOTS AND SHOOTS

© KAREN MENDELOW NELSON

AGES

8–13 years old

CONTRIBUTED BY

Full Option Science System (FOSS)
Lawrence Hall of Science, University of California, Berkeley
Berkeley, California
fossweb.com *and* outdoorbiology.com

There's more to a plant than meets the eye! Use a trowel to dig up and investigate the root structures of numerous schoolyard plants—weeds! Uncover these varied below-ground structures (roots) and find out how they support the shoots, the visible parts of the plants.

MATERIALS

- For each group of 4 students: 1 trowel and hand lens
- For the class: 4 marking flags, basin of water, plant with fibrous roots, plant with taproot, 2 opaque bags, marker, string

PREPARATION

Find one weed (grass) with a fibrous root system. Wash roots and enclose the plant in an opaque bag so that only the roots are visible; label the bag "1". Do the same for a plant with a taproot; label it "2".

Flag four different weeds growing in the schoolyard.

DIRECTIONS

Gather students in a circle near one flagged plant. Pass around mystery plant "1" so students can closely examine the roots. Have students describe them. Point to a flagged plant and ask students to describe the shoot (the above-ground part of the plant including the stem, the branches, leaves and flowers).

Explain that each group will carefully dig up several (two to four) different weeds (unwanted plants). Point out the four different flagged plants. Explain that students should try to find a plant that matches one of the flagged plants, dig it up, and rinse the roots in a basin of water.

Following root extraction, call students to the sharing circle and display the collected roots and shoots. Ask questions about the roots they dug up.

- "Are some roots harder to get out of the ground?"
- "Were you able to get all the roots out?"
- "Why is it hard to get the roots out?"
- "Was anything attached to the roots?"

Focus the discussion on root types.

- "Does anyone have a plant with roots like plant '1'?"

Discuss similarities and then identify them as fibrous roots. Introduce mystery plant "2". Ask for some descriptions of this root. Give students time to look at their roots to see if any are similar. Identify this as a taproot. Ask:

- "What do roots do?"
- "Which roots hold the most soil after they are out of the ground?"
- "Do roots "branch" like shoots?"
- "Shoots have stems, leaves, flowers and bark. Do roots have structures like these?"

Ask students to guess what the mystery plants will look like. Unveil the hidden plants. Compost the weeds and drain the dirty water onto a few plants.

Reference: Modified from the FOSS Next Generation Edition, Structures of Life Module, (*Investigation 2, Growing Further, Part 3: Roots and Shoots*) developed at the Lawrence Hall of Science, copyrighted by the Regents of the University of California, 2015, and distributed by Delta Education.

GROWING HEALTHY PLANTS AND LEARNERS

© OPENLANDS

AGES

6–8 years old

CONTRIBUTED BY

Openlands *and*
Phoebe A. Hearst Fine Arts Magnet School
Chicago, Illinois
openlands.org *and* hearst.cps.edu

Through reading a short book together and exploring the schoolyard, students will learn about the parts of a plant and what a plant needs to survive, and will create a list of questions to explore as a class.

MATERIALS

- *From Seed to Plant*, by Gail Gibbons, or other age-appropriate book about how plants grow
- Construction paper
- Poster paper
- Pencils, colored pencils
- Bag to carry supplies outside
- Clipboards

PREPARATION

Walk through the garden to ensure that it is ready for your students.

DIRECTIONS

Take your students into your schoolyard and bring the bag of supplies. Create a "KWL chart" that documents what students know (K), want to know (W), and learned (L). Start by asking students what they already know, and complete the "K" section of the chart.

Read *From Seed to Plant*, or another book that describes how plants grow.

Direct students to pick a tree or plant in their schoolyard to sketch, using colored pencils and paper. Ask students to label the parts of the plant that they can see.

Bring the class back together at a predetermined meeting spot. Ask students to explain the different parts of the plant they observed, using their sketches.

When you return to the classroom, continue working on the "W" section of the KWL chart by asking the students to list more questions. Over the next several days, investigate those questions with the class. As students learn new information, add to the "L" section of the chart.

EXTENSIONS

Ask students to use construction paper to create parts of a tomato plant (roots, stem, leaves, flowers, and fruit) and the different things that plants need to survive (sunlight, water, air, and nutrients).

Create a "What Plants Need" chart, on poster paper or construction paper. As your students learn what all plants need to grow (sunlight, water, air, and nutrients) add a picture of each of them to the display.

What do you KNOW?	*What do you WANT to know?*	*What have you LEARNED?*

Example: KWL chart

ENGINEER A SEED GETAWAY

© JOAN CHADDE

AGES

6–15 years old

CONTRIBUTED BY

Joan Chadde, Michigan Tech CSEO *and*
Susan Trull, Ottawa National Forest
Houghton, Michigan
wupcenter.mtu.edu

This activity engages students in learning about plant life cycles, adaptations, and characteristics that contribute to survival. Students observe a variety of seeds and classify them according to their "getaway" strategy from the parent plant. Next, the activity incorporates engineering as students design a seed get-away that will allow the seed to be carried the furthest by the wind (a box fan).

MATERIALS

- Samples of plants with seeds
- Samples of seeds, ranging in size and dispersal method
- Box fan
- Seed get-away design materials—rice or lentils, tissue paper, feathers, colored paper, tape, scissors, glue sticks
- Pencils, data sheets, markers, and masking tape
- Cups and water for float test, 1 cup per group
- Terrycloth towel for stick-to-fur test, 1 per group

DIRECTIONS

Go outside to the school grounds and show plants that have seeds on them. Ask students to find the seeds.

Discuss. "What is a seed? Why do seeds disperse?" Seeds come in many shapes and sizes and use gravity, wind, water, and animals to disperse. Show examples. For younger audiences: Ask students to act out the life of a plant from seed to the parent plant dropping its seeds.

Classify seeds by dispersal mechanism. Have several types of seeds ready: some that use animals (e.g. burdock, berries); some that float (e.g. crab apple); some that are windblown (e.g. milkweed, maple); some that use gravity (e.g. evening primrose or apples).

Give each group six to ten seeds and a data sheet. Ask students to test for different properties using materials provided. Discuss results and fun facts about each plant.

Use the engineering design process to design a seed get-away: Tell students they are to design a seed that could be wind dispersed, and should be able to fly as far as possible. They will test their designs with a fan. Students choose a seed—lentils, split peas, beans—that is light and easy to hold onto. Provide glue stick, scissors, and a variety of attachments such as tulle, tissue paper, confetti strands, shredded paper, small feathers, etc. Ask students to follow the engineering design process:

Ask. Can you design a way for the seed to get away from the parent plant?

Imagine. With a partner, write down at least three ideas for helping a seed to get away.

Plan. Tell students what materials they will have to choose from today. Ask them to draw their seed get away design using these materials.

Create. Allow each group time to follow their plan and build their seed get-away mechanism.

Test and improve. Evaluate each design with the students and give them time to make changes, if needed. When most students have a design ready, start the performance test. Point the fan along an open floor with at least 12 ft (3.7 m) clear for the seeds to fly. Ask each student to drop their seed into the air stream. Ask each student to mark the location where their seed lands with a piece of tape with their name. Give students time to make improvements to their designs and test them again.

HAVE SEEDS, WILL TRAVEL

© SARA SCHWARTZ

AGES

3–10 years old

CONTRIBUTED BY

Michigan Project Learning Tree
Traverse City, Michigan
michiganplt.org

Students will improve their observation skills while creating bracelets and bookmarks from small items they find in nature during schoolyard exploration.

MATERIALS

- Clear packing tape, at least 1 in (2.5 cm) wide
- Scissors
- Optional: hole punch and string or ribbon

PREPARATION

Scout the site ahead of time to ensure there are no poisonous or harmful plants for children. If working with young children, designate safe boundaries ahead of time.

DIRECTIONS

Help students to loosely wrap a strip of clear packing tape like a bracelet around their wrist, sticky-side out.

Go on a hike around the schoolyard or a wooded area and ask students to collect small treasures from nature such as plant seeds, pieces of leaves, blades of glass, petals from flowers, etc. As students collect these items, they can attach them to the sticky surface of their tape bracelet.

Once the bracelet is full, cover with a second piece of packing tape sticky-side down to seal the collection.

When finished, students cut the bracelet off their wrist and flatten. Punch a hole at each end and tie with a ribbon to create an adjustable bracelet. Students can also re-purpose the bracelet by flattening and using it as a bookmark while reading interesting books about the outdoors!

DISCUSSION

"What did you hear, see, smell, touch while you were exploring?"

"Why did you pick what you did? Are there brighter items on the bracelets? Did anyone carefully arrange the collected items? Or just stick it on there?"

"How are seeds moved in nature?" Discuss methods like: wind, floating on water, bouncing or rolling away from parent, eaten or stored then later dropped by animals, sticking to animal fur, or being released by extreme heat.

"Why does a plant need to distribute their seeds away from the parent plant?"

EXTENSIONS

Learn more about seed dispersal with PLT's Connecting Kids to Nature activity page for family and friends: **http://bit.ly/1UzkcWm**

Reference: © American Forest Foundation. Adapted from *Activity 43: Have Seeds, Will Travel* from Project Learning Tree's *PreK-8 Environmental Education Activity Guide*. Michigan educators can receive the complete guide by attending a PLT workshop.

STEAL THE NATIVE PLANT

© MATT LECHMAIER

AGES

8–18 years old

CONTRIBUTED BY

Center for Land-Based Learning
Winters, California
landbasedlearning.org

This game is modeled loosely after "steal the bacon". Teams of students learn to identify native plants and then compete with other teams to be the first to tag the correct plant when called. This game promotes team building, helps students hone their plant identification skills, and encourages students to run.

MATERIALS

- 3–7 different native plants (either growing in pots, or cuttings you've taken from mature plants)
- Plant identification cards or field guides with information about the native plants (1 set for each team)
- A large, flat area, safe for running

DIRECTIONS

Create two to six teams with equal numbers of players, up to six in each team. Give each team time to learn all the plants by looking carefully at each one, describing its unique characteristics using the field guides.

Assign each person in each team a number from one to six, depending on the size of the teams. If you do not have the same number of people in each team, you can give one person two numbers. (For example, if you have three teams of six and one team of five, you can give one of the people in the team of five two numbers to be responsible for.) Each team should have a #1 person, a #2 person, etc.

Arrange all of the players into two lines, opposite each other, and declare these to be the starting lines. Place one plant of each species on the center line, between the players.

Call out the name of a plant and then a number. If you called out Toyon #2, for example, the #2s from each team would run to the centerline and try to be the first student to touch the Toyon. Calling the name of the plant first, before calling out the number of who will go touch the plant, makes all the students think about which plant that is, instead of just the students whose number you called. The person who touches the plant first, wins a point for their team. You can play until a team reaches a specified number of points, or until all the plants and numbers have been called.

Remind players that they must be aware not to harm the plants or each other. Be aware that students will be running toward each other from multiple directions and possibly looking down at a plant instead of up at each other.

You can choose to place multiple plants of the same species in the center to allow multiple students to find the correct plant. You can also call out a unique characteristic of a plant instead of the plant's name.

© EMILY JAMES

WILDFIRE AND FIRE FUELS EXPERIMENT

© SHERALYNN BAUDER

AGES

8–14 years old

CONTRIBUTED BY

Jim Hall Foothills Learning Center, City of Boise
Boise, Idaho
bee.cityofboise.org

Fire causes natural disaster and natural rejuvenation! Students will understand the effects wildfire can have on the local ecosystem and how fire has shaped our landscape. Students will be introduced to the fire triangle, fire ecology in both forest and sagebrush-steppe ecosystems, and human influences on fire in the West. Students will understand fire's role in nature, noxious weed invasion, and the challenges of the urban/wildland interface.

MATERIALS

- Empty metal cans
- Lighters or matches
- Safety goggles and oven mitts
- Collected fuel types (see below)
- Experiment sheets for recording results
- Water and sand, to snuff out flames
- Large branches
- Native plant species of the sagebrush steppe
- Invasive plants of Idaho (or your local area)

INTRODUCTION

Start by having students discuss if they think fire is good or bad. Have them share their answers and reasoning. Explain both the positive and negative effects of fire and what the current role of fire is in our ecosystem. Makes sure to share how fire suppression and the spread of invasive species have affected the natural fire cycle.

Discuss the Fire Triangle: Fire needs oxygen, fuel, and heat in order to burn. To reduce its ability to burn, remove or reduce any one element.

FIRE AND FUELS EXPERIMENT

Divide the students into teams of four or five. Give each team a metal can to fill, no more than half-way, with one of the following fuels:

- Green branches and leaves
- Dead and dry branches and needles
- Wet branches and leaves

Explain to students that they will be burning their material. Each group has a bucket with one type of fuel, and must plan a strategy to burn their fuel in the allotted time. Review the fire experiment rules before going outside (see below).

Give students 10 minutes to burn their material. Have ALL groups snuff out what is still burning and record their results. Groups examine the differences in fuel types and the success of burning.

DISCUSSION

Which groups were successful? Why? Point out strategies observed, such as blowing on or fanning the fire. Ask students to identify which part of the fire triangle suppressed their fire from burning, or allowed it to burn.

Rules for experimenting with fire

- All fires must be built within the metal bucket on the designated surface area.
- No additional fuels may be used.
- The lighters may only be used in seven, three second intervals (to mimic how wild fire starts in nature).
- A two-minute group-planning session is mandatory.

INSECT BIODIVERSITY IN THE PRAIRIE

© DILRUKSHI DYBAS

AGES

6–13 years old

CONTRIBUTED BY

Prairie Crossing Charter School
Grayslake, Illinois
prairiecrossingcharterschool.org

Students explore the biodiversity of the prairie ecosystem through studying its creepy crawly inhabitants. Students use sweep nets to catch insects and other arthropods from the prairie, and study them up close using bug viewers. Depending on age and curriculum goals, classes can use this activity as a way to learn about life cycles, animal classification, biodiversity, adaptations, food chains, or interrelationships.

MATERIALS

- Insect field guides and insect sweep nets (student-made or purchased), 1 per group
- White bedsheets and magnifying boxes
- Pencils, colored pencils, nature journals, and/or clipboards

PREPARATION

Insect sweeping works best in a prairie, since the presence of many trees would hinder net movement and monocultures don't yield sufficient biodiversity. Spread a white sheet to serve as the insect-viewing area. When finished, release all specimens, unharmed, to their natural habitat!

DIRECTIONS

Demonstrate how to use a sweep net. Swing the net in a figure-eight in front of you as you walk through the prairie grasses. The net should skim the plants but not destroy them. After several sweeps, grab the top of the net like a sack and walk back to the sheet.

Empty the net by placing the opening on the sheet. Shake the fabric so that specimens fall onto the sheet. When you lift the net, bees/wasps should fly away.

Explain how to catch the insects gently, and that they will be returned to the prairie at the end of the lesson. Carefully place specimens in insect viewing boxes.

Ask students to collect their own specimens using the sweep nets in groups of two or three.

Have students choose which insects to draw and describe with scientific accuracy. Ask students to look up their chosen insects in field guides.

EXTENSIONS

This activity can have different foci:

Biodiversity. Compare a prairie sweep with a lawn sweep. Count the number of species and individuals in each location and discuss the differences and implications.

Animal classification. Sort the critters found into insect and non-insect groupings. Discuss the characteristics used to scientifically classify species and define some of the categories the class found.

Life cycle. Look for examples of metamorphosis phases in the specimens. Show the class pictures of butterfly, dragonfly, and other insect life cycles to illustrate the concept. Have the class put pictures in order.

Adaptations. Review the definition of "adaptation". Have students identify adaptations of different critters they caught and describe how these features help the animal survive.

Food. Have students place the critters they caught into a food chain or web. Ask them to draw and label their food chain.

Reference: Written by Naomi Hershiser.

INSECTS: GOOD, BAD, OR BOTH?

© SHARON DANKS

AGES

8–18 years old

CONTRIBUTED BY

Kansas Association for Conservation and Environmental Education (KACEE)
Manhattan, Kansas
kansasgreenschools.org/green-schools-garden-gate

Insects are an integral part of every garden. In vegetable gardens, beneficial insects (bees, ladybugs, etc.) help the garden by pollinating plants and eating pests. Harmful insects (squash bugs, aphids, etc.) may cause damage to crops if left unchecked. As in any balanced ecosystem, beneficial insects can assist in pest management and help reduce the number of harmful insects. This activity will guide students on an exploration of insects in the garden.

MATERIALS

- Pencils, plus clipboards and paper, or journals
- Dry erase markers for each group of students
- Insect net
- Online field guide about insects, e.g. http://bit.ly/1XDZ7t3

PREPARATION

Using an online field guide such as eNature (above), create a scavenger hunt sheet of insects your students are likely to find in your schoolyard or garden. Print this information on a double-sided handout, with beneficial insects on one side and harmful insects on the other. (These may be laminated and re-used.)

DIRECTIONS

Provide students with field guides about insects. Allow a few minutes for them to explore the field guides and become familiar with insects that interest them.

Ask the students to think about which insects they expect to see in the school garden and rank them in the order in which they expect to see the most. Then students share their thoughts with a partner. This can be a chance to define "insect" for younger students, distinguishing them from earthworms, spiders, pill bugs, etc.

Divide students into groups of three or four. Hand out an insect scavenger hunt sheet, dry erase marker, and pencils for each group. Tell the students that they will be conducting a survey of the insects in their garden.

Take students to the garden location for the insect scavenger hunt! For each insect a student sees, the group recorder will place a tally mark next to the picture of that insect. Remind students that there are insects on both sides of the sheet. Encourage the students to observe and take notes about each insect's behavior and sketch it if time/interest allows. If a student sees an insect that is not listed on the insect scavenger hunt sheet, their notes and sketches can be used for later identification.

Ask students to analyze their findings: "What observations can you make about the number and types of insects you found in your scavenger hunt? Which insects did we find most frequently? Why do you think this is? Which insects do you think are beneficial to the garden? Why? Which insects might be harmful to the garden? Why? What might this tell us about the health of our garden? What do you think we could do to improve the health of our garden?"

Discuss ways we can encourage the beneficial insects to stay and live in our garden. (e.g. by providing habitat, planting nectar source flowers or larval food sources, water sources for puddling, etc.).

"In what ways can we decrease the number of harmful insects? What do you think the trade off might be for each of these strategies?" There are a number of ways we can control the harmful insects in our garden. We need to discover the best way to meet our needs.

Reference: Written by Mandy Kern

POUR A POND: WETLAND INSECT EXPLORATION

© PROJECT F.I.S.H.

AGES

8–18 years old

CONTRIBUTED BY

Project F.I.S.H.
East Lansing, Michigan
projectfish.org

This lesson will allow the students to discover the tremendous diversity of aquatic life right near their school, become familiar with the organisms in the water, learn the life cycles of unfamiliar aquatic life, and learn how these animals are adapted for aquatic life.

MATERIALS

- 2-gallon buckets, 1 per group of 3–4 students
- Homemade collection net, 1 per group (This can be a simple kitchen strainer tied to a mop handle or a window screen on two dowels, if you don't have a net.)
- Hula hoops, 1 per group of 3–4 students
- 1 roll of white plastic or a plastic table cloth
- White spoons, magnifying glasses, white ice cube trays
- Identification resources for:
  - Macroinvertebrates **http://bit.ly/1kP31iV**
  - Pond Life **http://amzn.to/20poajS**
  - Pond Watch Bug Dial **http://bit.ly/1PmfGqA**
- Optional: Hip boots or youth waders

BACKGROUND

Wetlands support a greater variety and number of organisms than any other ecosystems. Most elementary students have very limited knowledge of the organisms found in lakes and ponds. This "pour a pond" activity provides a unique way for students to discover and study aquatic life in the classroom and in the field. In the Midwest, spring (March through May) is the best time to study the aquatic environment, but it is possible to collect and study wetland organisms at any time of the year.

DIRECTIONS

Collection. Each group of three to four students is given a bucket and a collection net. Place a few inches of clean pond water in each bucket prior to collecting living samples. Show the students how to use the sampling gear. Macroinvertebrates can be found on the pond floor in leaves and detritus or with floating or emergent vegetation. Sweeping the scoops near and against these will dislodge the organisms. Students use spoons or their fingers to transfer the animals into the clean water from their collection scoop. (All of the true bugs have piercing mouth-parts so handle carefully and don't grab them by the head.) Students can pick up sticks, small logs, and rocks along the water's edge to look for creatures.

Teaching procedure. Place one hula hoop per group on a flat piece of ground, or picnic table, and cover with the plastic table cloth. Pour the collection buckets into these to view the macroinvertebrates. This is the stage where students can explore the pond creatures and use the ID keys, spoons, and ice cube trays to separate and identify the organisms. They can use the magnifying glasses for a closer look. Ask the students to rotate to other "ponds" to see what others caught.

Clean up and release. It's a little tricky to pick up the pond. Carefully lift the edges of the plastic sheet (all four corners and four sides) and gather them into a bag with the pond water at the bottom. You can carry this back to the water's edge to release or you can empty the water gently into a bucket to release later.

Extensions. You can keep the macroinvertebrates in an oxygenated aquarium for a couple of weeks, for further study. Many students enjoy seeing the pond creatures for an extended period of time. During this time the students may be able to observe life cycle changes in some of the organisms. In addition, it will become clear which organisms are predators and which are prey.

SPRINGTIME MATH WITH WORMS

© CHIPPEWA NATURE CENTER – PRESCHOOL

AGES

3–5 years old

CONTRIBUTED BY

Rachel A. Larimore Consulting
Midland, Michigan
rachel-larimore.com

Spring evokes images of tulips, bursting tree buds, frogs calling, puddles, and...worms! For many young children worms are a dream come true. They wiggle and squirm, and they have just enough slime to be fascinatingly gross. Young children's interest in worms is a great opportunity to extend play to include math exploration and learning. Of course, worms are fun in other seasons too, so don't just limit this activity to spring!

MATERIALS

- Buckets or other containers for collecting worms
- Small hand trowels
- Dry erase board and markers
- Rulers and measuring tapes
- Balance or scale
- Stop watch or timer (optional)

BACKGROUND

Developmentally appropriate teaching in early childhood includes two broad categories—providing a rich physical environment, and teacher-child interactions that extend and scaffold children's learning. With that in mind, this activity description provides ideas about materials to give the children and how to use those materials to encourage rich conversations between children and teachers.

First and foremost, the fun of worms is finding and collecting them. Buckets and other containers provide a safe place for the worms so they won't get squished in little hands. Plus, buckets hold more—which is fun!

DIRECTIONS

Bring the children to an unpaved, vegetated part of your school grounds, or a public space in your neighborhood. Begin the activity by asking questions like, "Where might we find some worms?" Encourage the children to search out large numbers of worms and start to identify patterns of where the worms are located. They may use their hands or small trowels to gently move a small amount of soil and leaf litter to find the worms.

As they're collecting worms, encourage the children to count them. "How many worms do you have?" or "How many more worms do you have, than I have?" Some children will choose to count as they are collecting. Others may choose to count by peering into the top of their bucket, or might pour them all out on the ground to count. All of these are great options! For children who are enjoying keeping track of their collection, you can provide a dry erase board and markers for recording their progress. This not only supports math, but also emergent writing skills.

Once the children have gathered their collection, encourage them to measure some of the worms. Ask, "Which ones are longest? Shortest? Which ones are thicker or thinner?" The math lesson can then be extended by using a balance to weigh the worms.

The activity leaders can also capitalize on children's interest in worms by using them as part of a small group activity. One possibility is worm races! Draw a large circle or square with a stick on a smooth patch of open soil, and place the worms in the middle. The edges of the shape serve as the "finish line." Engage the children with questions like, "Which worm do you think will finish first? Why do you think that?" Then prepare for fun, enthusiastic, and loud cheering as the children root for their worm to cross the finish line. If desired, the group can also measure the time it takes the worms to get to the "finish line" using a stop watch or other timer.

WHAT MAKES A BIRD A BIRD?

© CHRIS NICOLAI

AGES

4–8 years old

CONTRIBUTED BY

Central Valley Joint Venture
Sacramento, California
centralvalleyjointventure.org

Through observations of birds, bird stories, images, and teacher-led discussions, students will learn about the features, adaptation and traits of birds. Students will then draw pictures and text to create a booklet that helps them answer the question: What makes a bird a bird?

MATERIALS

- Children's story about birds. Some suggested books include: *That Chickadee Feeling* by Frank Glew, *What Makes a Bird a Bird?* by May Garelick, or *It Could Still be a Bird* by Allan Fowler
- White paper, tabloid or legal size preferred (A3 size)
- Clipboard
- Crayons or colored pencils

OPTIONAL MATERIALS

- Ability to observe wild birds; binoculars for older children would be useful
- Printed images of birds, including pictures of key concepts and vocabulary listed below
- Stuffed life-like toy birds or puppets
- Bird feathers (clean feathers, obtained at a craft store)
- Hard boiled chicken egg
- Any other props useful to describe the concepts and vocabulary outlined below

DIRECTIONS

In an outdoor environment, the teacher will read aloud an introductory children's story about birds. The teacher will then lead a brief discussion to find out what the students know about birds. Following the discussion, the teacher will use some of the available learning aides to discuss the key characteristics of birds. Students should be given the opportunity to observe wild birds if possible.

Concepts and vocabulary to introduce includes:

- Beak or bill. All birds have a beak or bill, but so do some mammals like the duck-billed platypus.
- Wings. All birds have wings but some mammals do as well like bats.
- Flight. Most birds fly but not all birds fly, for example penguins. Some mammals, such as bats can fly, too.
- Egg. All birds lay eggs, but so do some other animals including reptiles.
- Nest. Most birds build nests but so do some other animals including insects (wasps) and some reptiles (turtles).
- Feathers. Only birds have *feathers*! This along with the features above makes a bird a bird!

Students will then create a booklet of their own by folding one or more pieces of paper in half depending on how many pages are desired. On each page the students should use colored pencils or crayons to draw and describe some of the things that they learned that make a bird a bird. The clipboard is used to support the paper while the students are drawing and writing.

BIRD BLIND

© TANYEKA PERCENTIE

AGES

4–11 years old

CONTRIBUTED BY

Louisville Nature Center
Louisville, Kentucky
louisvillenaturecenter.org

Bird feeders are particularly important for birds during the winter because of migration. However, some birds do not migrate and they depend on feeders all year long. These are called feeder birds. Building a bird blind allows students to more closely observe the feeder birds that visit their schoolyard, giving them insight into these species and their local ecological community. It also provides the opportunity to track and record data for national scientific use!

MATERIALS

- At least 1 bird feeder (purchased, or can be made from a recycled clear 2-liter bottle)
- Bird seed
- Trees (or, if trees are not available, use shepherds hooks)
- PVC pipe: 1 piece 5 ft (1.5 m) long, 4 pieces 8 ft (2.4 m) long (You can also make it bigger to hold more people.)
- 2 pieces of 3-way PVC elbows
- 1 or 2 earth-tone colored shower curtains, with hooks
- Clear packing tape
- Velcro strips
- Pictures of local feeder birds (optional)

DIRECTIONS

Show students pictures of feeder birds local to your area. Discuss different characteristics we use to identify different types of birds (size and shape, color pattern, behavior, habitat).

Give birds the opportunity to find and get used a new food source. A week before your observation, find a quiet place in your yard that would be optimal for observation. Fill bird feeder(s) with seed and set them on sturdy tree branches or shepherds hooks. (Trees are ideal because they provide cover for birds from predators.) Feeders should be about 6 ft – 10 ft (1.8 m – 3 m) from the observation spot. Add seed as needed.

Cut a number of small rectangular holes in the shower curtain(s) at varying heights. Tape over these on both sides with clear packing tape, to create viewing windows.

On observation day, assemble the pipes like a swing set, with one three-way elbow at each end of the shorter pipe. Hang the shower curtain(s) from the shower hooks. Use the velcro strips to secure the curtain(s) to the legs of the PVC frame.

Remind students that even though the birds cannot see them, they can still hear them—the quieter we are, the more we will see. Let students observe for about 15 minutes at a time. Once observation is complete, break down the bird blind, fold up the curtain, and store it until the next use!

Citizen science extension. Students can be part of a world-wide citizen science effort by counting the birds, recording their species, and submitting observations to **ebird.org.**

Lower cost variation

A cheaper, easier option is to make a blind by covering a window of the classroom with cardboard. Cut holes in the cardboard with the box cutter large enough for students to peak out of and hang the pieces using the masking tape so that they cover the windows facing the feeders. Even though you are inside, it still helps to be quiet!

SIERRA NEVADA ANIMAL OLYMPICS

© KIRA LUCIER

AGES

8–11 years old

CONTRIBUTED BY

Yosemite National Park Education Office
Wawona, California
nps.gov/yose/learn/education

Animals in Yosemite National Park have some amazing adaptations to help them survive. This activity helps students learn about some of these unique characteristics by imitating them and competing with their friends. Students will collect data to determine if humans have the same abilities as black bears, mountain lions, frogs, owls, or bighorn sheep! Teachers can emphasize concepts including adaptations and variation, the scientific method, data collection, and analysis.

MATERIALS

- Masking tape
- Measuring tapes
- Stopwatches
- White boards and markers or pencils and notebooks for recording data/creating simple graphs.

PREPARATION

Prepare each Adaptation Station with a leader and supplies. Students will rotate between the stations in small groups. Ask a leader at each station to introduce each animal adaptation and record the data.

DIRECTIONS

Ask each small group to pick an Adaptation Station. Learn about an animal's amazing ability and then try it! Measure and record the results for each student. Compare with the results within the group. Rotate to a new station and repeat the steps above.

Debrief students at each station and at the end of the activity. Questions can include:

Variation within species. "Did you have the same results as your friends for each task?"

Adaptations. "Why does each animal have its special ability? What was the most amazing ability you learned about? What adaptations do people have to make us special?"

Adaptation stations

American black bears can run at a speed of 35 miles per hour (56 kph)—or about 100 ft (30.5 m) in two seconds. With masking tape mark off a distance of 100 ft (30.5 m). Use a stopwatch to measure each students' time running 100 ft (30.5 m).

Mountain lions can jump 25 ft (7.6 m) in one leap from a standstill. Hold up a measuring tape perpendicular to the ground, and ask each student to stand next to the measuring tape one at a time and give their best jump.

The **great gray owl** is the largest species of owl. They can be up to 33 in (0.8 m) tall with a wingspan of 60 in (1.5 m)! Ask students to stretch their arms out side to side, and then measure their "wingspans" fingertip to fingertip.

Sierra Nevada bighorn sheep are an endangered species that live high on the rocky peaks of Yosemite's mountain ranges. Make a "tightrope" made of masking tape with periodic distance markers, and see how far each student can tiptoe on this "narrow ledge".

The highly endangered **Sierra Nevada yellow-legged frog** breathes not just through their mouths but also through their skin, allowing them to stay underwater for minutes or even months when hibernating. Use a stopwatch to measure how long each student can hold their breath like an underwater frog!

CALIFORNIA DESERT ANIMAL OLYMPICS

© SARAH CARTER

AGES

8–11 years old

CONTRIBUTED BY

Death Valley National Park
Death Valley, California
nps.gov/deva

The Mojave Desert might not seem like an inviting home, but some animals have adaptations that help them thrive in the hot dry climate. This activity helps students learn about these unique characteristics by imitating them and competing with their friends. Students will determine if humans have the same abilities as mountain lions, kangaroo rats, roadrunners, and ravens. This can be a "jumping off point" for studies of adaptation, variation, the scientific method, data collection, and analysis.

MATERIALS

- Masking tape
- Measuring tapes
- Stopwatches
- White boards and markers or pencils and notebooks for recording data/creating simple graphs.

PREPARATION

Prepare each Adaptation Station with a leader and supplies. Students will rotate between the stations in small groups. Ask a leader at each station to introduce each animal adaptation and record the data.

DIRECTIONS

Ask each small group to pick an Adaptation Station. Learn about an animal's amazing ability and then try it! Measure and record the results for each student. Compare with the results within the group. Rotate to a new station and repeat the steps above.

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Variation within species. "Did you have the same results as your friends for each task?"

Adaptations. "Why does each animal have its special ability? What was the most amazing ability you learned about? What adaptations do people have to make us special?"

Adaptation stations

Mountain lions can live in the desert mountains, as well as the Sierra Nevada. They have the amazing ability to move quietly and quickly. Divide students into pairs. Ask one student to close their eyes as the other student tries to slowly and silently sneak up and tap them on the shoulder.

People need water every day, but the **kangaroo rat** never has to drink. They are named for their giant kangaroo-like feet. They are about 4.5 in (11.4 cm) long and can jump up to 9 ft (2.75 m)! That's about 24 times the length of their body. Set a measuring tape on the ground, and ask each student to stand next to the measuring tape and give their best jump. Ask: If you were a kangaroo rat, how far could you jump?

The **roadrunner** can run 20 miles per hour (32 kph)—or about 100 ft (30.5 m) in 3.5 seconds. With masking tape, mark a distance of 100 ft (30.5 m) on the ground. Use a stopwatch to measure each student's time running 100 ft (30.5 m).

Ravens can live almost anywhere, from the hottest deserts to the coldest mountains. They can also imitate other animals or even people. Ask students to listen to the sounds around them for 30 seconds and pick one to imitate.

CITIZEN SCIENCE: CONTRIBUTING DATA TO PROJECT SQUIRREL

AGES

9–13 years old

CONTRIBUTED BY

The Chicago Academy of Sciences
Peggy Notebaert Nature Museum
Chicago, Illinois
naturemuseum.org/education

Be a citizen scientist and help Project Squirrel track squirrels in your community and look for patterns across the country. Observe the characteristics of your local environment and focus on how squirrels interact with the environment around them. Identify fox and gray squirrels and record information about the amount, types, and location of squirrels to help Project Squirrel researchers learn what squirrels tell us about our neighborhoods.

MATERIALS

- Mobile device with the Project Squirrel app installed
- Science notebook

PREPARATION

Review the Project Squirrel website and download the app at **http://bit.ly/PrjSqul**

DIRECTIONS

Show students images of fox squirrels and gray squirrels. Lead students in a discussion about the differences they notice. Show students the video on Project Squirrel's homepage. Ask students what they could learn when observing squirrels and what kind of information they would need to gather.

Prompt students to think about why scientists are asking citizens to observe squirrels in their neighborhoods. Answers may include: scientists want a larger selection of data from a greater area; squirrels are easy to see and observe; squirrels act as indicators of local ecology because they live in small territories and are active year-round.

Preview the Project Squirrel app with students and discuss the questions they will be asked. Ask students to observe and record:

- Time, date, and location of their observations
- Number of individuals of each squirrel species
- Types of trees located in the area
- The food source for any observed foraging behavior
- The types of predators that they see
- Other observations

Ask students to photograph and submit pictures of the squirrels. What behaviors do they see from the squirrel?

Discuss with students: "What do the squirrels need in their habitat? What about your schoolyard is beneficial or dangerous for squirrels? Why is it important for citizens to track data? What are the benefits of more data?"

EXTENSIONS

Ask students to do a longitudinal study of looking at squirrels throughout the seasons.

Ask students to do similar studies to compare observations in different schoolyards or share information with a school in a different city.

Participate in another citizen science project such as:

- Monarch Watch: **http://bit.ly/MonarchW**
- ebird: **http://bit.ly/eBird12**

Investigate squirrel foraging behavior to calculate and compare Giving Up Densities (GUDs) in different locations: **http://bit.ly/1TCSnfS**

Reference: Written by Sarah Anderson, Holly Katz, Shannon Phillips, Michelle Rabkin

LEAST WANTED: THE INVASIVE SEA LAMPREY

© SHARON DANKS

AGES

11–18 years old

CONTRIBUTED BY

Michigan Department of Natural Resources
Lansing, Michigan
michigan.gov/natureprograms

This activity will engage students in an active simulation of the relationship between native lake trout, the invasive sea lamprey, and introduced non-native Chinook Salmon. This activity illustrates the importance of the early warning and detection of invasive species as they attempt to establish themselves in an ecosystem. It is a demonstration of a professional biologist's management of an invasive species before and after its establishment, and conveys the understanding that once an invasive population is established it remains indefinitely.

MATERIALS

- 50 name tags total, labeled as:
  - "invasive species", 1 per student
  - "biological control", 1 per student
  - "first invasive species", just 1
  - "habitat biologist", up to 3
- Chart paper and markers
- Cones for playing field boundaries

DIRECTIONS

Ask participants how they think the sea lamprey got into the Great Lakes and spread. Discuss.

Tell the students they are going to simulate a sea lamprey entering a local native ecosystem, represented by a 50 yd^2 (41.8 m^2) playing field, and the impact it has over five years.

One student will be the "first invasive" sea lamprey. The rest of the students represent native species. Ask all the students, both the first invasive and natives, to spread out in the playing field which represents Lake Huron.

Chart "Year #1" using a bar graph, with one invasive and the total of the remaining participants as native fish.

The goal of the "first invasive" student is to tag as many native fish as possible. The natives try not to get tagged. Tagged students must freeze, standing straight with arms at their side. Stop after 30 seconds, or less if necessary, so that not all natives are tagged. Ask all natives that are frozen to raise their hands. Hand an invasive name tag to anyone who has their hand up. They have all been overtaken by the invasive sea lamprey. Chart results as "Year #2".

Repeat for another 30 second period, with all new sea lamprey able to tag the remaining native fish. Chart results as "Year #3".

Ask the class what they could do to stop or reverse the impact the invasive sea lamprey has had on The Great Lakes ecosystem. What can stop or slow the spread of invasives including the sea lamprey?

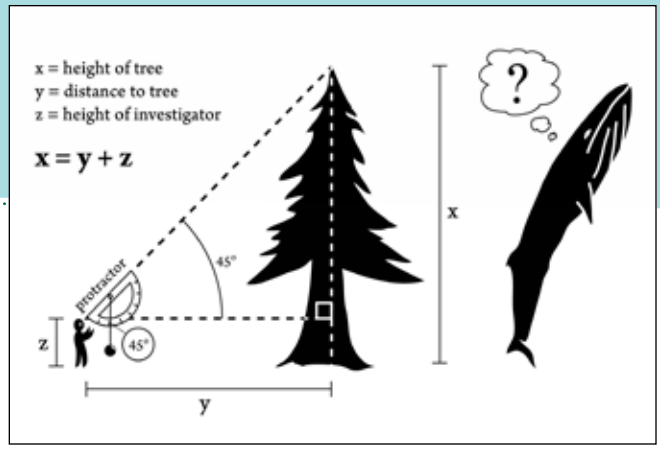
Introduce a "habitat biologist" (a student from the native or invasive population). That student can administer the "biological control" that has been scientifically determined to work.

The "habitat biologist" tags "invasives" and hands them a "biological control" label. Once a student has been given a "biological control" name tag they are safe from being tagged by any "invasive" students.

For "Year #4", run a 30 second round and chart the results with the "invasives" and "habitat biologist" both tagging species. Did adding a biologist slow the spread of the invasive species? For "Year #5" add a second biologist and chart results.

Lead student discussion about the chart results.

BLUE WHALE: AN ANIMAL OF UNUSUAL SIZE



AGES

10–18 years old

CONTRIBUTED BY

California Coastal Commission
San Francisco, California
coastforyou.org

Blue whales are the largest animals known to have lived on Earth, and they can be seen right off the coast of California! Could a blue whale fit in your schoolyard? Compare the height of a tree in your schoolyard to the length of a blue whale.

MATERIALS

- A yard stick and a 100 ft (~30 m) rope or measuring tape
- Clinometer made with a protractor, a straw, string, and a paper clip or metal washer

DIRECTIONS

How can you tell if a blue whale could fit in your schoolyard? Start by asking students what they know about blue whales. There are many options for learning about these whales, and you can have students do research ahead of time or share information from the resource links included at the end of this activity.

Come prepared with a piece of rope that has been pre-measured to 100 ft (~30 m), or a long measuring tape. Have two students each take one end of the rope and walk slowly apart until the rope is taut, then place it on the ground. Explain that a blue whale can grow to this size. Have students line up along the rope with their arms outstretched, fingertips just touching. Are they as big as the whale? Have students close their eyes and imagine an animal as big as a blue whale, swimming next to them. What do they think it is like to be a creature that size?

Older students can compare the length of a blue whale to the height of the tallest tree on their school grounds (or to a flag pole, their school building, or other tall feature). How tall do the students think the tree is? One method to calculate the height is to compare shadows on a sunny day. Use measuring tape to measure the shadow cast by the tree. Next measure a shadow cast by a yard stick (or meter stick) held perpendicular to the ground. The shadows will be proportional to the original objects.

Use ratios to calculate tree height:

(Shadow of measuring stick) / (Shadow tree) =
(Length of measuring stick) / (Height of tree)

⟶

Height of tree =
(Length of measuring stick) x (Shadow of tree) / (Shadow of stick)

Another method to calculate height is to use a clinometer. Tape a straw or a small roll of paper to the flat side of a protractor. Thread some string through the hole in the protractor (near the center of the straw), and tie a weight (a paperclip or a washer) to the string so it stretches past the bottom of the protractor and swings freely. Have one student look through the straw to see the top of the tree. Have the student move farther from or closer to the tree until a partner tells them that the string is hanging down at a 45 degree angle on the protractor. The student has now formed an isosceles right triangle with the tree (see diagram above). The distance from the student to the tree, plus the student's height, equals the height of the tree. Is the tree taller than a blue whale is long? Imagine a blue whale next to the tree. How many trees would it take to equal the length of the blue whale? Why might it be useful to measure a tree this way?

Additional resources

- Making a clinometer: **http://bit.ly/1r1eEco**
- Blue whales: **http://bit.ly/1W5JGep**


© SHARON DANKS

Watershed Stewardship

Clean, fresh water is a precious resource. It comes to our schools and communities in the form of rainfall and through municipal plumbing systems and natural waterways. It leaves school grounds through man-made storm drains and sewer networks, and by flowing over the landscape, percolating into the soil, and running through local creeks. In most cases, water from these sources is relatively clean when it arrives on school grounds and dirtier when it leaves. School communities have the power to improve their local water systems and to use them as educational resources at the same time by incorporating stormwater planning into the design and use of school grounds.[1]

Stormwater Management. Schoolyards designed to manage stormwater can be beautiful and educational while holding and utilizing rainwater, and purifying runoff. Small scale stormwater management projects like rain gardens, vegetated swales, rain barrels, and cisterns can often be developed by the school community with some assistance from local experts. Larger stormwater management projects usually require substantial assistance from landscape architects and engineers, but they can have important beneficial impacts for their school and community.

Some schools around the world are removing large amounts of asphalt, concrete, and other impermeable surfaces and developing "green infrastructure" on their grounds that makes them feel more like parks. Converting school grounds to multi-use spaces with topography, ground cover plants, and trees can make it possible to absorb *all* of the runoff from the whole school site—helping to recharge the water table and prevent flooding of the school and surrounding neighborhood.

Water Conservation. Living schoolyards can conserve water by finding and fixing leaks, incorporating drought tolerant plant species, building gardens with efficient irrigation systems, and deeply mulching planted areas.

Water Quality Monitoring. Well-designed green schoolyards can improve the purity of local water bodies by removing particulates, nutrients, and pollutants from stormwater flows by catching them in planted areas before they can reach nearby rivers and lakes. Students can conduct citizen science studies to check the water quality of surface water on their school grounds and in their community.

Greywater Reuse. Schools can capture lightly used water from the building, purify it, and then use it to water trees, reducing the amount of fresh water they need from the municipal system. Each country and municipality has different rules that govern the use of greywater, so it is important to do some local research before implementing your own greywater reuse system.

WATERSHED UNDERSTANDING

STORMWATER MANAGEMENT

WATER CONSERVATION

WATER QUALITY MONITORING

RELATED ACTIVITIES IN OTHER CHAPTERS

FOLLOW THE WATER: MAKE A STORMWATER MAP

© JEANINE STRICKLAND

AGES

7–10 years old

CONTRIBUTED BY

The Trust for Public Land
San Francisco, California
tpl.org

In this activity, you will map where rainwater flows around your schoolyard, observing where it collects and moves faster and where it slows down and soaks into the ground. You will also learn about where stormwater goes after leaving the school.

MATERIALS

- Schoolyard plan (map) or aerial photo
- Map of your neighborhood
- Pens and/or pencils

DIRECTIONS

If you were outside during a rainstorm recently, did you notice water flowing across the pavement? You may be familiar with the term "watershed"; it is the land area from which surface runoff drains into a stream, channel, lake, reservoir, or other water body. The next time it rains, watch the stormwater's behavior as it hits the ground at your school and flows downhill. How does it flow over different types of materials? Where does the water go? What else do you observe? Make a schoolyard stormwater map with your class to find out.

Landscaped areas with plants, grass, sand, gravel, or mulch hold water like a sponge. These are "pervious" or "permeable" materials. Mark them on your map.

Hard surfaces such as paving and buildings do not absorb water. During your rainy day observations, you may see large amounts of water collect in the gutters, pour from the downspouts, and flow toward the storm drains. Mark these "impervious" surfaces on your schoolyard map.

Roofs drain to gutters which collect water that then flows into downspouts (often at corners of buildings) and onto the school grounds. When it is raining, you may see water gushing out of each downspout. Mark the school building's "downspouts" with an "X" on the map.

Follow the streams of water flowing during a storm to find the storm drains and catch basins and mark them on your schoolyard map with a square. These drains lead to a broader network of city storm drains, which may flow directly to a creek, river, lake, or other water body.

Check your neighborhood map to see if you can identify where the water goes after leaving your school site. If that water flows to a stream, can you trace the stream downhill to see which larger water body it joins?

Mark the puddles and soggy spots on your schoolyard map. Where are the biggest or deepest ones? Which ones evaporate and disappear first? Can you find any "swales" (ditches)? If so, observe how planted swales slow the rainwater and allow it to be filtered and partially absorbed before the remainder flows to the storm drain.

Can you identify any opportunities at your school to protect water quality by reducing stormwater runoff and/or preventing stormwater pollution? Stormwater pollution occurs when rain or snowmelt flows over streets or paving and picks up trash, oil, dirt, and other materials as it travels. These pollutants are then carried to the storm drains and then to local creeks and streams.

Ask your city if they have a water quality "stenciling" program to mark your local storm drains with an educational message that will help to improve water quality and habitat downstream.

Note: See the East Bay Municipal Utility District's website for free outdoor classroom materials: **http://bit.ly/1STWDWi**

OBSERVING A CREEK

© LAUREN WOODFILL

AGES

8–18 years old

CONTRIBUTED BY

The Watershed Project
Richmond, California
thewatershedproject.org

Creeks connect schoolyards and neighborhoods to bays and the ocean, forming a critical piece of the watershed. This activity introduces students to the creek and riparian zone. Through observations of a creek habitat, students learn about the health of the watershed and experience their connection to it. This activity is designed for schools that have a creek on or near their school campus and will help both teachers and students build comfort in engaging with this unique landscape feature!

MATERIALS

- Journals
- Pencils
- Creek Field Guides to help identify plants, animals, and insects (optional)

DIRECTIONS

Introduce the concept of a watershed (the area of land that drains rainwater into a body of water). Ask students to consider where rainwater on their schoolyard might go. Guide students to think about the creek on or near the school campus. Ask: "Where does the water in the creek go?" Introduce the riparian zone (the area of land next to a creek).

Explain that students will have a chance to closely observe the creek and riparian zone. Provide appropriate safety considerations. This activity can be done entirely from the banks or a short distance away from the water, if necessary or desirable.

Walk to the creek. If possible, walk along the creek for a few moments. Invite a few students to share their initial observations.

Return to a place where students can observe the creek. Ask students to consider the following questions and record notes in their journals:

- Time, date, and weather
- Where does the creek go? Where does the creek come from? Which direction is downstream?
- What does the creek water look like? (clear, muddy, etc.)
- How does the water move? How fast is the water moving? Note riffles/rapids, pools (still water), bends, etc.
- How does the creek smell?
- What is in the riparian zone? (plants, mud, cement, etc.)
- Do you see any evidence of erosion?
- What animals to do you see or hear? (birds, insects etc.) Is there other evidence of animals? (tracks, feathers, etc.)
- What types of plants do you see? (trees, shrubs, grasses, etc.)
- What evidence is there of humans? (trash, walls, pipes, etc.)

Invite students to make a detailed drawing of the creek. Pass out field guides and give students the opportunity to add to their drawings.

Discuss observations. Ask students to share their thoughts about the health of the creek and watershed based on their observations. Ask (if relevant): "What do you think are the sources of trash or pollution? How are your actions on your schoolyard connected to the creek and watershed?"

Return to the creek often to observe how it changes through the seasons.

KNOW YOUR SNOW

© CINDY KOEPKE

AGES

7–12 years old

CONTRIBUTED BY

Green and Healthy Schools Wisconsin
Madison, Wisconsin
ghswisconsin.org

Falling snow is a great way to explore the relationship between the freezing temperature and the physical phases of water. Use snow on the ground to explore temperature, melting, sublimation, runoff, and water quality. Permeable surfaces filter water and allow it to infiltrate to groundwater, although frozen ground drastically slows infiltration. Impermeable surfaces might give dirty runoff a quick path to a lake, stream, or wetland—either directly or through a storm sewer.

MATERIALS

- Coffee mug with white interior
- Pour-through coffee funnel
- Coffee filter
- 0.5 cup (11.8 cL) water mixed with 1 TBL (1.5 cL) of sand
- Water cycle chart (see link below)
- Yardstick and/or snow gauge; or make your own with a wooden garden stake and a permanent marker

DIRECTIONS

In the classroom, show students how "dirty water" goes through a coffee filter by preparing a simple demonstration. Let each student see a mixture of sandy water before pouring, sand caught in the filter, and cleaner water in the mug. Water goes through the filter because it is permeable, like unfrozen ground. Water doesn't go through the mug because it is impermeable, like a parking lot or roof.

Outside, choose where to measure snow depth. It's best to measure it away from snow removal operations, fences, walls, or other obstacles that might affect your measurements. If you plan to use a snow gauge, place it before the ground freezes.

Young people love piling up snow next to the gauge, so they can surprise an adult with the "sudden increase" in snow. Keep a yardstick handy as a backup measuring device.

Ask students to observe falling snow. Explore its relationship to temperature: "Is it only snow or mixed with rain? What does that mean for air temperature here and in the clouds? Where does snow pile up first? What do you notice about pavement, sidewalks, and roofs? Is this different if the ground is already frozen or if it's only recently been cold?"

Students can chart snow depth over time. Older students can also track air temperature and graph it with snow depth to understand more about melting and sublimation.

When you have snow accumulation, explore the water cycle. "Where in the water cycle is snow on the ground? What needs to happen for that solid water to go somewhere?" Discuss melting and sublimation. "When snow does melt, will it run off to a permeable surface?"

Ask: "What happens to snow that's been shoveled or plowed into a pile? Is the ground underneath permeable or impermeable? What is in that pile besides snow (sand, dirt, trash, etc.) that we don't want in our water? How does that relate to the coffee mug demonstration? Where should we pile our snow to help protect our watersheds?"

Additional resources

- USGS: Water Cycle for Schools: **http://on.doi.gov/1ePVVqm**
- How much does snow evaporate?: **http://bit.ly/1Peuntw**

SUBNIVIAN EXPLORATIONS

AGES

8–12 years old

CONTRIBUTED BY

Learning by Nature
Bozeman, Montana
learningbynature.org

Winter presents many mysteries to explore above and below the blanket of white snow. Plants, animals, and humans, too, depend on snow-pack for survival. The word "subnivian" refers to the space in and under the snow-pack. The objective of *Subnivian Explorations* is to investigate the wonders of snow from multiple perspectives—including the perspective of wildlife, plants, winter recreation, snow, and ourselves.

MATERIALS

- 4 snow shovels for the class to share
- 1 per student for each of the following items: tongue depressor; metric ruler; black laminated 3 in x 3 in (7.6 cm x 7.6 cm) card; 3 in (7.6 cm) wide paint brush; hand lens or jewelers loop, tied with bright string or flagging to help find when dropped; drawing journals; and pencils

DIRECTIONS

When the weather is cold and fresh snow has fallen, walk to an appropriate location for digging a snow pit. A snow pit is a method used to study the snow-pack, or the subnivian environment.

Discuss student observations of the snow pack around them. "How does it sound and feel? Is it all the same? What are some differences? What causes these differences? How might these differences affect wildlife? How might they affect people? How could we more closely investigate the snow pack?"

Demonstrate how to dig a vertical pit into the snow-pack. Ask students to take turns digging a trench long enough for all students to line up in. If space is limited, make the pit's wall long enough for half of the students and the others can stand behind, or take turns.

To dig the pit: make the vertical wall north facing, throw the snow to the sides, avoid touching the walls, and make a clean, flat vertical face to observe snow.

To study the pit, ask students to:

- Brush the face of the pit wall lightly with a paintbrush to help distinguish layers. Feel for different layers by 'cutting' through them (from top to bottom) with tongue depressors.
- Reach group consensus on the locations of layers; mark them with tongue depressors inserted horizontally.
- Measure and record the height of each layer (from the ground up) and the total depth of snow-pack.
- Test the hardness of the layers by gently pushing fists with even pressure into the different layers. Describe the relative hardness and softness of the layers.
- In each layer, collect a sample of snow crystals on a black laminated card; observe with a magnifying lens and make a detailed sketch of two different crystals.

Discuss observations. "Why are there layers in the snow?" With the group, draw a snow profile (graph) illustrating the different layers and depths. "What weather patterns may have caused the layers they see and feel? What layer(s) would make good snowballs and which felt like large grains of unconsolidated "sugar"? How do these layers affect snow stability? How might these snow conditions affect wildlife and plants, human winter travel, and recreation? What causes snow crystals to transform in the snow pack?"

For more information about snow:

- http://fsavalanche.org/snowpit
- http://winterwildlands.org/snowschool/

FOLLOW THE DROP

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AGES

9–18 years old

CONTRIBUTED BY

Earth Partnership
University of Wisconsin-Madison Arboretum
Madison, Wisconsin
arboretum.wisc.edu/learn/eps

This activity introduces the concepts of watersheds and stormwater management. Students observe and collect information about water runoff on their school grounds or in the community. Using observational and critical thinking skills, students learn about the nature of water in the landscape, how to calculate the volume of rainwater runoff, and ways to reduce stormwater impacts.

MATERIALS

- *Follow the Drop* field sheet: **http://bit.ly/EP-FollowDrop**
- Map of your schoolyard showing the location of buildings, driveways, north arrow, and scale
- Average annual rainfall data: **http://bit.ly/NCEI-Climate**
- Clipboards and pencils or colored pencils

BACKGROUND

Water moving over the landscape in a large city or single schoolyard after a rain will flow across the surface like a sheet, collect in channels, drain into pipes, and puddle or soak into the ground. In undeveloped areas, most rain soaks into the ground, and only a small amount flows away. In built areas, land is covered by surfaces that shed water quickly, like roofs, sidewalks, roads, and parking lots. This is called runoff or stormwater.

In conventional stormwater management, untreated water goes into drains that flow into nearby water bodies. This contributes to soil erosion and sediment loads, increases water pollution, and can cause flooding. If we want clean water and a healthy watershed, each site requires thoughtful stormwater management. One of the best ways to ensure clean water is to control where precipitation first comes into contact with the land. Examples of good stormwater practices include building rain gardens to collect and infiltrate water, using rain barrels to collect water for future use, using native plantings in the landscape, and replacing impervious surfaces with permeable pavement.

DIRECTIONS

Identify water patterns. Teachers lead teams of students outside to identify patterns of water movement. Students locate features on their map including impervious (hard) surfaces and porous (absorbent) surfaces, and high and low points. Draw arrows to show the direction of water movement and the way the water is moving (e.g. in sheets or in channels). Locate places where the water puddles. Find the downspouts, storm drains, and where water exits the property.

Calculate runoff. Select an area to study and measure its square footage. Using the *Follow the Drop* field sheet and average rainfall data, calculate the amount of runoff generated in your chosen area. Possible areas to measure include roofs, parking lots, sports fields, playgrounds, gardens, and natural areas. You may also consider measuring pervious areas compared to impervious areas. If your base map is drawn to scale, these measurements may be made using rulers or a grid system. Use measuring tapes or paces to make on-the-ground measurements outdoors.

Discuss observations and results. As a group, share your findings based on observations and data generated. Brainstorm ways to reduce runoff and increase infiltration. Identify likely spaces to create rain gardens and other stormwater best practices.

Extend your project. Earth Partnership's *Rain Garden Curricular Sampler* includes more lessons. See: **http://bit.ly/EP-RainCurric**

WATCH THE WATER: PERVIOUS OR IMPERVIOUS?

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AGES

8–12 years old

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NEXT.cc
Milwaukee, Wisconsin
NEXT.cc

Rain is the ultimate source of fresh water. Rainwater runs off roofs, terraces, streets, and yards into low lying areas draining into creeks, rivers, lakes, and oceans. Much of this rainwater can be stored and used, offsetting the need for tap water and reducing water pollution during storms. Rainwater harvesting collects runoff from roofs and built surfaces, directing water into barrels, tanks, wells, or cisterns. This "stormwater" can be used for things like irrigation—everything but drinking!

MATERIALS

- 1 ft x 3 ft (30.5 cm x 91.5 cm) flat pieces of various materials, e.g. plywood, cardboard, metal, or plastic (3 or more types)
- 18 in (46 cm) object, or stack of objects, to prop up flat pieces
- Gallon pitchers
- Stopwatches
- Collected rainwater (or tap water)
- Clipboards, pens, paper

DIRECTIONS

Rainwater that runs over impermeable surfaces collects minerals and delivers it directly to the water body. Rainwater that is absorbed into soil is filtered by soil horizons before reaching the water table below. Rainwater management requires storing or filtering water onsite so that it re-enters the water cycle cleanly.

Introduce the concept of stormwater runoff: "Which surfaces shed rainwater the fastest? What environmental impact can this have?" (e.g. Streets collect pollution from cars, and rain can wash this into a local water body.)

Make a chart to measure the time it takes for water to flow from the top edge to bottom edge of each surface.

Head outside and set up the flat materials side by side on an incline using the 18 in (46 cm) prop (about a 30° incline). Each student group is assigned one surface type, and one student has a stopwatch, one has a pitcher of water, and one charts results.

Document the time it takes the water to flow from top to bottom. Catch and measure (or just measure) the water that runs off. If resources are limited, one at a time is OK. Repeat four more times for each surface. Add dirt, leaves, or plastic to the surfaces and observe what happens.

Discuss results and compare surface types. "Which surface is most similar to roofs, asphalt, or concrete (built structures)? Which surface absorbs water? What are the benefits of absorbing water during a flood?" Discuss ways to absorb more water on campus, like rain barrels, rain gardens, cisterns, tall plants, trees, etc.

Look around your campus to see where rainwater might be captured. Perhaps a downspout could be redirected to fill a rain barrel or irrigate a garden. Discuss different ways to use collected rainwater.

To calculate the amount of water your school could harvest in a month, just from roofs, you'll need:

- Roof area (ft^2 or m^2): Google Maps' Earth view has a scale in the bottom right hand corner to help measure.
- Your city's average rainfall by month (typically given in inches or centimeters; convert to feet or meters)
- Roof runoff (cubic feet/month) = (roof area) x (average feet of rainfall in one month)

Full lesson available here: **http://bit.ly/1Tp707t**

CALCULATE RAINWATER RUNOFF

AGES

10–18 years old

CONTRIBUTED BY

Education Outside *and*
San Francisco Public Utilities Commission
San Francisco, California
educationoutside.org *and* sfwater.org

In this activity, students in dry climates determine how many gallons of rainwater fall on a roof linked to their cistern. They also estimate how much water their school uses to irrigate a drought tolerant garden and determine how many cisterns they would need to meet this demand. Students will learn that a lot of water can be captured from roofs for irrigation.

MATERIALS

- 50 ft or 100 ft length of string or rope for measuring, and a measuring tape
- Rainfall chart for your area

BACKGROUND

The average annual rainfall in the San Francisco Bay Area is about 20 in (1.7 ft). This means that if it rains on a hard, impermeable surface like a roof or pavement, and there are no drains to remove the water, there would be 1.7 ft of water covering that area over the course of the rainy season. In many cities, rainwater flows from storm drains to the sewer system and is treated before it is released into the ocean. In non-urban areas, where much of the ground is permeable, rainwater is absorbed, recharges groundwater aquifers or flows into rivers that empty into the ocean.

Rainwater can be captured and used to irrigate school gardens or to flush toilets at school. Cisterns are large containers that can hold rainwater that flows off a school's roof. Cisterns come in many sizes and may be able to collect enough water to irrigate a school garden during dry periods, reducing tap water use.

DIRECTIONS

Begin by visiting a cistern in your schoolyard or envisioning where you would like to put one in the future. To determine the area of the roof that drains to the cistern, roughly measure the building's length and width (on the ground) using pre-measured lengths of string or using a very long tape measure. Then multiply the length and width to estimate the roof area:

Area = Length x Width

Example: If your building measures 100 ft long by 30 ft wide, then: 100 ft x 30 ft = 3,000 ft^2

Calculate the volume of runoff generated by rainfall in one year by multiplying the roof area by the annual rainfall.

Area of Roof (ft^2) x Depth of Annual Rainfall (ft) = Volume of Water (ft^3)

Once you have estimated the annual volume of water that falls on the roof, convert cubic feet into gallons by multiplying the volume of water (ft^3) by 7.5.

_____ Cubic feet x 7.5 = _____ Gallons

Discuss: How many gallons of rainwater fall on your roof annually? Can your cistern hold it all? Where does overflow go? How can you use the water you capture? How many gallons of rainwater does the school garden need? How many cisterns do you need to meet this demand?

Determine the area of garden space that needs irrigation. Determine the capacity of your current cistern. Gardens with natives and drought tolerant plants use less water than most other gardens. To calculate the annual water need, assume a native plant garden needs 1,000 gal of water per 100 ft^2 and use this formula:

(Area of Garden / 100 ft^2) x 1,000 Gallons = _____ Gallons Needed Annually for Irrigation

To find out how many cisterns you need to store the water, divide your school's water need (calculated in previous step) by the capacity of your cistern. Example: 200,000 Gallons (annual need) / 1000 Gallon Cistern = 200 cisterns! Does this surprise you?

Reference: Techbridge. SFPUC. Adapted by Education Outside, 2009.

SCHOOL OUTDOOR WATER USE AUDIT

© SHARON DANKS

AGES

9–18 years old

CONTRIBUTED BY

Sacramento City Unified School District
Sacramento, California
scusd.edu/project-green

Water plays a critical role in our school operations every day. In order to reduce our water usage a complete understanding of a school's water use is needed to identify potential water efficiency opportunities. This outdoor water use audit will allow students to explore some the many areas of water use outside the classroom and guide discussion toward water saving actions and opportunities at their school.

MATERIALS

- Notebook or paper
- Pencil
- Camera (optional)

PREPARATION

Coordinate with the necessary building staff to have someone available who can turn on your school's sprinkler system and locate your water meter so your students can view it and make observations.

DIRECTIONS

Begin by locating your school's water meter(s). Discuss how the water meter measures the amount of water being supplied to your school.

Ask the students to draw a picture of the meter or take a photo and record the number on the meter and the time. Pay special attention to the units that the meter uses—gallons, cubic feet, and hundred cubic feet are common units for water meters.

Next, locate the irrigation controls for your school and turn on the sprinklers for all areas. Discuss with your students how the irrigation system is controlled and how often the sprinklers are used and why.

Locate each of the different irrigated areas on your school property and assign a group of students to each area. (e.g. athletic fields, schoolyard, garden, ornamental landscape, etc.)

Ask the students to make the following observations of their assigned area:

- Describe your area in detail, including types of plants: e.g. grass, bushes, native plants, garden. What hard surfaces surround your area or are a part of this zone?
- How does the water flow after it hits the surface? Does it run off or is it absorbed into the ground? Do you see any puddles or standing water resulting from irrigation runoff? If yes, describe the location and what you see. Take photographs or make a sketch of the area.
- Do you see any of the sprinkler heads broken, leaking and/or gushing water? If yes, describe the location and what you see. Take photographs or make a sketch of the area.
- Do you see any sprinklers that are over-spraying onto sidewalks, concrete and/or asphalt? If yes, describe the location and what you see. Take photographs or make a sketch of the area.

Once finished with observations, visit the water meter again and record the number on the meter and the time.

Return to the classroom to discuss each group's findings including their water meter recordings on the amount of water that was used during the time it took to complete this activity.

Follow up discussion topics can include: drought, water efficiency, surface runoff, permeability, and evaporation.

SHEET MULCHING: TURN LAWNS INTO NATIVE GARDENS

AGES

9–18 years old

CONTRIBUTED BY

StopWaste
Alameda County, California
stopwaste.org

Many San Francisco Bay Area native plant species are adapted to extended periods of time with little rainfall, due to California's dry summer climate. These drought tolerant plants contrast greatly with the thirsty, non-native lawns that make up much of our built environment, including school grounds. Sheet mulching is an easy, hands-on approach to converting a lawn into a healthy layer of soil ready for planting California native species and creating a diverse schoolyard ecosystem.

MATERIALS

- Biodegradable "sheet" material, such as cardboard
- Mature compost
- Coarse mulch materials (wood chips or tree trimmings)
- 1 bucket per student; access to water
- Gardening gloves and sunglasses to protect hands and eyes from splinters and dust
- 4 inch starts (small pots) of California native plants, as desired (If you live outside California, use plants that are native to your own region.)

BACKGROUND

Sheet mulching uses cardboard to block the sun, enabling grass and weeds to decompose and adds nutrients to the soil, accelerated by the water. A layer of compost creates a welcoming environment for plants to go directly on top of the cardboard. A top dressing of mulch protects the soil and helps retain moisture, reducing the need for water.

DIRECTIONS

Identify and measure the space (lawn or bare soil) you want to sheet mulch and make sure you have enough material to create one layer of cardboard, a 1 in (2.5 cm) layer of compost and a 2 in (5 cm) layer of mulch. A handy sheet mulching calculator can be found at: **http://bit.ly/1Vwi7g2**

If the space is surrounded by a sidewalk, work with students to dig shallow trenches, 8 in wide x 6 in deep (20 cm x 15 cm) along the hardscape perimeter to prevent sheet mulching materials from overflowing onto the sidewalk.

Sheet mulching is accomplished one step at a time:

- Lay cardboard directly on top of the lawn (or bare soil), overlapping different pieces by at least 8 in (20 cm).
- Wet the cardboard until it is completely saturated.
- Add a 1 in (2.5 cm) layer of compost on top of wet cardboard.
- Add a 2 in (5 cm) layer of mulch on top of compost.
- Pull back the layer of mulch to plant 4 inch starts (small plants) directly into the compost, as desired. Carefully place the mulch back around the starts.
- Protect the new sheet mulched, planted zone from foot traffic until the plants are well established.
- Enjoy the garden!

BUILD A STORMWATER FILTRATION SYSTEM

© ANNE STEPHENS

AGES

11–18 years old

CONTRIBUTED BY

California State University, Chico
Chico, California
csuchico.edu/cmse
sandrinematiasek.weebly.com

During a rainstorm, water falls to the ground and picks up pollutants that have accumulated over time, such as: fluids from cars idling in parking lots, dog waste, and trash. Water that cannot infiltrate into the ground becomes stormwater runoff, which flows directly into streams where pollutants may harm aquatic life. Filters can be constructed to allow water to soak into the soil instead of running off into waterways. In this activity, students will build stormwater filters and compare the infiltration capacity of different materials.

MATERIALS

For each group of students:

- Clear empty 2 liter plastic bottle with perforated cap (drill 3 holes in cap)
- 2–3 cotton balls
- A variety of media for building the filters such as: sand, gravel, soil, activated charcoal, mulch, etc.
- Water jug and clumps of soil
- Water

DIRECTIONS

Introduce the concepts of runoff generation and stormwater filters. Describe the relationship between particle size, porosity, infiltration, and pollutant removal. Sand has larger pores than fine soils, which infiltrate water quickly but do not remove pollutants as efficiently.

Step 1: Building the filters

Cut a plastic bottle in half. The top portion becomes the filter.

Screw the perforated cap on the bottle. Invert the filter (cap facing down). Place two cotton balls at the neck of the filter (inside the cap). Fill the filter with one or two types of media, leaving 2 in (5 cm) on top for water. Note the types of materials used.

Place the constructed filter on the bottom half of the bottle. You can also use a quart sized Mason jar for more stability.

Ask students to predict if their filter will: 1) infiltrate water quickly or slowly, and 2) remove contaminants from stormwater.

Step 2: Testing the filters

Add water to the jug and a small clump of soil to replicate stormwater. Mix well. Slowly apply stormwater to the filters until thoroughly wet.

Ask students to record the infiltration rate. How long does it take for water to exit the filter? How frequently is water dripping from the cap?

Once water starts accumulating in the filter base, ask students to note if the filtered water is clear or cloudy. Sediment and fine particles will make the water cloudy or "turbid". Many contaminants will stick to fine particles and sediment, so turbidity is a good indicator of water pollution. The more turbid the water, the more contaminated it likely is.

Discuss how to improve the filtration device. Repeat the activity based upon the revised plan.

Which media would you recommend using for a stormwater filter? Remember that an ideal filter decreases runoff by infiltrating water and removing contaminants from stormwater.

Energy and Climate

School facilities use a substantial amount of energy for heat, light, and power, and many school community members use fossil fuels to commute to school. Schools can engage students in reducing their facility's energy footprint (and saving money), while teaching real-world lessons about where energy comes from and what it takes to produce and transmit power. Students can also be encouraged to walk and bike to school to reduce fossil fuel use.[1]

Renewable Energy. School grounds can host renewable energy demonstration systems that power decorative fountains—or the entire school—teaching children and their communities about clean and sustainable sources of energy. Schools around the world are incorporating solar energy systems into their buildings and grounds, and many also use simple, low-tech "solar box cookers" to demonstrate the power of the sun's energy to cook foods that the children like to eat. Some schools also use small or large scale wind turbines, biomass demonstrations (e.g. burning wood), and other techniques to demonstrate and use renewable energy at school. All of these renewable energy demonstrations can serve as models and provide context for teaching about the math, physics, and design concepts that underlie renewable energy systems.

Climate Improvement. School ground design can address climate change and make the site more comfortable by removing pavement, rubber, and plastic, which heat up in the sun, and by planting trees and shrubs to provide shade for students and school buildings.[3] Students can engage in citizen science projects to analyze their school ground microclimates to understand variations in temperature, wind, and other factors, and look for ways to make their schoolyard landscapes more comfortable year-round. Teachers can also demonstrate climate improvement techniques by composting with their students, to illustrate concepts related to carbon sequestration.

Solar Analysis. School grounds are an ideal setting to provide hands-on learning opportunities for solar science and other curricula related to the movement of the Earth around the sun. The changing seasons afford opportunities to study the ways that day length and sun and shade patterns shift throughout the year. Younger students can use art and science activities to help them understand the sun's power to provide heat and light. Older students can use their school grounds to understand the solar system's geometry and motion, and use math to calculate the best location for photovoltaic (solar) panels to power their school buildings.

RENEWABLE ENERGY

CLIMATE UNDERSTANDING AND IMPROVEMENT

SOLAR ANALYSIS

RELATED ACTIVITIES IN OTHER CHAPTERS


© SHARON DANKS

INTRODUCTION TO RENEWABLE ENERGY

© EDUCATION OUTSIDE

AGES

9–11 years old

CONTRIBUTED BY

Education Outside
San Francisco, California
educationoutside.org

In this lesson, students learn about renewable energy and explore solar, wind, and hydroelectric energy using hands-on models. Before using this activity, students should have already explored the concept of "energy" and its sources.

MATERIALS

- Whiteboard and markers
- Science notebooks
- Pinwheel supplies: unused pencils, push pins, pinwheel template: **http://1.usa.gov/1NuyZes**
- Model windmill generator
- Model solar panel or garden solar feature
- Model waterwheel: **http://bit.ly/267w338**
- Posters or other information about renewable energy sources (solar, wind, and hydropower)
- Resources can be found at: **http://bit.ly/EOpath**

PREPARATION

Write the word "renewable" on the white board. Set up three renewable energy stations with supplies, models, and information about different energy sources.

DIRECTIONS

Begin by asking students a few questions: "What does the word renewable mean (able to be replaced by nature)? What are some examples of sources of energy that are non-renewable (burning oil, natural gas or coal)?"

Ask students to discuss forms of energy that are renewable with a partner, and list examples of naturally occurring energy in "nature" (waves, wind, sun, etc.). Take suggestions from volunteers to share with the class.

Tell students that they are going to learn about three sources of renewable energy today: solar, wind, and hydropower. Using informational posters for help, discuss each form of renewable energy: "What forms of renewable energy have the students seen before? (A local dam? a wind farm? solar panels?) How do they work? Where does the energy come from and go?"

Divide students into three groups and ask each group to start at one of the stations. Give students 5–8 minutes at each station, depending on the available time.

Wind power group. At this station, students will make pinwheels to demonstrate how a wind turbine works. They can also play with a model windmill generator.

Solar power group. At this station students experiment with a solar powered fan or another schoolyard solar feature such as a solar powered pond pump, observing what happens when the panel is partially blocked.

Hydropower group. At this station students will use water from a hose or watering can (or a water feature, if the school garden is equipped with one) to rotate a waterwheel.

After each group has had a chance to rotate through each station, reconvene the students and ask them to share one thing they learned about renewable energy with a partner. Ask one volunteer from each group to share their comment with the entire class.

End the lesson by asking students to recap the lesson's objectives in their science notebooks. Ask: "What is the difference between renewable and non-renewable energy? What are three forms of renewable energy?"

DIMINISHING RETURNS

© KEEP

AGES

10–14 years old

CONTRIBUTED BY

Wisconsin K-12 Energy Education Program (KEEP)
Stevens Point, Wisconsin
KEEPprogram.org

This activity introduces students to the First and Second Laws of Thermodynamics through a water relay race. This also demonstrates the inefficiency of coal energy production, which supplies almost half of our nation's electricity. Coal-fired plants are only able to use 38% of the energy stored in coal after conversion. (Source: National Academy of Sciences)

MATERIALS

- 1 gal (38 dL) of water
- 1 plastic yogurt container (1 pound size) with 1 hole in the bottom
- 1 plastic yogurt container (1 pound size) with holes covering one-third of the bottom
- 6 small paper cups (5 of the cups should have 1 hole punched in the bottom)

BACKGROUND

Energy is constantly changing from one form to another. This is called energy conversion. We use technology to convert energy stored in fuels such as coal into electricity. The first law of thermodynamics states that energy cannot be created nor destroyed. Therefore, an equal quantity of energy must exist before and after a conversion.

Although the same amount of energy exists before and after, not all the energy is converted into the desired form. This illustrates the second law of thermodynamics: with each energy conversion, some of the energy becomes unavailable for future use. "Efficiency" describes how much of a given amount of energy can be converted from one form to another useful form.

Additional resources

- Energy Sources and Uses: **http://bit.ly/1WGep00**
- Smart Energy Solutions: **http://bit.ly/1S3ZLvG**

DIRECTIONS

Tell students they are going to simulate what happens to the chemical energy in coal as it is converted from one form to another during the electrical generation process. The water will represent the energy within coal (and electricity and light) and not the coal itself.

Go to a large outdoor grassy area and divide the class into teams of eight students.

One student (representing a coal miner) will take one cup of water with a hole in the bottom and transfer water from the gallon to a student holding the yogurt container with one hole in the bottom.

The student holding the yogurt container with one hole in the bottom (representing transportation, such as a train) will carry the water to a third student holding the yogurt container with many holes (representing electricity generation).

The water then goes down a line of four students in a row, who are each holding a cup with a hole in the bottom (representing a power line).

The final student in the line will pour any remaining water into the cup without a hole (representing a light bulb) held by the last student. The relay is done when the cup is filled or when water runs out.

Discuss energy production and efficiency with students.

To download this activity in its entirety, visit:
http://bit.ly/WiscEnEd

SCHOOLYARD SOLAR OVENS

© ANGIE SMITH

AGES

11–18 years old

CONTRIBUTED BY

South Carolina Green Step Schools
Columbia, South Carolina
greenstepschools.com

General George S. Patton said, "Never tell people how to do things. Tell them what to do and they will surprise you with their ingenuity." South Carolina Green Step School projects try to promote this philosophy. Of course, educators provide guidance, but they also let their students use their own creativity to tackle environmental challenges. For instance, some South Carolina Green Step educators are challenging students to design and build solar ovens from at least 75% repurposed materials that students can find at school or at home. This project allows students to research cardboard box solar ovens online, practice engineering and design process skills, and collaborate with peers. It also provides an opportunity for students to apply their understanding of the Law of Conservation of Energy, as they transform solar energy to thermal energy through conduction, convection, and radiation.

DIRECTIONS

The goal is to build a cardboard box oven that will get warm enough when sitting outside on a sunny day to complete a specified task (e.g. make s'mores, bake cookies, or melt old crayons). Students can add reflective materials to intensify the solar rays, transparent film to seal the oven and trap heat, and dark liners and insulating materials to absorb and retain heat.

Students can test their devices by using thermometers to measure the internal temperature of the ovens and then bake or melt as planned.

Teachers can then help students compare the principles of their solar ovens to the warming effect greenhouse gases have on our planet leading to global warming and climate change.

© JANE HILLER

© REGAN MOORE

EXTENSIONS

Here are some creative ideas of how to build on this activity from our partner schools:

- Irmo Middle School students record videos showing their personal energy conservation measures on the Do One Thing Challenge, a project of the Alliance for Climate Education (accessible at **acespace.org/dot**).
- River Bluff High School students retrieve crayons to remold that would otherwise be thrown away at local family restaurants.
- Catawba Trail Elementary School students collect single-serve carrot bags from their cafeteria lunches to package the remolded crayons they make.

Thanks to: Regan Moore, Irmo Middle School, Amy Price, River Bluff High School and Vikki Pasco, Catawba Trail Elementary School for sharing their educational expertise and creative ideas.

CREATE A WIND TURBINE

© ERICA FINE

AGES

8–18+ years old

CONTRIBUTED BY

The Energy Coalition
Irvine, California
energycoalition.org

This activity provides an experiential learning about how wind turbines operate. By building, testing, and trying to improve upon their designs, they will better understand how we harness the power of the wind to create energy.

MATERIALS

- Bamboo skewers
- Thumbtacks and scissors
- Hot glue
- Small bead
- Wind turbine templates (see below) or square of paper

DIRECTIONS

Begin by introducing students to the concepts of renewable energy and wind power.

Before you start cutting out the pinwheel, stick the non-pointy end of the bamboo skewers into a small glass of water. Once the skewers soak up some water, it will be easier to push the thumbtack into the skewer to attach the pinwheel, and the wood will not splinter.

While the skewers are soaking, cut out the windmill template, including cutting along the dotted lines. Poke holes using your thumbtack where indicated on the template.

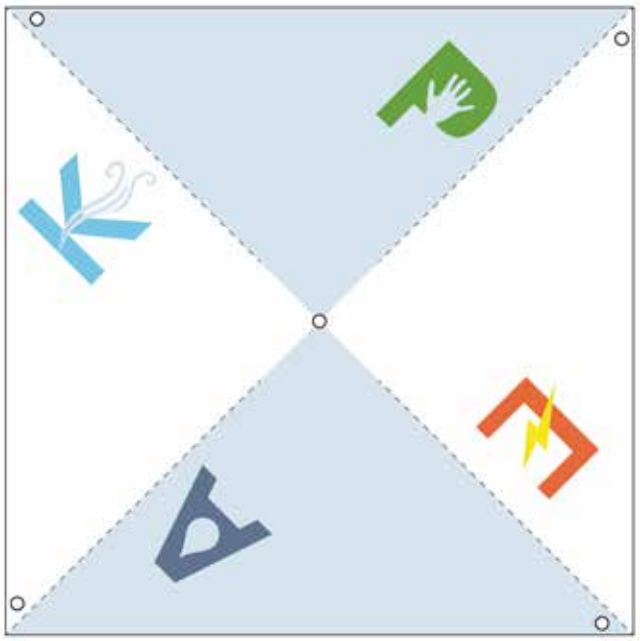
Once your shape is cut out, take one spoke of the pinwheel and push the thumbtack through the hole from the back. Bend the next spoke over and push the thumbtack through the hole on that spoke as well.

Continue pushing the thumbtack through each individual spoke until the thumbtack is through all four spokes. Push the thumbtack through the hole in the center of the pinwheel, then slide the small bead onto the thumbtack.

Then push the thumbtack into the wet end of the skewer. If you need to, you can gently tap the front of the thumbtack with a hammer. Keep pushing the thumbtack into the skewer until the skewer touches the small bead on the thumbtack.

Cover the bead with glue! The bead helps space the pinwheel away from the skewer, allowing the pinwheel to spin freely without getting caught on the skewer as it turns.

Extension. Can your students designed an even better wind turbine that moves even faster than this one? Pass out graph paper to your students and tell them to design a Wind Turbine for future generations.



EXPLORING MICROCLIMATES

© LEAH MADISON

AGES

14–18 years old

CONTRIBUTED BY

Desert Research Institute's Science Alive Program
Reno, Nevada
sciencealive.dri.edu

Exploring Microclimates emphasizes the importance of photosynthesis and cellular respiration in temperature regulation. This activity highlights these two processes and their role in the cycling of carbon among the biosphere, atmosphere, hydrosphere, and geosphere. Students will create mini-microclimates and produce carbon dioxide that will be introduced into each environment, modeling a portion of the Earth's carbon cycle. While carbon dioxide is naturally present in the atmosphere, human-related activities are responsible for rising global CO_2 levels.

MATERIALS

The list of materials below is enough for 10 groups:

- 1 box of baking soda
- 1 bottle of vinegar
- 10 empty plastic bottles, 12 oz – 16 oz size (3.5 dL – 4.7 dL)
- 10 plants
- 10 empty plastic containers (preferably used)
- 20 large balloons
- 20 oven bags
- 20 thermometers
- 40 binder clips

DIRECTIONS

Ask students questions about the importance of photosynthesis. "What would the world look like without the sun?" Carbon dioxide and oxygen are key terms that should come up during this conversation.

Begin by placing both oven bags in a sunny area. Attempt to position the bags so that they each receive the same amount of sunlight.

Place a thermometer in each oven bag. Place a plant in only one of the bags. Take an initial temperature reading and record it in your science notebook.

Take a balloon filled with roughly two tablespoons of baking soda and place the opening of it carefully over the mouth of a bottle filled with about a quarter cup of vinegar. DO NOT let the baking soda fall into the vinegar until it is securely over the mouth of the bottle.

Lift the balloon so that the baking soda falls into the vinegar. You just created carbon dioxide in the balloon! Carefully take the balloon off of the bottle without letting any gas escape. Close the balloon securely with a binder clip.

Place the balloon in the oven bag with the plant and close it with a binder clip, ensuring that no air is able to get in or out.

Repeat the same steps with another balloon. This time, place the gas-filled balloon in the bag that has no plant.

Remove the binder clips from each balloon at the same time. Do so from the outside of the oven bag so that all of the gas remains inside.

Record the temperature in each environment every five minutes for a total of 30 minutes.

DISCUSSION QUESTIONS

"Were there differences between the two "climates"? Why or why not? How does the plant and the process of photosynthesis affect the carbon dioxide in the bag? How does carbon dioxide impact temperature? Why?"

HOW COOL IS YOUR SCHOOLYARD?

© SHARON DANKS

AGES

8–18 years old

CONTRIBUTED BY

Green Schoolyards America
Berkeley, California
greenschoolyards.org

Why are cities often hotter than the surrounding countryside? In this activity, students study the microclimates on their schoolyard and explore the influence of the built environment on surface and air temperatures. They will use infrared and standard outdoor thermometers to measure and compare the temperatures of the air, pavement, and natural areas.

MATERIALS

- One handheld infrared thermometer for measuring surface temperatures (e.g.: **http://bit.ly/Fluke62**)
- One standard outdoor thermometer, for measuring air temperature, attached to the top of a meter stick. (Use this to measure air temperature at a consistent distance from the ground, approximately the height of a young child.)
- Notebook(s) and writing materials to record findings

BACKGROUND

Man-made surfaces, such as buildings, asphalt, concrete, rubber, and metal often trap and store more heat from the sun than vegetation and other natural materials such as trees, grass, wood, and soil. We can cool the temperature of our schoolyards—and cities—through our choice of materials; for example, by replacing pavement with plants and adding trees for shade. (See: **http://bit.ly/EPAtemp**) This is important to understand as the effects of climate change increase.

DIRECTIONS

Lead a brief discussion about microclimates, factors that influence them, and why this matters. Ask: "How do different materials in our schoolyard influence local temperature?" Walk outside onto the school grounds with a class on a warm, sunny day. Observe and discuss the wide range of materials used onsite. Ask students to hypothesize which areas of the yard are the warmest, coldest, and why?

Identify five or six areas within the yard that the class believes have different microclimates, to be your "study areas". You might consider including: a patch of asphalt in full sun and one in full shade; a concrete sidewalk; a shady tree grove; a soil-covered garden bed; a metal slide; rubber safety mats; a natural lawn; artificial turf; etc.

Establish set intervals for measuring temperatures in the study areas and decide on the length of your study. E.g., plan to take measurements once per hour (with different classes), from 9:00 am - 4:00 pm, for a week. Create a data table for the class(es) to share to record their measurements.

Model how to use both types of thermometers, following all of the directions for use of your infrared thermometer. (Some infrared thermometers require a different setting for each material to properly measure surface temperatures; others only have one setting.)

Divide students into teams and distribute responsibilities for taking measurements of the surface temperature and the air temperature at the appropriate times and in each of the specified locations. Ask students to record their findings on the shared data table.

When the data have been collected for the entire study period, analyze the results with the class(es). What patterns did you notice? Which areas of the school grounds were the warmest and coldest? Do any of the areas on the grounds get dangerously hot? Temperatures hotter than 111°F (44°C) can cause pain; temperatures hotter than 140°F (60°C) can cause burns.

After drawing out patterns, ask students to develop explanations for how and why these patterns might exist. Then have students apply their working hypotheses to generate ideas about how to cool the hottest temperatures onsite.

COMPOSTING AND CARBON SEQUESTRATION

© ALANA SIEGNERW

AGES

14–18 years old

CONTRIBUTED BY

Alana Siegner
Energy and Resources Group
University of California, Berkeley
Berkeley, California

This activity engages students in local solutions to climate change, by framing composting as an opportunity for carbon sequestration. Students will participate in a brief mini-lesson on the potential of well-managed agricultural systems to re-store atmospheric CO_2 in soils via best management practices such as composting. Students will then construct a compost container and add appropriate materials to the compost, taking action on their school grounds!

MATERIALS

- Compost container (can be purchased or constructed from wood, pallets, or any scrap materials readily available in the schoolyard or teacher's home)
- "Starter" compost can be purchased at garden stores, or procured from existing compost piles if available
- Food scraps, leaves, twigs, yard/garden debris
- Thermometer and string, twine, or zip ties
- Carbon sequestration worksheet/note taking guide

DIRECTIONS

Begin by leading a brief lesson on soil carbon sequestration (SCS). Human activities like tilling and cultivating soils cause them to release their carbon into the atmosphere. SCS is the process and ability of soils to re-capture and store carbon; therefore reducing the amount of CO_2 in the atmosphere. Plants with deeper root systems and agricultural "best management practices", like composting, enable this process.

Have students fill out a short worksheet of key terms including: carbon sequestration, climate change mitigation, composting, and climate smart agriculture.

Draw a carbon cycle diagram on a board or with chalk and have students add directional arrows showing where carbon has been going for the last few hundred years (into the atmosphere) vs. where we want it to go (back into the soil).

Assemble the compost bin, add "starter" compost, and add materials to be composted—garden debris, dead leaves, twigs, food scraps, etc. (Optional: Add red wriggler worms for faster decomposition.) Attach a thermometer to the side of the compost bin to measure temperature and track the bacteria present at different phases of the composting process (psychrophilic, mesophilic, and thermophilic). Students can set up graphs to track the temperature of the pile over time and label which bacteria are present.

DEBRIEF

Connect back to climate change and SCS. Composting helps build soil fertility and life; life promotes faster carbon cycling and storage in deeper, more protected layers of soil where the stored carbon won't be re-released (perennial plants help with this process). This all helps mitigate climate change as CO_2 removal is considered an increasingly important tactic for avoiding undesirable levels of temperature rise. There are other ways to remove carbon from the atmosphere, but promoting healthy soils is by far the most accessible option!

EXTENSIONS

Share examples or videos of local farms that are practicing sustainable agriculture, composting, and/or carbon farming. Bring in or schedule a guest lecture from a local farmer who is managing their lands in accordance with environmental and climate resilient practices.

MATH IN THE REAL WORLD: ANGLES OF THE SUN

AGES

9–10 years old

CONTRIBUTED BY

REAL School Gardens
Washington, DC
realschoolgardens.org

In this lesson, students will apply the use of angles to a real-world problem—finding the angle of the sun to determine the placement of solar panels. This activity can be used to teach about angles or to reinforce and apply an understanding of angles.

MATERIALS

- 1 white board or chart paper and drawing materials, for the teacher
- Protractors, 1 per pair or team of students
- Journals and pencils for each student

DIRECTIONS

Engage. Ask the class to describe what they know about solar power, and where they think solar panels should be placed on the school grounds.

Discuss that people need to know the angles of the sun to solve real-world problems for things like solar panel placement. Explain that they will now find the angle of the sun relative to locations around the school building to determine the ideal placement for solar panels.

Explore. Ask the students to explore their schoolyard or outdoor classroom in pairs or teams and to imagine the apparent movement of the sun across the sky during the day.

Allow students to determine the best way to find the sun's angle before offering support. At this point, it's okay for them to have misconceptions. Those can be corrected later.

Move from group to group asking guiding questions that lead the students to use the ground as their starting point line (like the bottom of their protractor). If more support is needed, the leader can help model how to sketch the current angle of the sun. Place yourself at the center of the protractor's base, and match its arc to the sun's path across the sky. Try to ask questions that allow the students to figure out how to use their protractors to measure the angle themselves.

Explain. Ask students to convene to share their findings with one another. Some students may have found different results depending on which directional orientation they started with. See if the students can figure out why their numbers are different. Ensure that students understand that the sun is directly overhead in the middle of the day (a right angle).

Explain that the sun rises in the east and moves through the acute angles in the morning, passes the right angle around noon, and moves through the obtuse angles in the afternoon and evening.

Ask students to illustrate an obtuse angle that they might observe from the sun's position in the afternoon.

Elaborate. Ask students to work independently to identify times of the day when the solar panels in their chosen location would experience shade.

Ask students to sketch the angles which will produce shade, measure them, and label them. They should add details about the degrees of the angles, and whether they are acute, obtuse, or right.

Evaluate. Give students the following problem to solve: Imagine that they are installing solar panels, but the solar panels can only face east or west. The solar panels will be in the shade at the angles of 15° to 65° and again from 120° to 135°. Which direction should the panels face to get the most sunlight? Explain why this is the case using sketches, diagrams, and/or words.

MAKE A SOLAR ETCHING

© TOR ALLEN

AGES

8–18 years old

CONTRIBUTED BY

Rahus Institute - Solar Schoolhouse
Sebastopol, California
solarschoolhouse.org

Many years ago, people would start their family's cooking fire using mirrors or glass to focus sunlight into a high temperature beam. The power of sunlight can also be used to make artistic creations with the aid of a magnifying glass. Solar Schoolhouse learned of this technique from Solar B, a Santa Barbara artist who "solar carves" amazing artwork using only sunshine. You too can be a Solar Artist!

MATERIALS

- Magnifying glass (2x or 3x magnification, with a diameter of 4 in (10 cm)
- Protective eyewear for each student (welding goggles, Shade #5, 50 mm)
- Pencils and 1 or more clean pieces of wood per student

DIRECTIONS

Ask students to choose a piece of wood, and then draw or write something on the wood with a pencil.

Students should sit outside in a comfortable, sunny place, with the sun shining over the shoulder that matches the hand they use for writing (either to the right or left).

Ensure that each student puts on protective eyewear before they begin to etch.

Students should hold the magnifying glass with the lens perpendicular to the sun, above the wood.

Slowly move the lens closer to the wood, making sure the light beam is a perfect circle, and focusing it until it gets as small as possible. It should start burning at this point. If the lens gets too close to the wood, the beam will start to enlarge and it will stop burning.

To etch the design, move the beam in the direction of the pencil line, traveling slowly back and forth, and going further forward with each pass.

As you can see in the picture, the lens bends the heat essence of the sun and concentrates it. On a clear day, the temperature of a totally focused beam can reach over 800°F (427°C)!! Do not allow this hot point of light to come in contact with students' skin or flammable clothing. Always be safe and have fun!

Thoughtful Use of Materials

Everything a school chooses to include in its environment says something about its values. Over the last few decades as the green building movement has grown, many schools have started to question conventional playground materials—asphalt, concrete, stainless steel, plastic, and rubber—that are widely used. Schoolyard landscape features designed using sustainable, natural, and recycled building materials demonstrate green building practices to the school community and can reduce the school district's costs and impact on landfills and other urban infrastructure.[1]

Natural Materials. Living plants, wood, bamboo, straw, stone, sand, clay, adobe, snow, and other natural materials are teaching tools for lessons about environmental stewardship and time-tested building techniques that are still relevant today. They lend themselves well to artistic expression and cultural connections, and their simple construction techniques invite community participation in schoolyard building and stewardship projects.

Natural materials are also wonderful replacements for plastic toys, blocks, and math manipulatives. Their highly varied textures and colors provide a wide range of sensory experiences and, unlike man-made objects with predetermined forms, their identity and uses are flexible, affording endless opportunities for high-quality, imaginative play.

Decomposition. Plant-based materials are gentle on the Earth and can be composted at the end of their useful life. The decomposition process returns valuable nutrients to the soil and helps to make them more accessible to other plants. Students of all ages can study natural materials' decomposition process onsite using a compost bin to process landscape clippings. Some schools also intentionally harness the decomposition process by adding temporary features to their landscape. For example, straw bales can act as informal outdoor seating or as centerpieces of a nature play area, for about one season. After that, the bales begin to break down and can be moved on to a second use, as mulch in the school garden. Once the straw is spread on garden beds, it will last another season before fully decomposing and returning its nutrients to the soil.

Reclaimed and Recycled Materials. Using salvaged materials on school grounds diverts bulky waste from landfills and recaptures the remaining value of the materials for further use. It reduces the need to mine, harvest, process, and transport new materials, which in turn, saves additional energy and effort, and preserves environments at the extraction source.[1]

Reducing Waste. School grounds lend themselves well to life-cycle analyses of commonly used materials. Students can also conduct waste audits to see what they find on their grounds and explore ways their school community can reduce waste.

NATURAL MATERIALS

DECOMPOSITION

RECLAIMED AND RECYCLED MATERIALS

RELATED ACTIVITIES IN OTHER CHAPTERS

MAKE A CREATE-WITH-NATURE ZONE

© ZACH PINE

AGES

3–18 years old

CONTRIBUTED BY

Zach Pine Nature Sculpture *and*
University of California Blake Garden
Kensington, California
naturesculpture.com *and*
blakegarden.ced.berkeley.edu

Make a Create-With-Nature Zone to support creative play and construction using found materials from nature. The Zone can be set up and used for a one-time Create-With-Nature event, or installed permanently in a playground or outdoor classroom to be used during recess with minimal supervision or to support instructional time. Create-With-Nature Zones usually have agreed-upon rules or expectations, sometimes printed on a sign.

MATERIALS

Collect natural materials from school grounds, such as fallen leaves or twigs, or green waste from a school garden. Ask children to bring additional materials collected in an environmentally sensitive way, from home. Example materials include: leaves, rocks, sticks, flowers, cones, fronds, seeds, pods, wood, shells, evergreen needles, stalks, bark, seaweed, sand, mud, and water.

The size, types and amount of natural materials should be tailored to the age group and to the size of the Zone. A slight scarcity of materials can promote creativity, collaboration and sharing. Some materials can be kept in reserve to add in if needed.

Tree stumps or rounds, to show the boundaries of the Zone and provide work surfaces or seating, can be obtained free-of-charge from tree service companies and public parks and gardens.

DIRECTIONS

Create the Zone's borders using chalk lines, tree stumps, benches, planters, or existing walls and pathways. A cozy Zone promotes sharing, inspiration, and collaboration. Include a "nature library" along the edge of the Zone to lay out and sort the natural materials. Bins or baskets are helpful to store, transport, and collect items for use. If the Zone is not on pavement, provide a few flat surfaces such as stepping stones or tree rounds to highlight small objects that are less visible on grass, dirt, or mulch.

Orient students to the Zone. The purpose is to have fun while engaged in the activity, not to make something permanent. You can model this by making a creation, then quickly "recycling" it, making a new one from the same materials, and repeating this process a few times. You may introduce age-tailored vocabulary such as: under/over, symmetrical/asymmetrical, abstract/representational.

You may want to make a "rule" that materials should be put back in the "nature library" at the end of a session. Make it clear whether foraging from nearby nature is encouraged or not, and what the expectations are for protecting the environment. If the Zone is permanent, post a sign explaining how the Zone should be used.

The Zone can also be used as an outdoor classroom to achieve curricular goals in all subject areas, using structured activities and assignments.

NATURE ELEMENTS IN THE LANDSCAPE

© LISA HOWARD

AGES

3–18 years old

CONTRIBUTED BY

Bay Tree Design, inc.
Berkeley, California
baytreedesign.com

Students greatly benefit from having natural elements in their schoolyard landscape that they can explore and use—depending on their age—to enhance their imaginative play, develop gross motor skills, incorporate into their academic studies, or enhance informal relaxation spaces. This project places boulders, tree rounds, or logs in the schoolyard landscape. It is intended to be undertaken during a community workday or by school district facilities staff or a hired contractor.

MATERIALS

- Tree rounds or logs from long-lasting hardwoods like cedar or redwood; minimum 18 in diameter x 18 in long (46 cm x 46 cm)
- Boulders, a minimum of 18" in diameter (46 cm)
- Open-graded aggregate base rock, to place under the logs
- Winch, tripod, digging bar, and other appropriate tools
- Work gloves, safety glasses, and any other safety equipment deemed necessary for the activity
- Adults to supervise children, if they are involved, and to keep children's participation safe and age appropriate
- Insurance for volunteers, via the school, district or PTA
- Camera

© SHARON DANKS

CONSIDERATIONS

Select a location in a soft, landscaped area and decide if you will use boulders, tree rounds, and/or logs. When placing these natural elements onsite, consider: the ground surface, nearby traffic and use patterns, drainage, and desired uses. If these elements are intended for play, follow the CPSC and ASTM guidelines for safety. All materials should be onsite before work begins.

DIRECTIONS

Recruit adult volunteers from the school community to assist with construction and lend tools to the project.

To place tree rounds: Mark the ground to indicate where you wish to place the elements. Explain this layout to the assembled volunteers. Dig holes in the soil that are a few inches wider than each tree round you will be using, following your plan. The holes should be deep enough to accommodate a 6 in (15 cm) bed of compacted base rock plus half the height of the tree rounds.

Fill the holes with 6 in (15 cm) of base rock; compact it firmly. Place the tree rounds in the ground, with at least half the height below the finished grade and the other half above ground. Fill the hole around each piece of wood with additional base rock up to 3 in (7.5 cm) below finished grade, and compact firmly. Add wood chip mulch to the top of the holes to match the surrounding landscape.

To place boulders: Place boulders in the ground on compacted native soil, at least 1/3 below the finished grade with the other 2/3 exposed above the finished grade. Fill the holes with native soil and top with mulch, as desired.

THE SCIENCE OF SOIL TESTING

AGES

14–18 years old

CONTRIBUTED BY

The Huntington Library, Art Collections and Botanical Gardens
San Marino, California
huntington.org

Healthy soil is the key to a healthy garden. But how do you know what kind of soil is in your garden, and which plants will thrive in that soil? These "layers" of activities guide students in testing the soil make-up for a fuller perspective, and they are adapted from our on-site program, "Farm to Plate: Connecting with Our Food at the Ranch".

MATERIALS

- Soil from the school garden
- Magnifying glass
- Cups
- pH strips with reference scale
- Shovel
- Hose or watering can
- Ruler
- Mason jar with lid
- Soil texture triangle: http://1.usa.gov/22Bpb9s

DIRECTIONS

Begin by encouraging students to observe a soil sample from the garden. Ask them to use their senses to describe what the soil looks like, feels like, and smells like.

Part I: Soil pH

Ask students to fill cups with small soil samples from different parts of the garden. If it is dry, add enough water to moisten. For each sample, have students put the pH strip in the soil for a few seconds and then identify the pH color on the strip. Discuss if the results are uniform or if there is variation on your site. Knowing the pH of the soil is the first clue to what kinds of plants might be well-suited to that garden.

Part II: Soil drainage

Ask a student to dig a small hole in the garden, approximately 1 ft (30.5 cm) wide and 1 ft (30.5 cm) deep. Have another student fill the hole with water, and then stand the ruler in the hole. Time how long it takes for the measured water to drain into the soil. Discuss what conclusions can be drawn from the results. Knowing the drainage tendencies of the soil is the second clue to what kinds of plants might be well-suited to that garden.

Part III: Soil texture

Ask a student to fill the mason jar two-thirds with water and then add garden soil until the jar is almost full. Put the lid on the jar and shake until the soil has broken into particles, then set it to rest. After a few minutes, a layer of sand will form; after about an hour, a layer of silt; and after about a day, a layer of clay.

Ask students to estimate the percentage of each of the three soil layers, and then have them locate that percentage balance on the soil texture triangle. The result will indicate the type of soil that is in their garden, and it will offer them more insight regarding the soil pH and drainage results. Then ask students to deduce what kind of plants might be successful or unsuccessful in the garden.

COMPOST GOURMET

© TREEPEOPLE

AGES

5–10 years old

CONTRIBUTED BY

TreePeople
Beverly Hills, California
treepeople.org

A forest, in order to thrive, needs nutrient-rich mulch (fallen leaves and branches) to be converted to healthy humus—exactly what trees and plants need to grow! Composting is our attempt to promote the process of decomposition by recycling our yard clippings, food scraps, and other organic matter. Using compost to feed the soil, we can divert our organic matter from landfills and convert it into soil for our school and community gardens.

MATERIALS

- Mixing bowl, spoon, and apron
- Baking pan filled with organic compost
- Container of water
- Separate bowls of dried leaves, branches, food scraps and grass clippings
- Compost bin (or picture)

DIRECTIONS

Explain to the students that they will observe a demonstration by the Compost Gourmet who specializes in turning trash into treasure! Ask the students, "What do you think is natural trash?"

Set up a demonstration separating the bowls of items by "greens" (high in nitrogen—food scraps and grass) and "browns" (high in carbon—dried leaves and branches, including the mixing bowl, spoon, and water.

Wearing your apron, proceed as the "Compost Gourmet". (Silly voice is optional.)

© SHARON DANKS

Use the following script, modifying it as you choose: "I am going to show you how to turn what some people think is trash, into treasure! Look at these ingredients! What do we usually do with them?" (Throw them away.) "Not in my kitchen! All of these can be turned into compost. Compost is rich soil that is used to grow food and plants. Using a special recipe, I will mix these together to make compost. The perfect recipe calls for an equal blend of nitrogen and carbon. These are important elements for making soil. For our recipe we'll call nitrogen-rich ingredients "greens". Green ingredients are moist, like grass clippings, food scraps, and garden weeds." (Display some samples.) "The carbon-rich ingredients we'll call "browns". Brown ingredients are dry like bark, branches, and dry leaves." (Display some samples.)

Invite students to come up and add equal parts of green and brown ingredients to the mixing bowl, stirring it and adding water.

Demonstrate that the last step is to put it in the oven. "Do you think I should put it in a regular oven?" Share that the ingredients for compost go into a compost bin (show the bin or a picture), and that it acts like an oven. All the micro-organisms work so hard to process this material, that the compost bin actually gets hot inside. In about 3 months we have our finished product—compost.

Pull out a sample showing the baking pan filled with organic compost. Allow students to smell it, feel it, and add handfuls of it below a tree.

THINK BEFORE YOU THROW: 4RS RECYCLING RACE

AGES

4–18 years old

CONTRIBUTED BY

Green Schools Initiative
Berkeley, California
greenschools.net

In this activity, children learn about what everyday products are made of and what happens when items come to the end of their useful lives. This includes learning about the 4Rs and how to sort their waste properly as compost, recycling, and landfill trash to reduce their environmental impact on the Earth. Students practice sorting and have fun with a Recycling Relay Race.

MATERIALS

A large bag with examples of waste students encounter at school, including at least one example of each type of waste (items to be composted, recycled, and landfilled) per team. For example: used classroom paper, empty milk cartons, empty yogurt containers, paper napkins or towels, chip bags, paper plates, plastic bottles, aluminum cans, plastic forks, and non-messy food waste (e.g. banana peels).

Each team of students needs: one trash bin labeled "Landfill" (with a black bin or black sign), one recycling bin labeled "Recycling" (with a blue bin or sign), one compost bin labeled "Compost" (with a green bin or sign).

DIRECTIONS

Before you begin the activity with students, attach waste station signs to the bins and bring them outdoors. In the schoolyard, 5–10 yards (or meters) from the bins, arrange one pile of mixed waste per team, to be sorted by students during the race. Each pile should have the same number of items and the same examples of waste to sort.

The 4Rs

- **REDUCE:** Use fewer things, so less is wasted
- **REUSE:** Use durable goods, not disposable ones
- **RECYCLE:** Turn old materials into new ones
- **ROT:** Compost organic matter to create rich soil

Gather students outside near the prepared materials and tell them about the 4Rs. Ask if they'd like to be an Earth Protector (or other eco-hero). Tell them that everything we use is made with resources that come from the Earth—our clothes, houses, food, books, cars, computers, toys, and iPhones (modify for age). When we are done using our things we often throw them "away". Ask students: "Where do things go when we throw them away?" Answer: There is no such place as "away" because we only have one Earth. It all goes somewhere—to the landfill, or a recycling plant or a compost pile. The less we use, and the less we bring to the landfill, the more we save resources, replenish soils, and protect our Earth.

Waste sorting. Show an example of each item when you explain the activity. Ask what each item is made of and whether it can be recycled or composted (rotted) or whether it is landfill trash. Demonstrate where each item can be disposed of properly (in matching bin). Plastic items go to the landfill. Paper, bottles, and cans can be recycled. Food-soiled paper, milk cartons, and food waste can be composted. Tell students that it is important for them to "Think Before You Throw" and to practice the 4Rs. Ask the students if they understand the 4Rs.

Recycling relay race. Divide students into teams and ask them to line up behind each waste pile. Each student will pick one item, race to their waste bins, and put the item in the proper bin (landfill, recycling, compost). When they return to their pile, the next student takes a turn. The team that completes the race first and gets the most items in the correct bins wins.

BIRDS' NESTS AND PLASTIC WRAPPERS

© KRYSTLE N. RAMOS

AGES

5–14 years old

CONTRIBUTED BY

Community Nature Connection
Los Angeles, California
communitynatureconnection.org

This activity aims to inspire students to critically think about the ways that birds incorporate all materials within their habitat to build their nests. The materials needed for the activity are easily found in and out of the classroom. This activity will best support lesson plans focused on birds, conservation, ecology, cause and effect of littering, sustainability, and recycling, reducing, and reusing trash.

MATERIALS

- Any kind of classroom scrap materials (brown paper bags, construction paper, felt, etc.)
- Trash (plastic wrappers, chip bags, etc.)
- Natural materials (branches, leaves, etc.)
- Glue
- Yarn
- Scissors

PREPARATION

Collect scrap materials used in the classroom for the days leading up to the activity.

If your school grounds do not contain many natural materials or much trash, you may want to ask students to bring some in from home or collect some yourself in advance.

Bonus. Teachers can create their own nest(s) purely out of natural resources to display to students at the beginning of the activity.

DIRECTIONS

Introduce the students to birds, nest building, and the different types of nests that different birds create (e.g. Baltimore Oriole, Cliff Swallow, robin, hummingbird, etc.). We suggest focusing on native species and/or birds that migrate through your area.

Show students visuals of the various birds, nests, nest materials, and egg sizes to help students imagine the possibilities for their own models.

Collect materials from the school grounds. Students can collect anything they think a bird would be able to pick up in its beak and fly away with, including natural materials and litter. (Big or heavy items might have to be broken down into smaller pieces!) Remind students to only pick up natural materials that are already on the ground and not still attached to a plant.

Students can then take the materials they have collected and use them to build nests. They can use glue or yarn to keep their nests together, or can choose to do without. Dependent upon materials and types of nest, this can prove challenging!

DISCUSSION

Ask students to observe and share which physical traits they think help different birds create their nests. "What do birds need in their habitats to be successful nest builders? How do humans positively or negatively impact this process for birds? What are impacts of litter, and other human activities on nesting habitats? How can humans support the conservation of nesting habitats? What can be done at school to support these efforts?"

Bonus. Add a discussion about how humans can build with recycled or waste materials!

Community Engagement

School grounds are unique public spaces. They are community resources that are fully occupied during the school day—but may also be used when school is not in session to enhance the well-being of residents in the local neighborhood and the surrounding community. Community members can participate in enriching, maintaining, and using school grounds for all of their possible benefits—from habitat and curriculum connections to imaginative play and mental health.

Stewardship. The process of building and sustaining green schoolyards connects communities to place, and helps to engage students, teachers, staff, parents, neighbors, businesses, nonprofits, public agencies, and others in collaborations to care for and improve their school grounds. This cooperation reinforces interdependence and local self-reliance, and builds a "sense of community" while creating useful, beautiful school environments at affordable prices. Students and members of the school and local community can help to design the school grounds and also often participate in schoolyard work days to build, plant, and maintain elements of the school grounds.[1]

Festivals and Special Events. School grounds can be venues for school-related public events that draw parents and family members further into their child's education and invite neighbors and the wider community to participate in life at school.

Joint Use. Some school grounds become part of their city's public park system after hours, providing access to green space and recreation for students and other members of the local community when school is not in session. Engaging the community on school grounds after hours is an essential benefit of green schoolyards and also helps to ensure that there will be enough hands to build them, care for them over time, and help them to survive and thrive in the years to come.

SCHOOL GROUND STEWARDSHIP

FESTIVALS AND SPECIAL EVENTS

RELATED ACTIVITIES IN OTHER CHAPTERS

© SHARON DANKS

CREATE AN INSECT HOTEL

© MARIELLE SLAGEL

AGES

3–18 years old

CONTRIBUTED BY

IPS School 60 / Butler University Laboratory School
Indianapolis, Indiana
myips.org/ipsbutlerlabschool

Insect hotels are easy-to-make homes for creatures crawling around your schoolyard. Insect hotels can be assembled using all found, recycled, or up-cycled materials. These homes provide shelter for insects including solitary bees, ladybugs, and beetles, just to name a few! These beautiful homes provide yearlong shelter for insects you want to keep in your garden, while also contributing to your local ecosystem. They can be built with students and/or during a community work day.

MATERIALS

- Collect natural materials from the school grounds and ask children to bring additional materials collected from home. For example: cork, brick, blocks of wood, bamboo, rocks, sticks, pine cones, seedpods, or cardboard.
- A wooden box or open birdhouse that has an overhanging lip to keep the elements out; any size will work.
- Strips of wood
- Wire to hang your box, or a post to mount it on (It's important for the final project to be elevated.)
- A drill and a range of drill bit sizes
- Wood glue

DIRECTIONS

Measure the depth of your insect hotel frame and cut all of your materials down to size if they are too long.

If you have a large box, nail strips of wood inside to create sections or "rooms."

Begin adding materials at the bottom of your hotel and then work your way up. Add drops of glue as you go to keep materials in place.

Use a variety of materials and sizes in different compartments to attract diverse insects and to create a visually appealing structure. Keep in mind which insects you primarily want to attract: drilling varying sizes of holes in wood attracts bees, bark can attract spiders, beetles, and centipedes, while ladybugs are attracted to sticks and leaves.

Place the insect hotel near a garden or green area that provides essential food for butterflies, bees, and other flying insects.

BOTANICAL TRADITIONS GARDEN

© CHARLENE BRIGGS

AGES

3–18+ years old

CONTRIBUTED BY

Earth Visions Consulting
Downingtown, Pennsylvania
EarthVisionsConsulting.com

This activity is based on the Botanical Traditions Course at Temple University's Ambler Campus, and describes how to convert a grassy field plot into a garden of plants traditionally used for food, medicine, and dye. The activity can be used as the basis of a single lesson or a whole semester. The perennial plants come back year after year, providing course material that requires minimal maintenance. Our garden plot is 40 ft x 85 ft (12 m x 26 m). The garden grew from a patch of grass to a 40 ft x 40 ft (12 m x 12 m) garden from June to December. Our curriculum included teaching students how to identify, grow, harvest, store, and prepare plants for food, medicine, and dye. Students also created a design for a garden at their home.

MATERIALS

- Newspapers or cardboard
- Shovels, spades, rakes
- Compost and wood chips
- Edible plants: a variety suitable for your climate
- Medicinal plants: aloe vera (warm climates), calendula, echinacea, lemon verbena, peppermint, yarrow, etc.
- Dye plants: beets, berries, bronze fennel, goldenrod, hops, indigo, marigolds, onions, purple iris, red cabbage, etc.

DIRECTIONS

Identify an unpaved plot of land on your school grounds that receives full sun. Seek permission to convert this space into a garden. If this space is covered in grass when you begin, that's fine. This technique will grow a beautiful garden directly on top of grass without the need to till and will eliminate the grass naturally.

Open a newspaper fully. This will be the size of your garden row. Lay the newspapers down on the grass or bare soil. Lay another open newspaper next to this one, overlapping about ¼ of the original newspaper with the new one.

Put 8 in – 12 in (20 cm – 30 cm) of compost on top of the newspaper row. If it is windy, ask someone to help hold down the newspapers and apply the compost as you lay the newspapers. With a straight spade, dig both edges of the newspaper into the ground at each end of the garden. Lay another row of newspapers next to the composted row and use the same technique. This second row will be for walking, so apply wood chips on top of the newspaper.

Repeat this pattern to fill your space and fulfill your planting needs. Now you are ready to install the plants. Water thoroughly and allow the compost and newspaper to absorb the water. Dig the plant starts into the compost, arranging as desired. Be careful not to pierce the newspaper.

Curriculum. We started our garden at Temple University in June, and created space for making potions, drying plants, and meeting in an outdoor classroom. I tailored my curriculum the following fall around the existing plants, based on what was growing best. Our class made a variety of plant products including: dandelion salad, calendula oil/salve, chickweed pesto, boneset tincture, dandelion vinegar, violet syrup, and slippery elm throat lozenges. We also included dye plants, and dyed fabric and yarn with marigolds, goldenrod, and black walnut hulls. Enjoy!

INSPIRATIONAL TREE MURAL

© KIZZY HANNIBAL

AGES

5–18 years old

CONTRIBUTED BY

EcoRise Youth Innovations
Austin, Texas
ecorise.org

EcoRise Youth Innovations is dedicated to empowering youth to become the change-makers of our future. This activity encourages students to beautify their shared public space through inspirational mural artwork. The mural project can creatively communicate and educate viewers about local environmental issues pertinent to your community.

MATERIALS

- An available, solid-colored wall or paved ground surface
- Projector and transparencies
- Exterior paint, paint brushes, and drop cloths

PREPARATION

Locate a suitable wall or surface and obtain the necessary permissions to add a mural. Determine any preparation the site may need, such as cleaning, adding a base coat, etc. Come up with some ideas for a mural that includes a favorite local tree or species of tree.

© GREG RAISMAN

DIRECTIONS

Open by admiring the space around you, such as natural features, landscaping, specific trees, art, places to play and interact, etc. What makes a space enjoyable? Ask students to name some of their favorite outdoor spaces.

Discuss the beautification of shared common spaces and the importance of public art. Point out that spaces that combine nature and art are often inspirational and great places to interact with other people, nature, and art. Discuss how a mural can be a wonderful addition to a space and a terrific way to communicate an important message to the public. Explain that the group is going to paint an inspirational tree mural, inspired by their ideas.

Talk about the importance of trees in our lives. "What do they provide for us? What do they provide in nature?" Share the names and images of common local trees. "What are the differences among the trees? Are some evergreen? Deciduous? Fruit bearing? Nut bearing? Native? What is the difference in their leaf shapes? How are their barks different from one another? Are they slow growing? Fast growing?" See if students can identify any of the trees nearby. Explain that one of the most effective ways to help support the environment is by planting lots of trees.

Take students to the designated mural space and discuss what shape of tree would be the best fit. Then ask the group to choose the tree they would like to paint.

Next, discuss the words, messages, and themes that students would like to include in the tree mural. Ask the group to consider what is important to this community and how the mural can help support that message. Ideas might be: loving our planet; the joy of being outdoors; the importance of taking care of nature; protecting local endangered species; etc.

Discuss color selection with the group and create a color palette and tree-based design. Seek final approval for the design with the owner of the project site. Use a projector to transfer the image onto the wall or ground. Demonstrate painting techniques and processes. Allow students to paint the tree and fill it with inspirational messages!

COLD FRAMES

© STEVE WOOD

AGES

9–18+ years old

CONTRIBUTED BY

Concrete Couch
Colorado Springs, Colorado
concretecouch.org

Cold frames integrate science, construction, and gardening, and add life and vibrancy to an outdoor space created by and made for children. These "mini-greenhouses-meet-raised-beds" can be made entirely from recycled and reused materials. With a little love and care, they can provide healthy snacks for students on a daily basis throughout the shoulder season in places like Colorado that have cold winters. Students love every part of the process: designing, building, planting, and harvesting!

MATERIALS

Look for local sources of recycled materials to find:

- 1 double-paned "slider" glass door
- 2 in (5 cm) Styrofoam insulation, at least 16 ft^2 (1.5 m^2)
- 2 hinges and 1 large screw eye bolt
- 1 heavy-duty rope (e.g. an old climbing rope)
- 4 pieces of wood for the corners: 2 in x 2 in x 2 in (5 cm x 5 cm x 5 cm)
- About 10 wooden boards, 2 in x 6 in x 5 ft (5 cm x 15 cm x 1.5 m)—any 2-by size available is sufficient
- 1 heavy, durable object made from iron or other metal

DIRECTIONS

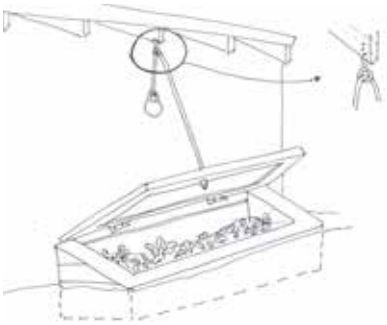
Find a suitable site facing south with ample sunlight and an overhang, nearby tree, or other stable object that can be used to tie a rope which will hold the cold frame's top open during the day.

Choose between two design styles (at right): embedded in the ground (#1) or above ground (#2). If above ground on concrete, foam insulation must be put on the bottom in order to insulate the soil from freezing temperatures. Both styles require a thermal mass to serve as the north wall of the cold frame. A concrete wall works well on the north side. If no northern thermal mass is available, the cold frame can have a Styrofoam and wood north side.

Construct the cold frame with 2 in (5 cm) foam insulation on the front and bottom, front and sides, or front, sides, and back. Create a pulley to lift the door. Hang a rope and a weight from a sturdy overhang or tie it to a stable tree nearby.

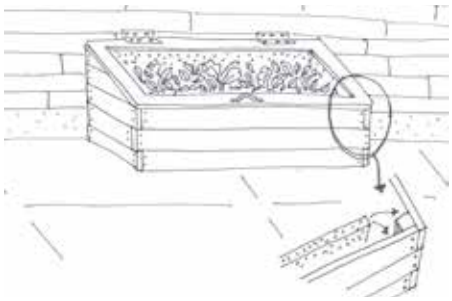
Plant seeds in early fall and early spring to harvest greens over the shoulder seasons. Open the cold frame during warm, sunny days. Close the cold frame at night when it is below freezing. Cover the cold frame with an insulated blanket during frigid winter nights and snowy days.

DESIGN #1



© KENDALL KULTGEN

DESIGN #2



FAMILY CAMPOUT IN THE SCHOOLYARD

AGES

6–18 years old

CONTRIBUTED BY

Outdoors Empowered Network
San Francisco, California
outdoorsempowered.org

This activity can be a terrific team builder for families whose children share a class or a grade level, or for an entire school community. Enjoy the sights and sounds of nighttime in your neighborhood and use this activity as a spring board for school camping trips to regional parks in your area!

MATERIALS

Tents, sleeping bags, sleeping pads, and flashlights are the most essential items. Some families might be able to provide their own gear. Others may not have tents, sleeping bags or other equipment. Camping gear can be borrowed from gear libraries in a small but growing number of cities (see: http://bit.ly/OENetwork) and many outdoor gear shops have rental programs.

It's very helpful to have somewhere to cook outside in the schoolyard, and if possible, a place to gather around a camp fire. If you have an existing outdoor oven or fire pit on school grounds, that's a wonderful place to cook and share a meal. If not, other options include a portable steel "fire pit", portable camping stoves, or BBQ grills (which encourage parents to get involved). Be sure to obtain proper permission from your school district to cook outside during your campout. Invite the local fire department to join you if you need help setting up and managing a temporary fire pit.

Food to share for dinner and breakfast (e.g. potluck style)

DIRECTIONS

Pick a date: fall or spring is best. You may want to start with a spring event and move it to the fall once you've built a tradition people are looking forward to!

Obtain permission from the school district for staff, students, and their families to be onsite overnight. Because your campout is at school, you probably won't need the same "field trip" form that you use to leave the site.

Advertise your event. Notify families about the campout as far in advance as possible to build excitement. Send multiple announcements and encourage attendance by announcing a BBQ dinner and s'mores.

Ask for RSVPs that include whether families have their own gear. Arrange to borrow and pick up the camping equipment for families in your school community that don't have tents, sleeping bags, etc. If you live in a city that has an Outdoors Empowered Network member organization, inquire about the camping training sessions they offer and gear library access, since their gear can be borrowed for FREE. Some local outdoor specialty stores may also be willing to rent/loan gear. http://bit.ly/GearCommons also loans tents through a peer-to-peer gear sharing program.

Recruit volunteers who can arrive early on the day of the event to help set up the camp site and assist families with their tents. Serve dinner after the group is settled. After dinner, roast marshmallows and make s'mores if you can, since this is an activity that is guaranteed to be popular. Let the kids play with their flashlights and get their teeth brushed, then make time for storytelling around the fire, as this is a great way to settle the kids down. Stargazing might be possible, and is a terrific tie-in to science curriculum. After kids are off to bed, parents can spend more time getting to know one another in an informal setting.

In the morning, serve breakfast and include everyone in clean up activities. Be sure to leave time for taking down the tents. Wet tents will need to dry before they are stored.

HAPPY BIRTHDAY, EARTH!

AGES

0–8 years old

CONTRIBUTED BY

Tinkergarten
Northampton, Massachusetts
tinkergarten.com

Through the ages, many cultures have looked at springtime as the Earth's birthday, celebrating this time of rebirth and renewal. It's no surprise that the people who started Earth Day chose this time of year! This activity uses the idea of the Earth's birthday to create a marvelous play scenario. Young children move effortlessly between reality and fantasy so it is an easy leap to personify our Earth and throw the planet a party. By doing so, you can activate imaginations, build in a sense of empathy, and a greater, more personal connection to the natural world. And to kids, the creative mess-making and pretend play are just a good old time!

DIRECTIONS

Plant the seeds. Ask kids about which season it is. Talk about how spring looks in your community. Talk about how the Earth is starting over into a new year... just like we do when it's our birthdays.

Let's have a party. Suggest, "Hey, do you think we should throw a birthday party for the Earth? What would the Earth want at its party? What do you like about birthday parties?"

Whip up treats. Set up an impromptu outdoor kitchen and start making mud pies, cakes, and stone soup. Sticks make easy candles and, since the Earth is so old, you can just use a few.

Decorate for the party. Sticks can be laid out to make a dining table. Wildflowers and dandelions make lovely centerpieces. String up twine to make a nature curtain. Note: We say that objects that are "found on the ground" can be used for play (e.g. leaves, sticks, bark). Objects still on a growing plant are needed by that plant and are not for our play.

What could be our present? If you have children over 3 with you, wonder together about what might be a present worthy of our planet Earth. Some of our favorites have included lovely nature displays, trash cleaned up from the park and ready to recycle, and pledges to care for the planet.

Feast and sing. Do a little clean up. Then, have a feast, pretending to savor your nature treats and nibbling on real treats that you've packed.

Talk about what makes our planet Earth such an amazing home. Sing the Earth Happy Birthday. Do whatever kids want to do to make this a party worthy of our planet.

Contributing Organizations

The *Living Schoolyard Activity Guide* is the result of a fruitful collaboration between Green Schoolyards America and 122 other organizations across the United States, who each contributed a school ground activity that reflects their own organization's mission, programs, and areas of expertise. The diversity of ideas they shared will now enrich school ground programs across the country and around the world. We greatly appreciate everyone's participation and extend our sincere and heartfelt thanks to this wonderful community of colleagues.

Source, both maps: Google My Maps. Map data ©2018 Google, INEGI

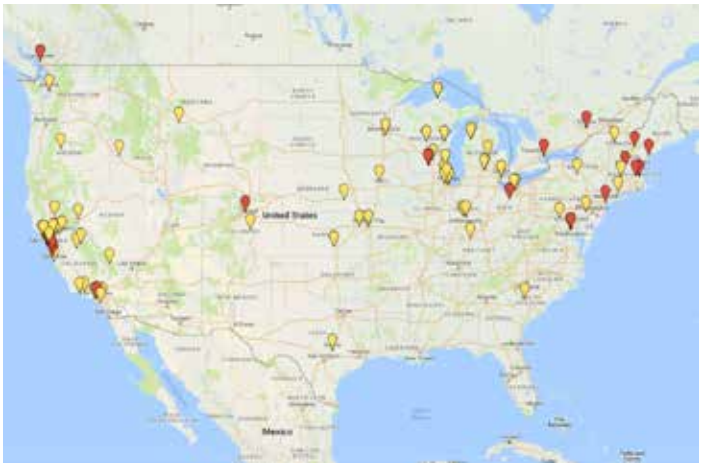
Organizations from the United States that contributed their ideas to the ***Living Schoolyard Activity Guide,*** are shown with yellow markers on the maps.

Organizations from around the world that contributed their ideas to the companion publication, the ***International School Grounds Month Activity Guide***, are shown with red markers on the maps.

Authors around the world!

The map above shows the fantastic geographic diversity of author-organizations that have contributed activities to this book. It also includes the locations of author-organizations from the companion guide in this set, produced by our colleagues at the International School Grounds Alliance (see map detail, right). This is truly a global movement!

Do you see your state or country on the map? If your organization helps schools use their grounds to their fullest, we'd love to include you in the next edition! Please contact us to find out more about how to submit an activity: **info@greenschoolyards.org**



Aldo Leopold Nature Center
Monona, Wisconsin
aldoleopoldnaturecenter.org

All Our Kin
New Haven, Connecticut
allourkin.org

American Heart Association
Los Angeles, California
heart.org

Avon Outdoor Learning Center
Avon, Indiana
avon-schools.org

Bay Tree Design, inc.
Berkeley, California
baytreedesign.com

Berkeley Public School
Gardening and Cooking Program
Berkeley, California
berkeleyschools.net/gcp

Boise Urban Garden School
Boise, Idaho
boiseurbangardenschool.org

Dr. Herb Broda
Ashland University
Ashland, Ohio
movingtheclassroomoutdoors.com

California Academy of Sciences
San Francisco, California
calacademy.org/educators

California Coastal Commission
San Francisco, California
coastal.ca.gov/publiced

California Native Plant Society
Sacramento, California
cnps.org

California State University, Chico
Chico, California
csuchico.edu/cmse

CalRecycle
Sacramento, California
californiaeei.org

Calypso Farm and Ecology Center
Fairbanks, Alaska
calypsofarm.org

Canopy
Palo Alto, California
canopy.org

Center for Cities + Schools
University of California, Berkeley
Berkeley, California
y-plan.berkeley.edu

Center for Land-Based Learning
Winters, California
landbasedlearning.org

Center for Regenerative Agriculture
Ojai, California
ojaicra.org

Central Valley Joint Venture
Sacramento, California
centralvalleyjointventure.org

Joan Chadde, Michigan Tech Center for
Science and Environmental Outreach
Houghton, Michigan
wupcenter.mtu.edu

The Chicago Academy of Sciences
Peggy Notebaert Nature Museum
Chicago, Illinois
naturemuseum.org/education

Chicago Botanic Garden
Lake Forest, Illinois
chicagobotanic.org

Children's Forest of Central Oregon
Bend, Oregon
childrensforestco.org

Chino Basin Water Conservation District
Montclair, California
cbwcd.org

Collaborative for High Performance Schools
Sacramento, California
chps.net

Community Alliance with Family Farmers
Davis, California
caff.org

Community GroundWorks
Madison, Wisconsin
communitygroundworks.org

Community Nature Connection
Los Angeles, California
communitynatureconnection.org

Concrete Couch
Colorado Springs, Colorado
concretecouch.org

Death Valley National Park
Death Valley, California
nps.gov/deva

Desert Research Institute
Reno, Nevada
sciencealive.dri.edu

Earth Partnership, University of Wisconsin-Madison Arboretum
Madison, Wisconsin
arboretum.wisc.edu/learn/eps

Earth Visions Consulting
Downingtown, Pennsylvania
EarthVisionsConsulting.com

EcoRise Youth Innovations
Austin, Texas
ecorise.org

The Edible Schoolyard
Berkeley, California
edibleschoolyard.org

Education Outside
San Francisco, California
educationoutside.org

Eisenhower High School
Goddard, Kansas
ehs.goddardusd.com

The Energy Coalition
Irvine, California
energycoalition.org

Ayesha Ercelawn
La Scuola International School
San Francisco, California
lascuolasf.org

Evergreen Elementary School
Rohnert Park, California
crpusd.schoolwires.net/evergreen

Explore Ecology
Santa Barbara, California
exploreecology.org

Felicitas' Family Child Care
New Haven, Connecticut
facebook.com/felicitasfamilychildcare

Full Option Science System (FOSS)
Berkeley, California
fossweb.com

Golestan Colab
Berkeley, California
golestankids.com/colab

Green and Healthy Schools Wisconsin
Madison, Wisconsin
ghswisconsin.org

The Greening of Detroit
Detroit, Michigan
greeningofdetroit.com

Green Schools Initiative
Berkeley, California
greenschools.net

Green Schoolyards America
Berkeley, California
greenschoolyards.org

Grow Your Lunch, LLC
San Francisco, California
growyourlunch.com

Hidden Villa
Los Altos Hills, California
hiddenvilla.org

The Huntington Library, Art Collections and Botanical Gardens
San Marino, California
huntington.org

IPS School 60 / Butler University Lab School
Indianapolis, Indiana
myips.org/ipsbutlerlabschool

Ithaca Children's Garden
Ithaca, New York
ithacachildrensgarden.org

Jim Hall Foothills Learning Center, City of Boise
Boise, Idaho
bee.cityofboise.org

Kansas Association for Conservation and Environmental Education
Manhattan, Kansas
kacee.org

KidsGardening.org
Burlington, Vermont
kidsgardening.org

Lake Erie Nature and Science Center
Bay Village, Ohio
LENSC.org

Lake View Elementary School
Madison, Wisconsin
lakeview.madison.k12.wi.us

Rachel A. Larimore Consulting
Midland, Michigan
rachel-larimore.com

Latino Outdoors
Capitola, California
latinooutdoors.org

Lawrence Hall of Science, UC Berkeley
Berkeley, California
outdoorbiology.com

LEAF - Wisconsin's K-12 Forestry Education Program
Stevens Point, Wisconsin
leafprogram.org

Learning by Nature
Bozeman, Montana
learningbynature.org

Life Lab
Santa Cruz, California
lifelab.org

Living Classroom
Los Altos, California
living-classroom.org

Lombard School District 44, Hammerschmidt Elementary, Learn + Play Gardens
Chicago, Illinois
whslearnandplaygardens.org

Los Angeles Unified School District Office of Outdoor and Environmental Education
Los Angeles, California
outdooreducation.org

Louisville Nature Center
Louisville, Kentucky
louisvillenaturecenter.org

Mary Michaud
Van Hise Elementary School
Madison, Wisconsin
vhgarden.wordpress.com

Michigan Department of Natural Resources
Lansing, Michigan
michigan.gov/natureprograms

Michigan Project Learning Tree
Traverse City, Michigan
michiganplt.org

MIG, Inc.
Berkeley, California
migcom.com

Mills College Children's School
Oakland, California
millscollegechildrensschool.org

Mississippi National River and Recreation Area
St. Paul, Minnesota
nps.gov/miss

Monterey Bay Aquarium
Monterey, California
montereybayaquarium.org

National Wildlife Federation, Schoolyard Habitats®
Midpines, California
nwf.org/california

NatureBridge
San Francisco, California
naturebridge.org

Nature Explore
Lincoln, Nebraska
natureexplore.org

Nature Kids Institute
Orangeville, California
naturekidsinstitute.org

Nature Net
Monona, Wisconsin
naturenet.com

Nature's Voices
Berkeley, California
naturesvoices.org

New Horizon School
Pasadena, California
newhorizonschool.org

NEXT.cc
Milwaukee, Wisconsin
NEXT.cc

NoVA Outside
Arlington, Virginia
novaoutside.org

OAK Learning Center at the Bay Beach Wildlife Sanctuary
Green Bay, Wisconsin
baybeachwildlife.com/kindergarten

Occidental Arts and Ecology Center
Occidental, California
oaec.org

Openlands
Chicago, Illinois
openlands.org

The Organic Gardener Ltd.
Highland Park, Illinois
theorganicgardener.net

OUT There Adventures
Seattle, Washington
outthereadventures.org

Outdoors Empowered Network
San Francisco, California
outdoorsempowered.org

Phoebe A. Hearst Fine Arts Magnet School
Chicago, Illinois
hearst.cps.edu

Pili's Day Care
New Haven, Connecticut
facebook.com/pilisdaycare

Playworks
Oakland, California
playworks.org

Prairie Crossing Charter School
Grayslake, Illinois
prairiecrossingcharterschool.org

The Presidio Trust
San Francisco, California
presidio.gov

Project Central
Kansas City, Kansas
projcentral.co

Project F.I.S.H.
East Lansing, Michigan
projectfish.org

Public Health Madison and Dane County
Madison, Wisconsin
publichealthmdc.com

Rahus Institute Solar Schoolhouse
Sebastopol, California
solarschoolhouse.org

REAL School Gardens
Washington, D.C.
realschoolgardens.org

Sacramento City Unified School District
Sacramento, California
scusd.edu/project-green-programs

San Francisco Botanical Garden
San Francisco, California
sfbotanicalgarden.org

San Francisco Public Utilities Commission
San Francisco, California
sfwater.org

San Francisco Unified School District
San Francisco, California
sfusdscience.org/environmental-science-center

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University of California, Berkeley
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Slide Ranch
Muir Beach, California
slideranch.org

Sandi Snyder
Big Pool, Maryland

South Carolina Green Step Schools
Columbia, South Carolina
greenstepschools.com

StopWaste
Alameda County, California
stopwaste.org

Tinkergarten
Northampton, Massachusetts
tinkergarten.com

TreePeople
Beverly Hills, California
treepeople.org

Trinity Gardens
Santa Barbara, California
trinitygardenssb.org

Susan Trull
Ottawa National Forest
Houghton, Michigan
wupcenter.mtu.edu

The Trust for Public Land
San Francisco, California
tpl.org

University of California, Blake Garden
Kensington, California
blakegarden.ced.berkeley.edu

U.S. Fish and Wildlife Service
Sacramento, California
fws.gov

Waldorf School of the Peninsula
Los Altos, California
waldorfpeninsula.org

The Watershed Project
Richmond, California
thewatershedproject.org

Wisconsin Green Schools Network
Columbus, Wisconsin
wisconsingreenschoolsnetwork.org

Wisconsin K-12 Energy Education Program (KEEP)
Stevens Point, Wisconsin
KEEPprogram.org

Yosemite National Park
Education Office
Wawona, California
nps.gov/yose/learn/education

Zach Pine Nature Sculpture
Kensington, California
naturesculpture.com

Index

INDEX BY SUBJECT

INDEX BY AGE GROUP

INDEX OF CONTRIBUTING AUTHORS / ORGANIZATIONS

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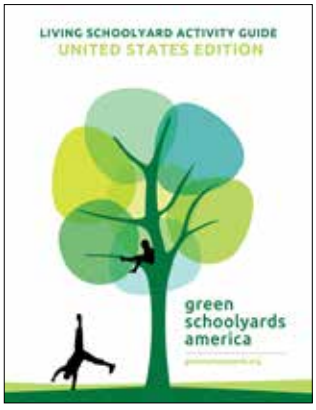
Companion Publications

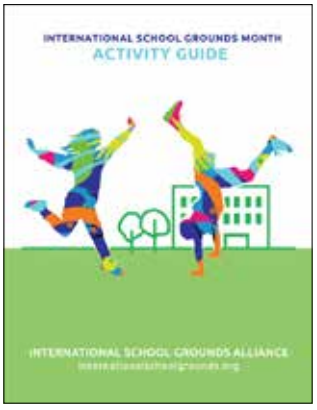
We hope you enjoyed the *Living Schoolyard Activity Guide*! We also invite you to download a free copy of the *International School Grounds Month Activity Guide*, a companion book in this set, produced by our partners at the International School Grounds Alliance. This *Guide* shares the same format and includes additional school ground activities from organizations around the world.

Green Schoolyards America's *Living Schoolyard Activity Guide* includes 131 ideas for year-round school ground activities, written by 122 organizations from across the United States.

The *International School Grounds Month Activity Guide* includes an additional 104 ideas for use outdoors in May, written by 73 organizations from 27 countries. It is published by the International School Grounds Alliance (ISGA) and was produced and edited by Green Schoolyards America in collaboration with our ISGA colleagues.

Together these two publications include a total of 235 outdoor activities written by 187 organizations! We hope the wide variety of geographic and cultural contexts in this set of *Activity Guides* will support your work anywhere in the world—during the month of May and year round. We encourage our readers to download and try activities from both books in this free set.





Now in Czech and Chinese! Both of the school ground ***Activity Guides*** are available on our websites in English. The international edition is also available in Czech and Chinese!

Green Schoolyards America

Living Schoolyard Activity Guide
greenschoolyards.org

International School Grounds Alliance

International School Grounds Month Activity Guide
internationalschoolgrounds.org

Green Schoolyards America

Green Schoolyards America is a national organization that inspires and enables communities to enrich their school grounds and use them to improve children's well-being, learning, and play; while contributing to the ecological health and resilience of their cities. We believe that all children have a right to go to school in vibrant, park-like environments that help them develop their curiosity, their sense of adventure, a healthy lifestyle, and an understanding of their own ability to be changemakers in the world. Our programs are designed to change the norm for school ground design and use, so that all children and youth will have access to the natural world, every day, right outside the classroom door. Our work includes:

Research. We conduct research that connects children's well-being and academic achievement to the ecological health of their school ground and neighborhood environments.

Policy. We advocate for policies that enable school grounds to become dynamic, multi-use, nature-filled public spaces that improve the well-being of children and the environment at the same time.

Support. We partner with school districts, public agencies, and other colleagues to develop city- and state-wide living school ground initiatives. We also offer public presentations, professional development, and publications.

We invite like-minded professionals and organizations to partner with us to nurture and grow the national and international movements to green school grounds for all children.

Resources for greening your schoolyard

- Subscribe to our newsletter: **bit.ly/GSA-SignUp**
- Visit our online resource library: **bit.ly/GSAlibrary**
- Read *Asphalt to Ecosystems*, by our CEO, Sharon Danks, for inspiring examples of green schoolyards around the world. Available from your local library or New Village Press: **bit.ly/DanksA2E**
- Join our Facebook page: **bit.ly/GSAFBk1**
- Follow our LinkedIn page: **bit.ly/GSALI**
- Encourage your city government and school district to adopt a Living Schoolyard resolution: **bit.ly/CaACR128**
- Please contact us at **info@greenschoolyards.org** if you'd like to bring living schoolyards to your school district or region.

Green Schoolyards America is fiscally sponsored by Earth Island Institute, a 501(c)(3) corporation.

IMAGINE. In one corner of the schoolyard, a small group of children play together at the edge of a puddle, learning about the water and its inhabitants, stretching their creativity, and building friendships. In another, a teacher supervises as students collect natural materials, improving their fine motor and numeracy skills as they arrange their treasures in patterns. Across the yard, older youth are running and jumping, testing, and growing the limits of their physical abilities, then sitting quietly under a tree, reflecting and releasing the stress of the day. After school, a family or community group uses the grounds for a performance and a party—celebrating their community in a space that they helped to envision, create, and maintain.

This is the spirit of the green schoolyard movement and the vision that many schools embrace when they transform their traditional asphalt- and grass-covered grounds into environments that feel more like parks. This *Activity Guide*, developed with written contributions from organizations across the United States, provides an introduction on how to enrich and use school grounds to create curriculum connections, foster community engagement, and improve the health and well-being of children and the environment.

This book was developed in honor of the annual May celebrations of International School Grounds Month and California's Living Schoolyard Month. We hope the ideas in these pages will encourage your school to take students outdoors regularly and to use your school grounds to their fullest year-round. A companion *Activity Guide* with additional school ground ideas, published by our colleagues at the International School Grounds Alliance, is also available for free on our website.

Come alive outside!

green schoolyards america

greenschoolyards.org