Schoolyard Habitat Resource Guide for K-6 Educators

Lessons and activities designed for grades K-6 to enhance outdoor learning experiences on school grounds

Audubon Society of Rhode Island

schoolyard habitat program

U.S. FISH & WILDLIFE SERVICE
DEPARTMENT OF THE INTERIOR

Schoolyard Habitat Resource Guide

Introduction

The U.S. Fish & Wildlife Service (the Service) and the Audubon Society of Rhode Island have been working in collaboration to promote and support the development of schoolyard habitats in Rhode Island. The Service's Schoolyard Habitat Project Guide provides planning teams with the guidance, resources and ideas to undertake and complete successful schoolyard habitat projects. To supplement the project planning guide, Audubon Society of Rhode Island educators have developed this comprehensive resource guide for teachers, parents and after school providers to encourage outdoor learning for students in grades K – 6.

This publication includes age-appropriate, interactive activities linked to science, as well as language arts, math, art and physical education. Each activity page identifies the objectives and the NGSS standards and Cross-curricular Connections pertaining to the investigation, project or game. Vocabulary, age-level, time frame and materials are clearly listed and the corresponding scavenger hunts and data sheets are embedded in the activity.

Helpful tips for teaching outdoors and safety guidelines can be found at the beginning of the guide followed by the nature activities and nature games. Following the activities, you will find a suggested list of science tools that are helpful for schoolyard investigations and an extensive list of resources, including citizen science projects, field guides and children's literature.

4 GREAT REASONS FOR LEARNING IN SCHOOLYARD HABITATS

- Schoolyard habitats promote academic achievement through hands-on, experiential learning and by enhancing the cognitive and emotional processes important for learning.
- Natural areas promote child-directed free play that is imaginative, constructive, sensory-rich and cooperative.
- Schoolyard habitats can enhance mental health and well-being and promote social-emotional skill development.
- Schoolyard habitats can promote physical activity by offering a variety of active play options that engage children of varying fitness levels, ages and genders.

Need more reasons to share with others? The Children & Nature Network has excellent research-based tools available for free on their website: childrenandnature.org/resources.

U.S. Fish and Wildlife Service

The mission of the U.S. Fish and Wildlife Service (the Service) is to work with others to conserve, protect, and enhance fish, wildlife, plants, and their habitats for the continuing benefit of the American people. The Service is a leader and trusted partner in fish and wildlife conservation, known for scientific excellence, stewardship of lands and natural resources, dedicated professionals, and commitment to public service. Through the Schoolyard Habitat Program, the Service works to connect children with nature by helping teachers and students create wildlife habitat on their school grounds. Typical projects include wetlands, meadows, forests, and variations based on specific eco-regions. Many projects are planned through multiple phases and change over time as children from various classes build upon the existing work of past students. Schoolyard Habitat projects give every student a chance to observe, learn from, and experience nature. To learn more about the Service and the Schoolyard Habitat Program in the northeast, please visit their website at: https://www.fws.gov/northeast/cpwn/schoolyardhabitat.html

Audubon Society of Rhode Island

Audubon Society of Rhode Island

The mission of the Audubon Society of Rhode Island is to protect birds, other wildlife and their habitats through conservation, education and advocacy for the benefit of people and all living things. Audubon protects more than 9,500 acres of land throughout Rhode Island and southeastern Massachusetts; serves 22,000 people annually through its high-quality education programs; and is actively engaged in developing and advocating for sound environmental legislation and regulation in the state. As a partner in the USFW Schoolyard Habitat Program in Rhode Island, Audubon works alongside USFW biologists, school administrators, teachers, students and community volunteers to plan and create outdoor wildlife habitats and learning spaces. Audubon provides professional development for teachers on the best practices teaching outdoors and the opportunities for linking outdoor activities to classroom learning. This Schoolyard Habitat Resource Guide was developed by Audubon educators to provide activities, resources and encouragement for teachers to bring students outside to explore, discover and learn.

To learn more about Audubon in Rhode Island go to our website: www.asri.org.

Engage your students and enhance your classroom curriculum with Audubon programs and animal ambassadors. We offer field trips, schoolyard and classroom programs, as well as virtual and video options. Home school programming and summer camps are also available.

We would like to recognize the U.S. Fish & Wildlife's Schoolyard Habitat Project Guide and Audubon Connecticut's Schoolyard Habitat Curriculum Guide as other excellent resources for outdoor learning and developing green schoolyard spaces.

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TIPS FOR TEACHING OUTDOORS

Positive Attitude, Enthusiasm, Respect, Adaptability

The outdoors is a natural classroom where teaching and learning can be enriched through diverse experiences. Here are a few strategies to help you have a successful teaching experience in your outdoor classroom.

- Model the behavior you expect. Show enthusiasm and excitement for the outdoors and all its inhabitants – enthusiasm is contagious. Try to put aside your fears or anxieties about the outdoors.
- Prepare students ahead of time for going outside. What is the weather going to be? What should they wear so they are comfortable? What shoes are appropriate?
- Make a checklist of standard equipment, such as clipboards, pens/pencils, first aid kit, magnifiers, bug boxes, field guides, phone, bug spray, sunscreen, Kleenex etc. Put students in charge of checking the list and carrying the equipment.
- Establish a routine for outdoor study. Leave by the same "science" door every time.
- Establish the safety rules. Include a regular tick check at the end of the activity.
- Encourage students to "do no harm" to the plants and animals outside.
- Start by gathering in a circle to review focus questions, investigation directions and materials.
- Set a home base where students should gather when summoned. Create a signal to gather the group together at home base.
- Set clear boundaries for the investigation, both in terms of physical space and time.
- When you address the group, note where the sun is and position yourself so that you face it, so students can see you.
- When leading a group down a trail, stop and step back to the middle of the group in order to talk.
- Partner students in groups of two or four to conduct investigations.
- Circulate among the groups to encourage their learning.
- It is *OKAY* not to know what something is. Say so. Encourage observation and inquiry. Discover things about the object together. Look it up later.
- Give students time to listen and observe on their own.
- Begin questioning when everyone is ready. Gear questions to the age and developmental level of the group. Include both open-ended and closed questions.
- Be flexible. Change your schedule to match the energy and interest level of the group.
- Watch for the unexpected "teachable moment". Nature is full of surprises!
- Go outside in every season.

Have Fun!

Safety

Poison Ivy

Poison ivy occurs in many forms. In early spring the new growth of poison ivy is usually greenish-red and very shiny. The short plants on the ground do not look particularly threatening and many people will walk right through a large collection of plants without realizing it. Their shoes, socks, and pant legs, exposed to the plant oils, may now cause an itchy reaction in some individuals. Later in the season, poison ivy turns a rich green color, bearing its leaves in a group of three. The leaves may or may not be shiny and may be either smooth or ragged along the edge of the leaf. An important note to consider is that poison ivy, being a vine, readily climbs on stone walls, posts and neighboring trees – be careful what you lean or sit on. The climbing growth of poison ivy is reddish-brown when young, gray when older. The older growth may be covered with projections, which look just like red hair. These hairs are a positive clue should you need to identify a climbing vine. Later in the season, poison ivy leaves turn beautiful shades of yellow and red. Beware! In winter, the vines will bear gray berries that are an excellent wildlife food. Remember that all parts of a poison ivy plant can cause you to itch – leaves, stems, berries, roots and hairs.

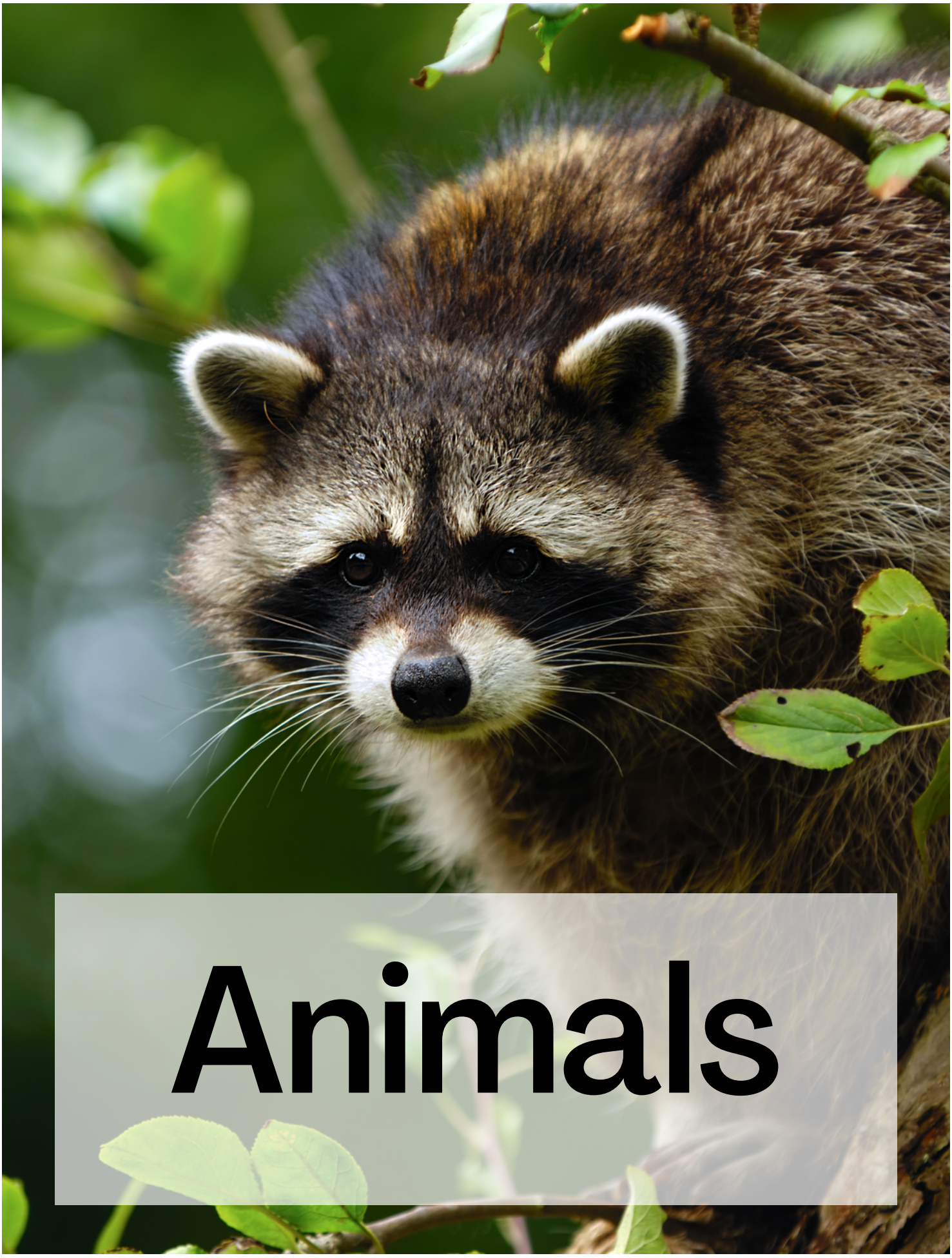
A little poem to help students identify poison ivy:
Leaves of three, let it be.
Hairy rope, Nope!

Ticks

Ticks are generally found in a wooded habitat near the ground. They may be active during any month, but late spring to early summer, and fall are seasons of high risk. When entering an area that may have ticks, one way to avoid them attaching to an individual is to tuck long, light-colored pants into socks. This way any ticks are easily seen. After being in an area where ticks may live, it is important to do a tick check. Remove imbedded ticks promptly. Grasp the tick at the point of entry (head) and pull back steadily using tweezers. Avoid squeezing the body. Swab the site with antiseptic when it is removed.

Deer tick adults and nymphs may carry Lyme disease, babesiosis and ehrlichiosis. If you suspect you have Lyme disease, see your doctor. Symptoms vary, but may include flu, headache, joint aches and/or a circular reddish rash. American dog ticks have not been shown to carry these diseases.

For more information visit the University of Rhode Island's Tick Encounter, https://tickencounter.org/.



Animals

A Bug's Life

Grades K - 3

Objectives:

Students will be able to

- give an example of an animal that has a simple life cycle
- describe what happens in complete and simple metamorphosis
- name animals that go through a metamorphosis
- describe the stages in an insect's life cycle

Vocabulary: life cycle, egg, larva, pupa, adult, nymph, metamorphosis

Age Level: Grades K-3

Time Allotted: 30 - 45 minutes

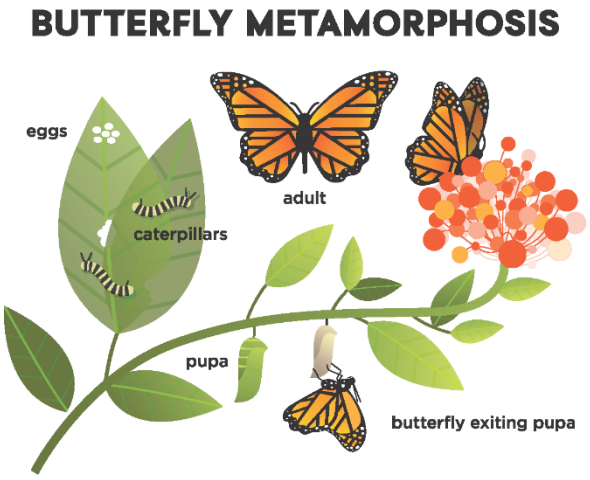
Standards Addressed:

Disciplinary Core Ideas: LS1.A, LS1.B, LS4.C, LS4.D, LS3.A, LS3.B

Cross-Cutting Concepts: Patterns, Cause and Effect, Systems and System Models

Cross-curricular Connections:

Math, Language Arts



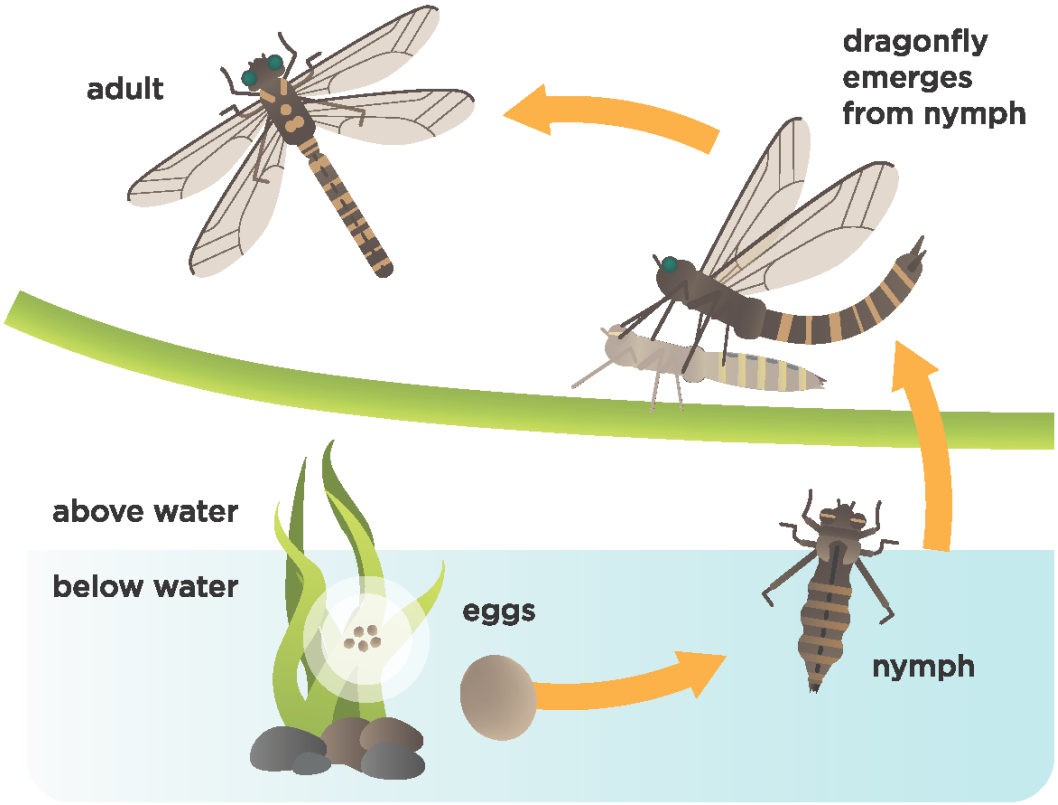
Materials:

- magnifying lenses & bug boxes
- simple field guides for insects
- diagram of life cycle of a butterfly and/or a frog
- diagram of life cycle of a grasshopper or dragonfly
- pictures of common mammals and birds as adults and as babies
- copies of the *Life Cycle Clues Scavenger Hunt* (included)
- clipboards
- pencils or crayons

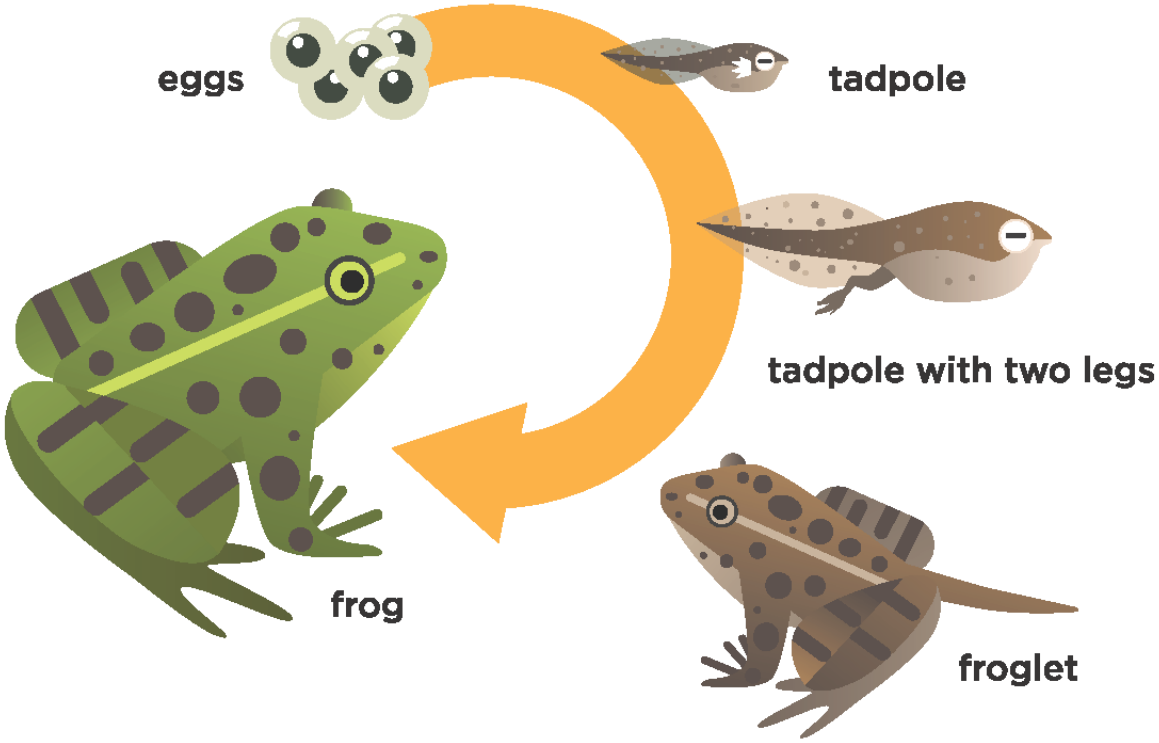
Discussion

1. What is a life cycle?
    - All animals have life cycles, meaning they change as they grow.
2. How do people change as they grow?
3. Name a familiar mammal or bird. How does it change as it grows?
    - Mammals and birds have simple life cycles, meaning the young mammals and birds look like smaller versions of the adults. Share pictures of young and adult animals.
4. Can you think of a young animal that does not look anything like the adult?
    - Some animals have life cycles that are more complex (insects, amphibians and others).
5. Show butterfly life cycle diagram.
    - What kind of an animal is a butterfly?
6. What is the evidence that butterflies are insects?
    - Insects have six legs, three body parts, an exoskeleton, and features like wings & antennae.
7. Review the stages of the butterfly life cycle, which is an example of **COMPLETE metamorphosis**.
    - In complete metamorphosis, there are four growth stages: egg, larva, pupa, and adult.
    - Many insects, such as mosquitoes, bees, fireflies, ladybugs, ants, and most beetles go through a complete metamorphosis.
8. Show grasshopper life cycle diagram. What is different about this insect's life cycle compared to the butterfly's life cycle?
    - **SIMPLE metamorphosis**, also known as gradual or incomplete metamorphosis, has three stages: egg, nymph, and adult.
    - Grasshoppers, praying mantises, cicadas and dragonflies go through simple metamorphosis. These insects do not go through the **pupa**, or resting, stage.

DRAGONFLY METAMORPHOSIS



FROG METAMORPHOSIS



Activity 1: Life Cycle Boogie

With the younger students: A good way to remember a concept is to act it out!

1. Here are some actions for the *Life Cycle Boogie*:
    a. egg – curl up in ball
    b. larva – munch and crawl and munch and crawl
    c. pupa – stick feet to ground and shed skin, then stand still like a statue
    d. adult – fly around
2. Try doing the boogie in slow motion, very quickly, or backwards.
3. Can you make up actions for simple metamorphosis?

Activity 2: Outdoor Investigation

1. Get ready to go on a walk in the schoolyard to look for insects and evidence of different life cycle stages.
    - Bring bug boxes, magnifiers and/or field guides if available.
    - Hand out the *Life Cycle Clues Scavenger Hunt*, a clipboard and a pencil to each small group. This will give students ideas of what evidence to look for and a way to keep track of what they find.
    - Set boundaries and time limit.
2. Where should we look for insects or evidence of insect life cycles?
    - Trees, bushes, cracks in the sidewalk, under logs and the edges of the school building are some ideas.
3. Can you make a prediction about where you will find the most insects? The fewest insects? INVESTIGATE!
4. Document evidence with notes, drawings and/or photos.
5. Count how many ants, grasshoppers, butterflies, etc. that you find.
6. Share what you find with others. Back in the classroom, graph the data collected.
    - How many different species did you find?
    - What was the most common insect?
    - How many life cycle stages did we find?

Extensions

Language Arts Extensions

- Write a short story from the perspective of an insect that goes through simple metamorphosis and then as an insect that goes through complete metamorphosis.
- Have insect related stories and non-fiction books available in the classroom. Ideas:
  - *Life Cycles* the series by Donna Schaffer (includes books on pill bugs, millipedes, painted lady butterflies, etc.)
  - Usborne *Mysteries and Marvels of Insect Life* by Dr. Jennifer Owen
  - *My Monarch Journal* by Connie Muther (includes a teacher's guide)
  - *Ladybug on Orchard Avenue* by Kathleen Weidner Zoehfeld (this is part of the *Smithsonian Backyard Series*)

Scientific Inquiry Extension

If *egg cases* or *pupae* are found on the hike:

- Observe the eggs or pupae weekly and record observations in science journals. What factors might have led the adult to lay eggs in that spot? Or the larvae to choose that spot to pupate?
- Use field guides to try to figure out who laid the eggs or who will emerge from the pupae. Then research the animal to learn more about its natural history.
- Try to predict how long until the eggs hatch or the adults emerge.
- Mark the spot outside to let other students know there is something interesting to see.
- Create posters to share research with others.

Life Cycle Clues Scavenger Hunt

Can you find any of the stages in these insects' life cycles?

In the GRASS/ GARDEN:

wooly bear caterpillar
larva of Isabella moth

grasshopper
nymph

honey bee
adult

milkweed bug
nymph & adult

praying mantis
egg case

sulfur butterfly
adult

dragonfly
adult

goldenrod gall
egg case

ant
adult

swallowtail butterfly
chrysalis
pupa

ladybug
larva

monarch caterpillar
larva

On the TREES:

tussock moth cocoon
pupa

bark beetle tunnels and exit holes
egg *tunnel in middle,* ***larva*** *tunnels off to the sides,* ***adult*** *exit holes*

forest tent caterpillar
larva

eastern tent caterpillar
larva

gypsy moth caterpillar
larva

How many EGGS did you find? _____

How many LARVAE did you find? _____

How many PUPAE did you find? _____

How many ADULTS did you find? _____

How many NYMPHS did you find? _____

Pollinator All-Stars

Grades K – 4

Objectives:

Students will be able to

- describe the life cycle of a plant
- explain pollination and why it is important in a plant's life cycle
- list some animals who are pollinators
- compare themselves to some of the animal athletes that are super pollinators

Vocabulary: life cycle, pollination, pollen, stamen, pistil, seed, fruit

Age Level: Grades K - 4

Time Allotted: 25 minutes initially, plus 10-minute follow-up trips outside if time permits

Standards Addressed:

Disciplinary Core Ideas: ESS3.A, LS1.A, LS1.D, LS2.A, LS4.D

Cross-cutting Concepts: Structure and Function, Patterns, Cause and Effect, Systems and System Models

Cross-curricular Connections:

Math, Art, Physical Education

Materials:

- magnifying lenses
- plant life cycle diagram
- parts of a flower diagram
- pictures of different kinds of flowers
- fun foam or poster board to make 5 – 10 large flower models
- petal pattern to trace (based on grade level)
- scissors & glue
- pencils and markers or crayons
- 10 – 20 small rectangles of sticky backed Velcro (the stiff side, not the soft side)
- 10 – 20 yellow felt/ pom-poms to be pollen pieces
- stopwatch
- science journals & pencils

Discussion

The diagrams and photos will be useful for the discussion.

1. Why do plants have flowers?
    - Flowers are where the seeds are produced.
    - Seeds grow into new plants.
2. What's in a seed?
    - A seed is made up of a tiny plant embryo and some stored food all contained within a protective coat.
    - Larger plants, like trees and shrubs, also produce seeds, often hidden inside tasty fruits and nuts.
3. What are the stages of a plant's life cycle?
    - Seed, germination, growth, flowering, pollination, seed development
    - Act it out!
4. Look at pictures of flowers.
    - What structures do you see?
    - Compare your picture with the diagram of the parts of a flower. Can you find all the parts?
    - Can you find the **stamen?**
    - On the stamen can you find the **pollen**? It is often yellow and looks like dust on the flower.
    - To make seeds, plants need pollen from one flower to reach the **pistil** of another flower. Try to find the pistil on your flower.
    - You'll look for these structures on flowers growing outside.
5. Flowers often depend on animals to carry pollen from one flower to the next. Can you name some pollinators?
    - Bees, hummingbirds, butterflies, moths, beetles, flies, bats are examples.
    - The pollinators get sugary, high-energy nectar and sometimes some pollen in exchange for helping the plant transport pollen from flower to flower.

Activity 1: Preparing Flower Models

1. Work together to make large models of flowers for a pollination activity.
2. Small groups will need fun foam or poster board, scissors, markers or crayons, petal patterns and 2 small rectangular pieces of stick-backed Velcro.
3. Use the pattern to trace 5 – 6 petals on the foam or poster board. Cut them out.
4. To make your petals more colorful, use the markers to add designs.
5. Cut out one big circle of foam to glue all the petals onto.
6. At the center of each flower, place 2 small rectangular pieces of the sticky-backed Velcro.

Activity 2: Finding Flowers

1. Head outside to look for flowers. The group will need to bring the model flowers, "pollen", i.e., yellow felt or pom-poms, stopwatch, magnifying lenses and science journals.
2. How many different types of flowers can you find in the schoolyard? How many different colors can you find? Record these numbers in your science journal.
3. Smell the flowers. What do you notice? How many of the different types of flowers have a smell? Can you describe the smells?
6. Use the magnifying lenses to look closely at the flowers. Can you find the **stamen**? Can you find the **pistil?**
7. Choose one flower to sketch in your science journal. Label the parts of the plant that you know.
8. Run a finger gently over the flower. Do you see any pollen grains?
9. Can you find any pollinators at work in the flowers?

Follow-up Activity: Revisit the flowers you sketched every few days to observe how they change. Record these changes in your science journal.

Activity 3: Practicing Pollination

1. Practice pollination! How many flowers can you successfully pollinate in 30-60 seconds.
2. The model flowers, yellow pollen pieces and stopwatch are needed for this activity. Each flower should have one piece of pollen attached to one of the pieces of Velcro in the middle.
3. 5-10 students are needed to hold the flowers. You are the stems of the flower! Stand 5 to 10 feet apart from each other.
    - The others will be pollinators.
    - Everyone can swap places after the first round so they can try pollinating.
4. One at a time, pollinators "fly" from flower to flower, picking up a piece of pollen from one flower and bringing it to another flower. At every flower, pollinators take a piece of pollen and leave the one from the previous flower. Continue this way for 30-60 seconds.
5. Successful pollination means that you were able to pick up a piece of pollen **and** leave a piece of pollen, so don't start counting flowers until the second one you visit. How many flowers were you able to pollinate successfully?
6. Between each pollination run, make sure all the flowers have only one piece of pollen.
7. In nature, bees do a lot of the pollination work. Farmers growing berries, pears and apples rely on bees to help with pollination.
8. Farmers in Maine timed how fast bees could pollinate blueberry flowers and here are the results:
    - BUMBLEBEES = 10 - 12 flowers per minute
    - HONEY BEES = 5 - 9 flowers per minute
9. How do you measure up to the bees? Figure out the average of how many flowers we pollinated compared to the bees.
10. How would our success rate change if the flowers were farther apart? Or the flowers were in the forest? Or if there were lots of pollinators in the same garden? Or there were predators present?

Extensions

Science Extension

- Tie pollinators into a larger food chain/food web discussion.
  - Can you think of some **predators** that might eat pollinating insects? Spiders, praying mantises, and birds hunt insect **prey**.
  - Who are the **producers** in this food chain? Plants produce their own food using carbon dioxide, water and energy from the sun.
  - Who are the **consumers**? Animals have to eat plants or other animals, so the pollinators and their predators are the consumers.
  - Who are the **herbivores** and **carnivores** in this food chain? Do bees only eat nectar and pollen from plants?

- More research could be done on the pollination rates of different pollinators and/or the predators that hunt pollinators.

Birds in our Schoolyard

Grades K – 4

Objectives:

Students will be able to

- list characteristics of birds
- describe features on a bird that might help identify it
- name at least 3 birds that can be found in Rhode Island
- name places where birds are found outside
- distinguish the sounds that different birds make

Vocabulary: habitat, feathers, bird watching, field marks, binoculars, camouflage

Age Level: Grades K - 4

Time Allotted: 30 - 40 minutes

Standards Addressed:

Disciplinary Core Ideas: LS1.A, LS1.C, LS1.D, ESS3.A, ESS3.C, LS3.B, LS4.B, LS4.C, LS4.D

Cross-Cutting Concepts: Patterns, Structure & Function, Cause and Effect, Systems and System Models

Cross-curricular Connections:

Math, Art, Language Arts

Materials:

- 10 - 15 stuffed or plastic bird models
- duct or masking tape
- feathers, eggs, beaks, nests or pictures of them
- binoculars (if available) or toilet paper tube scopes
- simple bird field guides
- bird scavenger hunt (included)
- science journals
- pencils
- clipboards
- bird sounds – www.allaboutbirds.org is an excellent resource
- 30 laminated pictures of 15 different local birds, 2 copies of each species (see next page for examples)

Preparation:

- Prior to the lesson, find a place outside to place the model birds.
- Look for spots in the trees, bushes, against the school, in the grass, on the rocks.
- Duct tape or masking tape can help secure the birds.

Common Birds of Rhode Island:

American Robin	Canada Goose
Northern Cardinal	Herring Gull
Rock Pigeon	Mourning Dove
Northern Flicker	American Crow
Downy Woodpecker	Wild Turkey
European Starling	House Finch
Tufted Titmouse	House Sparrow
American Goldfinch	Red-tailed Hawk
Mallard Duck	Mute Swan
Black-capped Chickadee	Blue Jay
Red-bellied Woodpecker	

Discussion

1. Today's lesson is on birds and the places they live. Where have you seen birds? Have you seen birds in your backyard and neighborhood? In a park? How about in the schoolyard?

2. What is a habitat?
   - A habitat is the natural home or environment of an animal, plant, or other organism.
   - Habitats provide an animal's basic needs: food, water, shelter, space, and oxygen.

3. How do we know whether an animal is a bird? What are the characteristics of birds?
   - feathers (birds are the only animals with feathers)
   - beaks
   - warm-blooded
   - lay eggs
   - most birds build nests

4. Share the feathers, eggs, nests, etc., or photos. What do you notice? What questions do you have?

5. What senses can we use to find birds in our school yard? What clues can we look for?

Activity 1: Bird Watching

1. Let's practice bird watching! Students will need binoculars or toilet paper tube scopes, science journals, clipboards, and pencils. A field guide could be helpful, and the bird scavenger hunt is an extra exploration option.

2. First, practice LISTENING for birds. Close your eyes for 30 seconds and count the number of sounds you hear.
    - How many of those sounds were birds?
    - Can you describe the sounds?
    - What else did you hear?

3. To practice LOOKING for birds, try to spot the "bird models" that have been placed in the schoolyard.
    - What do you notice about the different birds?
    - Where are they?
    - What colors do you see? Where is the color on their bodies?
    - Are some of the birds more difficult to find than others? **Camouflage** is the colors and patterns that help animals blend into their surroundings.
    - Keep a tally of how many birds you found or draw a picture of a bird in your science journal.

4. Now let's look for live birds! Walk quietly along the edges of the schoolyard, or in the neighborhood to look for birds and clues that birds have been there.

5. Remember to look up, down and all around. Watch for movement in the trees and shrubs. When you spot a bird, observe it for a while.
    - What is it doing?
    - What colors do you see? Where are the colors on its body?
    - Does it have any distinguishing features, like a crest or long tail?
    - Is it making any noise?
    - Is it in a tree or on the ground?
    - Is it flying, perching, swimming or walking?
    - Can you sketch the bird in your journal?

6. Also watch for clues that birds have been here or might be here in the future.
    - Can you spot any nests?
    - Where are some places in the schoolyard where birds might nest or where they might hide from predators?
    - Do you see any things that birds might like to eat? Depending upon the type of bird, they eat seeds, nuts, berries, insects, worms and other animals.

7. Make some notes in your journals about the bird walk.
    - How many birds did we see?
    - What clues did we find that birds live in our neighborhood?
    - What is the schoolyard habitat like? Are there trees, bushes, gardens or lawn?
    - Do you think the schoolyard provides everything a bird needs to survive?

Activity 2: Bird Identification

1. Give every student a laminated picture of a bird. There are two of each kind, go find your partner!

2. As partners, observe the bird in your pictures.
    - What do you notice? What makes it stand out?
    - What colors do you see? Where is the color on its body?
    - Do you see stripes? Spots? Where are they located on the body?
    - Does your bird have a crest on its head? A long tail?
    - What is the shape of the beak?
    - Can you use the field guide to figure out what type of bird you have?

3. The distinguishing features of a bird are called **field marks**. Let's share our observations with each other.
    - What are the most distinguishing features of your bird?
    - Do some of the birds have features in common?
    - If two birds are the same color, could you tell them apart?

4. Bird watchers also use bird songs to identify birds. Listen to some of the songs and calls of the birds in our pictures.
    - Does the sound remind you of something? Do you think you would remember it if you heard it outside?
    - Can you imitate the song?

Extensions

Science and Language Arts Extension

- Choose a local bird species to research. Learn what it eats, how many eggs it lays, where it nests and other facts about its life.
- Write up the information as a report or turn it into a bulletin board display with graphics and text.

Science and Art Extension

- Go bird watching in the schoolyard 1-2 times every season. Are some birds always there? Do you see some only during one season or another? Create your own field guide of the birds seen in the schoolyard.
- Conduct some research to determine which birds stay in Rhode Island and which birds migrate. Create a map of a bird's migration route and figure out how far it travels each fall and spring.

Engineering Extension

- Research different types of birds' nests and try to re-create them using craft materials.
- Cornell Lab of Ornithology is always a good resource: https://nestwatch.org/learn/how-to-nestwatch/identifying-nests-and-eggs

Engineering Challenge

- Construct a nest that can hold 3 – 5 "eggs" (golf balls, ping pong balls, wooden, plastic or clay eggs, etc.) Design different tests to make sure the nests will hold up.
- Ideas:
    - Hold the nest in front of a fan for 1 minute to test its ability to withstand wind.
    - Pour water from a watering can through the nest to test its ability to withstand rain.
    - Find a place to hide the nest outside to test its camouflage ability.
    - Place the nest in a bush and shake the branches like they might in a storm. Do the eggs stay in the nest?

BIRDS in their HABITATS

Scavenger Hunt

 something a bird could use to build a nest	 a plant a bird could eat	 a place where a bird could find a drink of water
 a bird on a tree	 a bird singing	 a bird flying
 a small animal a bird might eat	 signs a bird has been there	 a place where a bird could build a nest

Adapted from CT Audubon's BIRD Scavenger Hunt

Squirrel Sightings

Grades K – 5

Objectives:

Students will be able to

- explain what makes a squirrel a mammal
- list the habitat needs of squirrels and explain how they meet those needs in the schoolyard
- describe two or more squirrel behaviors and what they mean

Vocabulary: mammal, animal behavior, adaptation, habitat

Age Level: Grades K-5

Time Allotted: 20 - 25 minutes

Standards Addressed:

Disciplinary Core Ideas: LS1.A, LS1.B, LS1.C, LS1.D, LS2.A, LS2.B, LS2.D, LS3.A, LS3.B, LS4.C, LS4.D, ESS2.E, ESS3.A, ESS3.C, ETS1.B, ETS1.B

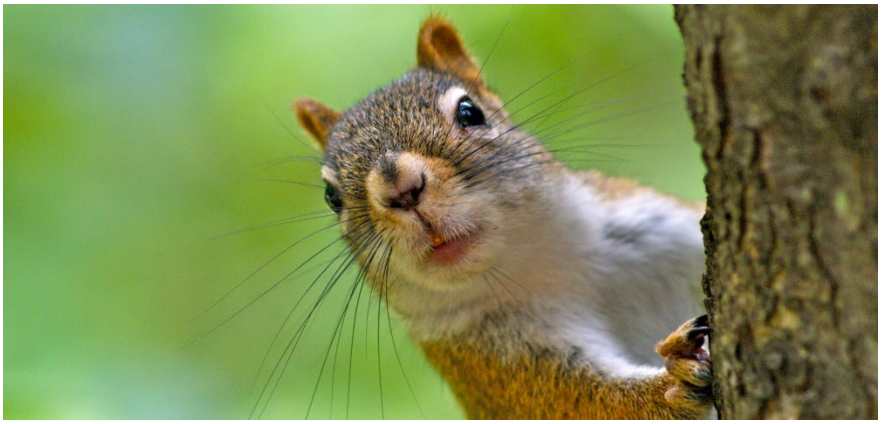
Cross-Cutting Concepts: Patterns, Cause and Effect, Systems and System Models

Cross-curricular Connections:

Math, Language Arts, Art

Materials:

- photos of squirrels - different species include gray, red, black, fox and flying squirrel
- *Squirrel Behavior Investigation* (SQUINGO) sheets included in this activity
- blank card stock
- glue sticks
- scissors
- clipboards
- pencils
- *If available*: videos of squirrels, binoculars



Discussion

1. What are the characteristics of **mammals**?
    - warm-blooded
    - fur or hair
    - live birth
    - babies drink mother's milk
2. Is a squirrel a mammal? Explain your answers.
3. What kinds of mammals have you seen in the schoolyard? Don't forget humans!
4. What is the most commonly seen mammal in our schoolyard besides humans? In many cases it is squirrels.
    - There are many different types of squirrels in the world, but the ones common to schoolyards are gray squirrels.
    - Red squirrels and flying squirrels also live in Rhode Island, but are not as common as gray squirrels. Red squirrels like pine forests and flying squirrels are nocturnal.
    - Gray squirrels can vary in color; some are even black!
    - Take a look at the pictures of different squirrels. What features do they have in common? How are they different?
5. If there are squirrels living in the schoolyard, then the schoolyard is their **habitat**.
    - Review the term habitat: the natural home of a plant, animal or other living thing.
    - What do squirrels need to survive that a habitat provides?
        - Food, water, shelter, oxygen and space or room
        - When we go outside to observe squirrels, let's also look for evidence of these basic needs.
6. We are going to investigate the behavior of our schoolyard squirrels. What does the term "animal behavior" mean?
    - **Animal behavior** is the scientific study of everything animals do, whether the animals are single-celled organisms, invertebrates, or vertebrates like mammals.
    - Behavior can be an adaptation for survival in a particular habitat or environment.
    - Animal behavior involves investigating the relationship of animals to their physical environment as well as to other living things.
    - Animal behavior includes topics such as how animals find and defend resources, avoid predators, choose mates and reproduce, and care for their young.

Activity 1: Making SQUINGO Boards

1. Each small group will need a Squirrel Behavior Investigation Squingo Board, Squirrel Behavior Pictures, scissors and glue to make their own SQUINGO board.
2. Cut out each squirrel photo. Then glue them on the Squirrel Behavior Investigation Squingo Board in any order you choose.
3. Before heading outside, review the various squirrel photos/behaviors. What do you think each behavior might mean?

Activity 2: SQUINGO

1. Take our SQUINGO boards outside to investigate the behaviors of our local squirrels. Each group will need a clipboard, pencil and SQUINGO board.
2. When you observe animals, it helps to be slow and quiet.
3. When you spot a squirrel, watch its behavior for a minute or two. Is it demonstrating any of the behaviors on your SQUINGO board? If so, check it off!
4. The first group to get three across or three down should call out "SQUINGO!"
5. Keep playing till everyone gets SQUINGO or you run out of time.
6. What behaviors did you see?
    - Does this behavior give us more information about squirrels or mammals in general?
    - Are there clues in the environment to tell us why a behavior is being done?
    - Are there behaviors we observed that are not on our sheets?
    - How do we think other animals would behave in similar situations?
    - How do humans act in similar situations?
7. In the squirrel's schoolyard habitat, did you see any food that they might eat? Water they might drink? Places to sleep or hide?

SQUIRREL BEHAVIOR INVESTIGATION

 ALERT SQUIRREL	 CLIMBING SQUIRREL	 EATING SQUIRREL
 LEAPING SQUIRREL	 FREE SQUIRREL!	 REACHING SQUIRREL
 BALANCING SQUIRREL	 DIGGING SQUIRREL	 HIDING SQUIRREL

Camouflage Capers

Grades 1 – 4

Objectives:

Students will be able to

- explain camouflage as an adaptation
- describe three types of camouflage
- describe the relationship between predators and prey

Vocabulary: camouflage, adaptation, predator, prey, disruptive coloration, concealing coloration, disguise

Age Level: Grades 1 - 4

Time Allotted: 50 minutes

Standards Addressed:

Disciplinary Core Ideas: LS1.A, LS1.D, ETS1.B

Cross-cutting concepts: Structure and Function, Patterns, Systems and System Models

Cross-curricular Connections:

Math, Physical Education, Arts

Materials:

- 100-150 pieces of yarn or pipe cleaners in a variety of colors, approximately 2 inches in length
- cones or other markers to designate boundaries
- science notebooks and pencils
- two different pieces of patterned wrapping paper per student,
- two pieces of construction paper of the same color per student
- assorted colors of construction paper
- small sticks or twigs
- old science or nature magazines with pictures of animals
- scissors and glue
- rulers or yard sticks for camouflage extension

Discussion

1. What do all animals need to survive?
    - Food, water, shelter, oxygen, space to live
2. We are going outside to pretend we are birds looking for food. What kinds of food might hungry birds look for?
    - Depending on the kind of bird – worms, caterpillars, adult insects, berries, seeds, small animals, and fish are some examples.
3. What part of the bird's body does it use to pick up and eat its food?
    - Most birds use their beak or bill to pick up and eat their food.
    - Raptors, such as owls and hawks, pick up their prey with their talons/claws and then eat with their beaks.
    - Different kinds of birds have differently shaped beaks depending upon what they eat. Birds' beaks are adaptations that help them gather the type of food they need to survive.

Activity 1: Camouflage in Action

Preparation:

- Find an area in the corner of the schoolyard and designate boundaries with cones.
- Scatter pieces of colored yarn/pipe cleaner (worms) on the ground within the boundaries.

1. Bring notebooks and pencils outside to record data.
2. Review activity directions:
    a. Every student will work with a partner. Each pair is a "bird family" searching for food for their hungry babies in the nest.
    b. The "food" you are finding is in the form of yarn/pipe cleaner worms spread out in the "feeding area" indicated by the cones.
    c. First choose a spot to be your nest. Mark it with a small stick or draw your initials in the dirt. This is where you will bring the food you collect.
    d. One partner always has to stay at the nest (to guard it from **predators**) while the other goes to find food. Take turns searching for food and guarding the nest.
    e. "Birds" can only pick up **one piece of food** at a time from the feeding area to bring back to the nest.

f. There is a time limit **X** to see how much food you can find.
    - Each round could be about 30-90 seconds depending on how large the area is, how many pieces of yarn were scattered and how far apart the "nests" are from the feeding area.

3. Find your nest spot.

4. Begin feeding!

5. When time is up, go back to your nest and record in your notebooks:
    - the total number of worms found
    - the number of worms of each color

6. Back in the classroom, graph the data and discuss:
    - What colors were found least often? Most often?
    - Did the color of the yarn "worms" make a difference? Why?
    - Did some of the "worms" blend in better with the ground?
    - **Camouflage** helps animals blend in. Camouflage is an **adaptation** for survival.

Activity 2: Three Types of Camouflage

1. Have you ever played hide-and-seek? What are some ways you can hide from the person who is "it"?

2. Why would animals want to hide or blend in with their surroundings?
    - Camouflage helps some animals avoid **predators** that want to catch them.
    - Camouflage can help **predators** sneak up on their **prey** – the animals that they want to catch for food.

3. **Disruptive Coloration**
   Patterns found on an animal's body, such as stripes, spots, and speckles, help break up the outline of its body, making it more difficult to see the animal clearly, especially in a group like a herd. This type of camouflage is called **disruptive coloration**.

    a. Each student chooses two <u>different</u> pieces of wrapping paper. One piece will be your background sheet. From the other piece, cut out several shapes (Think of the cut-out pieces as a pack or herd of animals huddled closely together.) Paste them closely together on the background sheet.
    b. Have students show their creations to the group. From a distance, can you tell how many shapes are pasted onto the wrapping paper? Why or why not?
    c. Does it make a difference if you move the paper closer?
    d. Extension: Experiment with the distance by going out in the hallway or schoolyard. Start farther away, and measure the distance using a ruler or

yardstick. Then determine how close the paper needs to be to be able to distinguish all the shapes on the wrapping paper. Record these results in science notebooks.

4. **Concealing Coloration**
   When animals use camouflage to hide against a background of the same color, this is called **concealing coloration**.

   a. Each student will need two pieces of construction paper of the same color.
   b. Cut out an animal shape from one piece of construction paper and paste it on the other piece.

5. **Disguise**

   When an animal's color and shape help it look like natural objects in its habitat, they are using a type of camouflage called **disguise**.

   a. Students will need another piece of construction paper, glue and an assortment of twigs or small sticks.
   b. Glue some sticks on the paper. Then on one of the sticks, draw an animal's head and legs.

Activity 3: Animals in Nature

1. Brainstorm a list of animals in nature that might use camouflage.

2. In your science notebook, make a chart with three titles: Disruptive Coloration, Concealing Coloration, and Disguise
   - Each column needs to be big enough to paste in an animal picture from the magazines.
   - Alternatively, the class could make a large wall chart.

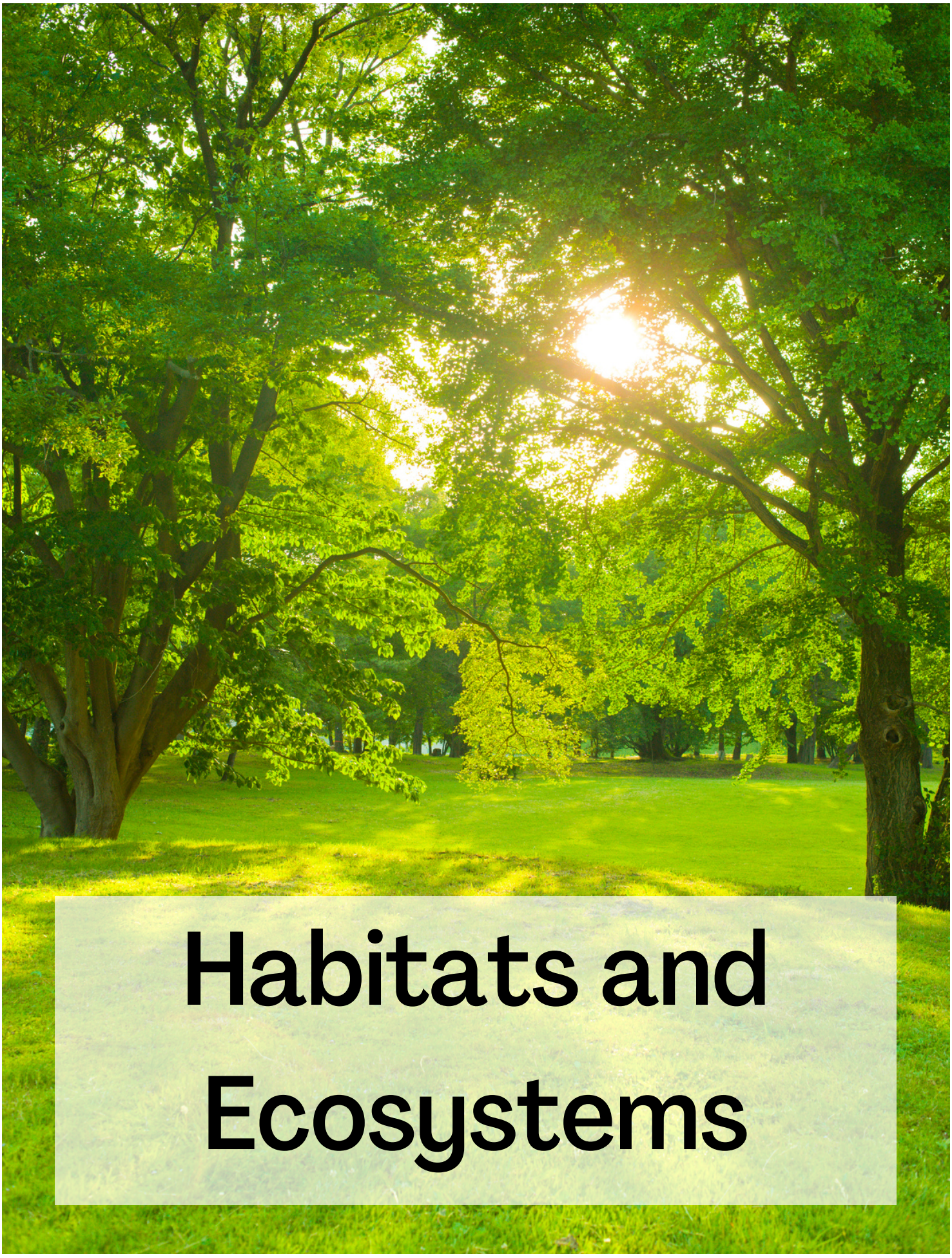
3. Look for examples of animal camouflage in nature magazines.
   - Provide students with magazines.
   - Can you find examples of all three types of camouflage in the magazines?
   - When you find one, cut it out, and glue it into your science journal.
   - Are some of the animals you found on our brainstorm list?
   - Did you find examples of **predators**? **Prey**?

Extensions

Language Arts Extension

Here are some children's books about camouflage, including some that challenge students to find the hidden animals:

- *I See Animals Hiding* by Jim Arnosky
- *Where's that Fish?* or *Where's that Spider?* by Barbara Brenner and Bernice Chardiet (*Hide and Seek Science* series)
- *How to Hide a Meadow Frog* or *Butterfly* or *Crocodile* or *Octopus,* all by Ruth Heller
- *What Color is Camouflage?* by Carolyn Otto



Habitats and Ecosystems

Wildlife Real Estate

Grades K – 3

Objectives:

Students will be able to

- define the term “habitat”
- state the things that animals need from their habitats to survive
- analyze which parts of the schoolyard provide what wild animals need to live

Vocabulary: habitat

Age Level: Grades K-3

Time Allotted: 25 - 35 minutes

Standards Addressed:

Disciplinary Core Ideas: LS1.A, LS1.C, LS2.A, LS4.D, ESS3.A

Cross-Cutting Concepts: Patterns, Cause and Effect, Systems and System Models

Cross-curricular Connections:

Language Arts, Arts

Materials:

- magnifying lenses & bug boxes
- science journal or *Wildlife Habitat Scavenger Hunt*
- clipboards
- pencils

Discussion

1. What types of animals do you think we could find in our school yard? Let's make a list.
2. What is an animal's habitat? A habitat is a place where an animal lives and can meet its basic needs.
3. What do animals need from their **habitats** in order to survive?
    - Food, water, shelter, space and air (oxygen)
    - Sunlight is the basis of all food webs and warms the earth, so it is important too.

Activity 1: Outdoor Investigation

1. Each small group will need magnifying lenses, a *Wildlife Habitat Scavenger Hunt* or science journal, pencil and clipboard.
2. Let's go outside to look for animals in the schoolyard!
    - The quieter you are, the more you will see.
    - Walking slowly and quietly will let you get closer to birds and squirrels.
    - Don't forget the little critters, like insects, worms and spiders. If you turn over a log or a rock, be sure to put it back carefully.
3. If you were animals looking for a new place to live, what does our schoolyard habitat provide for us? Does it provide everything we would need?
4. Alternatively, we could pretend that we are real estate agents who help animals find new homes. Is the schoolyard a suitable neighborhood/habitat for local animals? What animals do you expect to see in the schoolyard?
5. As you explore, record any animals you see and the things that in the schoolyard that will help them survive.
6. Breathe deeply. Does this spot have good air?
7. Is there clean water nearby? Is there a stream, puddles or snow and ice?
8. Is there a place to hide from predators?
9. Is there a place to raise young?

Name: _____ Today's Date: _____

Wildlife Habitat Scavenger Hunt

Is there AIR? **YES NO** Is there WATER? **YES NO**

What SHELTER can you find? (Ex: ant hill, squirrel nest, tree cavity)

What FOOD can you find? (Ex: berries, leaves with holes in them)

Is there enough SPACE? **YES NO**

Deconstructing Decomposers

Grades 2 – 6

Objectives:

Students will be able to

- define what a decomposer is and give examples
- describe the habitat requirements of organisms that live in soil
- explain what a niche is
- list the key features of insects and other soil invertebrates

Vocabulary: decomposer, consumer, leaf litter, invertebrate, niche, biotic, abiotic

Age Level: Grades 2- 6

Time Allotted: 20 minutes in the morning, 30 minutes in the afternoon

Standards Addressed:

Disciplinary Core Ideas: PS1.A, PS1.B, PS3.D, ETS1.B, LS1.A, LS1.C, LS1.D, LS2.A, LS2. B, LS2.CLS3.A, LS3.B, LS4.B, LS4.C, LS4.D

Cross-cutting Concepts: Patterns, Cause and Effect, Structure and Function, Systems and System Models, Energy and Matter

Cross-curricular Connections:

Math, Art, Language Arts, Art

Materials:

- metal spoons or garden trowels for digging
- containers to hold collected leaf litter/soil
- leaf litter/soil sample from the schoolyard
- funnels or the top half of soda bottles
- glass jars
- onion bag mesh or ¼ inch wire mesh
- clamp lamps with 60 watt incandescent bulbs
- magnifying lenses, bug boxes, and/or Petri dishes
- dissecting microscope or magnifying flex-cam (if available)

Discussion

1. Have you heard the word **decomposer?** What do you know about **decomposers**?
    - The **niche** or job of decomposers is to consume dead plants, animals, and waste products, i.e. “poop”.
    - Decomposers are **consumers** that help recycle dead things, breaking them down into non-living components.
    - Decomposers help release nutrients back into the soil and carbon dioxide into the air.

2. What are some examples of decomposers?
    - Decomposers include types of bacteria, fungi and **invertebrates**, such as worms, snails, insects, isopods, millipedes and others.
    - I**nvertebrates** are organisms that do not have vertebrae, i.e., back bones.
    - Where do decomposers live?
        - **Leaf litter** on the surface of the soil is where major decomposition happens.
        - Billions of decomposers live in the top layer of soil.
        - Bacteria and fungi are the primary decomposers in fresh and saltwater ecosystems.

3. Review the basic non-living or **abiotic** ingredients found in the soil:
    - Water, air, rocks and minerals

4. The next step is to collect leaf litter from the school yard to look for the living or **biotic** features of the soil.

Activity 1: Collecting Leaf Litter

1. ***In the morning***, take students outside to the schoolyard edges to collect 2 cups of leaf litter.

2. Each small group needs a spoon or trowel and a container to hold the leaf litter.
    - Explore under bushes or in shady areas where leaves have accumulated.
    - When collecting leaf litter, remove the driest surface leaves to find those that are moist.

- Collect the leaf litter all the way down to the topsoil.

3. Back in the classroom, each group places the litter into a Berlese funnel. (See included instructions for how to make a Berlese funnel.)

4. Make sure to direct the lamp over the litter. Leave the lamp over the sample for *at LEAST 3 hours* (the longer the litter is left under the lamp, the better the results).

5. Why do you think this technique will help us find the small invertebrates that live in the soil?
   - The light generates both light and heat, which will dry out the litter, driving the moisture-loving decomposers down, until they fall through the mesh and into the jar.

Activity 2: Investigating Soil Invertebrates

1. ***In the afternoon***, each group should take the bottom part of their Berlese funnel and carefully dump the contents into a petri dish or shallow container.

2. Examine the contents with magnifiers to see if you can find any small animals moving around.
   - If the school has a dissecting microscope or flex-cam (like an ELMO cam), place the petri dish under it to examine the things that fell through the mesh of the funnel.

3. Try to identify what kind of animals you find!
   - Make observations about each type. Do they have legs? How many legs do they have? Do they have antennae? What else do you notice?
   - Sort or classify these decomposers into groups.
   - Use field guides or the Internet to help you figure out what they are.
   - In your science journal, record your observations, and draw the animals.

4. After the investigation, please put all the animals back into the leaf litter and return it to where you found it.
   - Why is it important to return the decomposers back to their habitat?
   - What would happen if all the decomposers were removed from an ecosystem?

- Who would recycle all the nutrients back into the soil?

5. Make a bar graph or pie chart of the different kinds of animals found in the leaf litter.

6. Discussion Questions:
   - How many different invertebrates live in our schoolyard leaf litter?
   - Did some areas of the schoolyard have more organisms than other places?
   - Why might some areas have more decomposers than others?
   - What were the differences between the sites?
   - What new questions do you have about soil or decomposers?

Extensions

Science Inquiry Extension

- Repeat this procedure, collecting the leaf litter from different areas in the schoolyard, their backyards, different parks, or from the same locations in different weather conditions and seasons.

Arts Extension

- Use a variety of art materials to re-create the soil invertebrates that were found. Make a display for the classroom or posters for a bulletin board with the artwork.

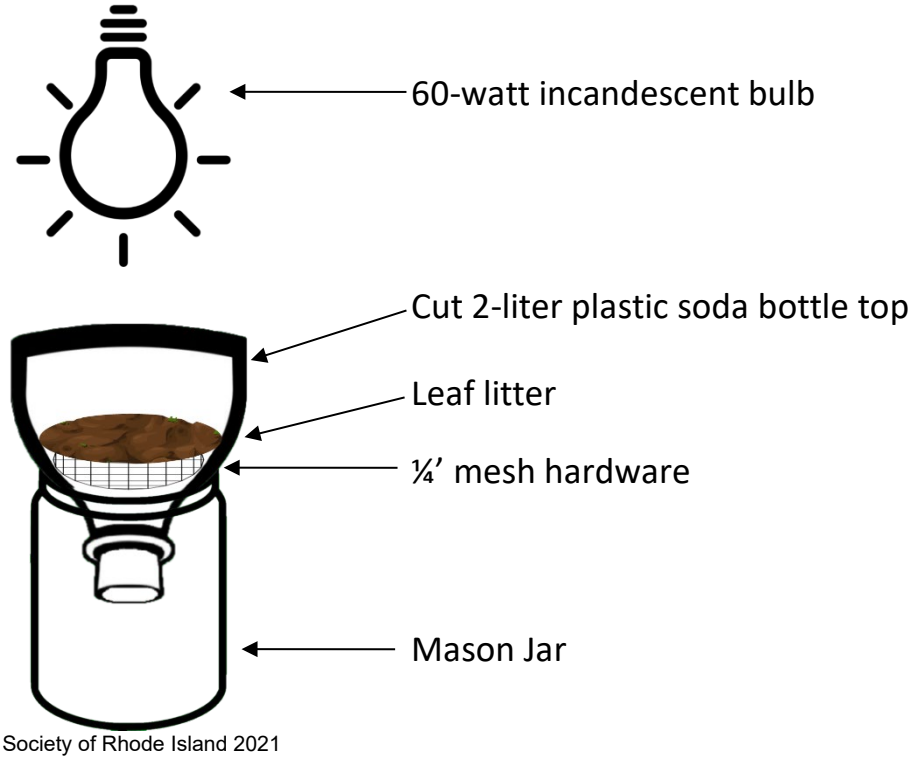
Berlese Funnel

Materials

- Large soda bottle or 1-gallon milk jug
- Clean, empty mason jar
- 1 /4” mesh hardware cloth, onion bag, or shower poof
- Lamp with a 60-watt incandescent bulb
- 2 cups of leaf litter/soil
- Petri dish or another shallow dish

Procedure

1. Cut the bottom off the soda bottle/milk jug.
2. Invert the soda bottle into the mason jar.
3. Place a small piece of 1 /4” mesh hardware cloth/onion bag/shower poof over the opening of the soda bottle.
4. Place leaf litter/soil in the soda bottle.
5. Place the lamp with the 60-watt incandescent bulb directly over the soda bottle at least 10 cm away.
6. Allow the Berlese funnel to sit under the light for approximately *three* hours.
7. After three hours turn the lamp off and transfer organisms that fell into the jar to petri dishes to examine.
8. Return soil and organisms to the location where you collected them.



Schoolyard Ecosystems and Biodiversity

Grades 3 – 6

Objectives:

Students will be able to

- define the term ecosystem
- determine if the schoolyard is an ecosystem
- explain human impact in the context of ecology
- list 5 biotic and 5 abiotic features of local ecosystems
- describe the interactions of animals, plants and other organisms in the schoolyard ecosystem
- define biodiversity, and state which of two spots in the schoolyard has greater biodiversity
- construct a visual/written record of various stages of succession

Vocabulary: ecosystem, ecologist, biotic, abiotic, human impact, biodiversity, predator, prey, decomposer, succession, organic

Age Level: Grades 3 - 6

Time Allotted: 45 minutes

Standards Addressed:

Disciplinary Core Ideas: LS1.C, LS2.A, LS2.B, LS2.C, LS3.B, LS4.B, LS4.C, LS4.D, ESS2.E, ESS3.A, ESS3.C, PS3.D

Cross-cutting Concepts: Patterns, Cause and Effect, Systems and System Models, Energy and Matter, Structure and Function, Scientific Knowledge Assumes an Order and Consistency in Natural Systems

Cross-curricular Connections: Language Arts, Math

Materials:

- flags or flagging tape
- metal spoons or garden trowels for digging
- bug boxes
- magnifying lenses
- air thermometer to share
- soil thermometers
- Peterson's First Guides, Golden Guides or Pocket Naturalist field guides to plants/ weeds, insects, spiders, birds, urban wildlife, etc.
- hula hoops or cardboard squares to designate study areas
- data sheets *(sample attached)* or science journals
- clipboards
- pencils

Discussion

1. Introduce the concept of an ecosystem. Can you define or give an example of an ecosystem?
    - An **ecosystem** is a community of living organisms and the nonliving components of their environment, interacting as a system. These **biotic** and **abiotic** components are linked together through nutrient cycles and energy flows.
    - When studying ecosystems, scientists look at the interactions between living things, populations of living things, and the **human impact** on the system.
    - Scientists also determine the **biodiversity** of life within ecosystems. Biodiversity refers to the variety of different living things found in a given area or ecosystem.
    - Ecosystems can be as large as a continent (a biome) or as small as a log (micro-ecosystem).
2. What type of biotic or living things might we find in a forest ecosystem? A freshwater pond ecosystem? A saltwater ecosystem?
    - plants, fungi, microorganisms and animals specific to each ecosystem could be listed based on prior knowledge or research

3. What are some of the abiotic or non-living features in an ecosystem?
    - air, water, precipitation, temperature, rocks and minerals, parts of the soil, sunlight
4. In what ways do humans impact ecosystems? On a large scale? On a smaller scale?
    - Large scale examples: climate change, replanting entire forests, etc.
    - Smaller scale examples: littering, beach clean-ups, etc.
5. Is the schoolyard an ecosystem? Head outside to figure that out.

Activity 1: Schoolyard Ecosystem Study (Grassy Area)

Preparation:

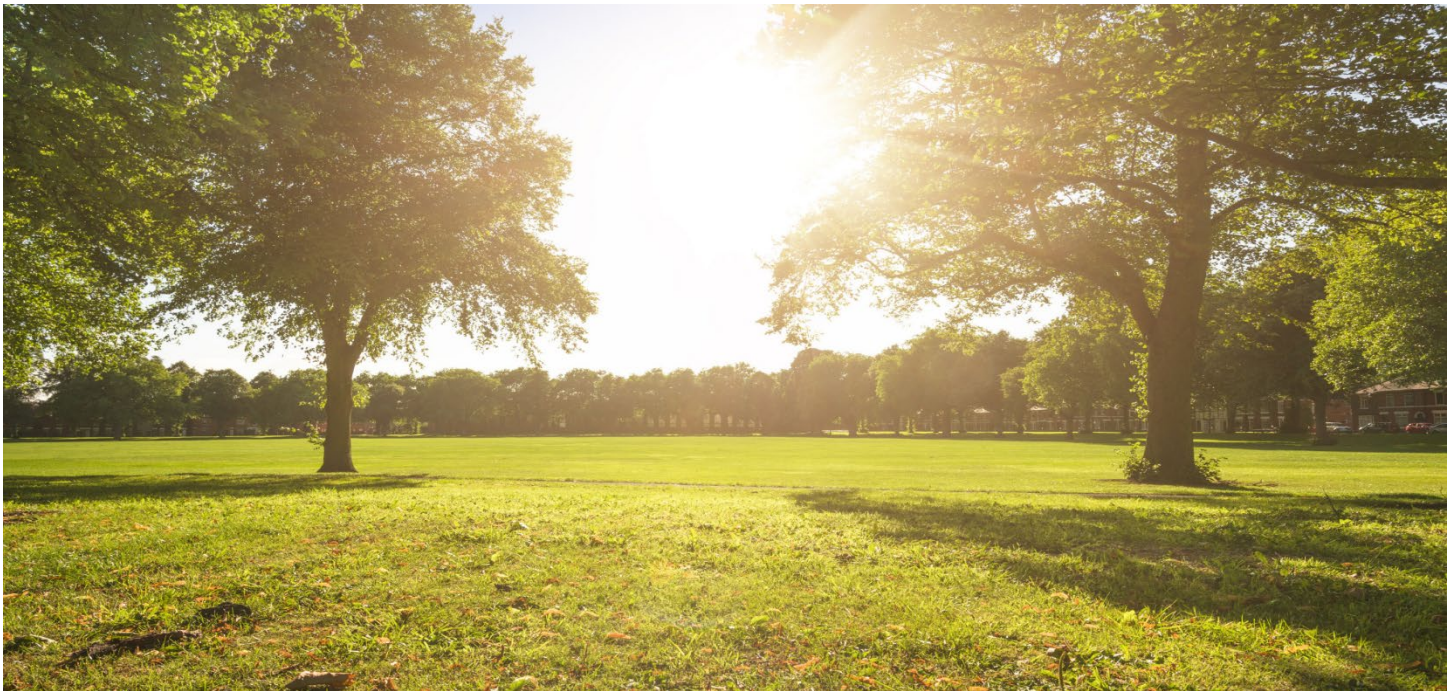
1. Choose two different areas in the schoolyard for students to investigate. A grassy area and the edge of a wooded or shrubby area are ideal.
2. Mark the boundaries of each area with flags or flagging tape.

1. Each small group of students will need a data sheet, clipboard, pencil, digging utensils, magnifiers, bug boxes, a soil thermometer and a hula hoop or cardboard square. Field guides and an air thermometer can be shared between the groups.
2. Scientists who study ecosystems are called **ecologists**. Ecologists keep records of their observations and the conditions under which the observations are being made. On your data sheet be sure to record your names, the date, the air temperature and the weather.
3. We will be comparing two different areas in the school yard. Notice the boundaries of the areas.
4. For 5 – 10 minutes, each small group will make observations and collect data on a small plot within each area.
    - The hula hoop defines the boundaries of your study plot.
    - The data sheet can help guide your investigation, but you may add other measurements or observations.
5. Once your team finds a spot to place the hula hoop, use your powers of observation, the tools and field guides to gather data on the human impact and living and non-living things found in your study plot.

- Before disturbing anything, sketch what you observe in your study plot.
- Is there evidence of human impact on the plot? (footprints, litter, mowing, etc.)
- How many kinds of plants do you observe?
- Is there shade from trees over your plot?
- Do plants cover the entire surface of the plot?
- Are there animals or evidence of animals in your plot? Can you identify the types of animals?
- Do you observe any "interactions" between plants and animals, i.e., are animals eating plants or using them for shelter?
- Note the abiotic aspects of your plot. Are there rocks? What color is the soil?
- Measure the soil temperature. Is it warmer or cooler than the air?

6. When you are done with your investigation, be sure to release any animals you caught and fill in any holes that you dug. Reduce your human impact!

7. As a large group, share and compare your observations on this grassy area.
   - What were the similarities between the study plots? Differences?
   - How would you describe the biodiversity of your plots?
   - How might human impact affect biodiversity?
   - If we combine the information gathered in the small plots, do you think it gives us a good description of the entire area? Would you describe this grassy area as an ecosystem?
   - What are the benefits of studying small plots within a larger area rather than studying the whole area instead? What are potential downsides?
   - What do you think would happen to this grassy area over time if we stopped mowing it? *(A longer discussion of **ecological succession** could supplement these investigations. More information on this topic follows these activities.)*



Activity 2: Schoolyard Ecosystem Study (Woody/Shrubby Area)

The next study area is the forest edge (or an area with shrubs and trees).

1. What are the obvious differences between this area and the grassy area? (Trees, understory shrubs, leaf litter, shade, etc.)
2. The data collection procedure in this area is essentially the same as the first, but take note that in a wooded area there is often more animal activity taking place under the leaf litter and/or rotting logs.
    - **Decomposers**, such as earthworms, bacteria, fungi, insects and other small creatures, are working to break down the **organic** material and turn it into soil.
    - Earthworms also break large particles of food into smaller particles. As food passes through a worm's digestive system, it is ground into fine particles. The worm castings or *scat* includes small pieces of rocks that were not digested, partially digested plant materials, and even some living microbes (which are microscopic organisms that help decompose the remaining materials in the worm castings).
    - How many decomposers can you find? Can you find any worm castings?
3. After 5 – 10 minutes of observation, share and compare your findings.
    - Based on your investigation, would you describe this wooded area as an ecosystem?
    - What biotic and abiotic components of each area are similar? Different?
    - Is there any evidence of human impact on the forest plots? How does the human impact compare between the two areas?
    - How would you describe the biodiversity of this area?
    - Compare the biodiversity of the two areas. If you determine one area is more biodiverse, can you propose reasons for the differences? Do you think human impact is involved in the differences?

Further Discussion: Ecological Succession

1. The schoolyard investigations of two different ecosystems, and the observations and data gathered, can provide the basis for a number of in-depth discussions and/or research projects. **Succession**, natural changes to ecosystems over time, is one key ecological concept to delve into further.
2. 12,000 years ago, New England was covered in a mile-high layer of ice called a glacier. Imagine what the landscape looked like after the ice melted. What do you think you would see immediately after the ice receded?
    - The landscape was very barren consisting mostly of dirt and rocks—which is the **first stage of succession.**
    - What do you think might have appeared on this landscape over time?
3. The **second stage of succession** is when plants begin to grow on the dirt and rocks. Our short grassy area in the schoolyard could be considered to be in this second stage.
    - Our grassy area may have a high percentage of grass cover, but because it is mowed regularly, it stays in this second stage.
    - Mowing is an impact on the ecosystem made by humans.
4. If we stopped mowing the grassy area, what do you think would happen over the short term? The longer term?
    - The short grass would grow into a tall grassy field or meadow with other plants mixed in.
    - Over time, sun tolerant shrubs and trees would take root and grow in the field.
    - These shrubs and trees would provide shade for less sun tolerant tree seedlings to take root and grow.
5. Eventually the trees would go tall and the ecosystem would become a forest.
    - In a deciduous forest biome like we have in much of the northeast, the forest is the final stage or **climax community of succession**.
6. Succession is an ongoing process even when in its final stages. As a part of this ongoing process, plants and animals will die and decompose.
    - Decomposers break down all the organic material and recycle it into soil.

- If we did not have decomposers, all the leaves and broken twigs from trees would build up until the forest would become impassable.
- The decomposers are very important in the nutrient cycling within any ecosystem.

7. Are there events that could change these ecosystems and bring them back to the first stage of succession (dirt or bare rock)? (examples: fire, volcanoes or human impact)
8. What if humans impacted the area and bulldozed the forest to build homes? Would the area still be able to return to a forest?

**See Signs of Succession in Nature Games for an active way to explore the concept of succession.*

Extensions

Science Extensions

- Research some of the animals found in schoolyard and share with others.
    - Are all the animal's basic needs being met in the schoolyard?
    - What do they eat? Are they **predators** or **prey** or both?
- How do the plants and animals observed fit into a food chain or food web? What is their role in the food web? Create a visual display of the schoolyard food web.
- Create a display, visual presentation or report of comparing the two ecosystems including the biotic and abiotic components, and the comparisons of human impact and biodiversity.

Math Extension

- Take the numbers of different organisms found and calculate the average number per study plot with the grassy area. Do the same for the forested area.
- Create a visual representation, such as a bar graph or pie chart, to share the information with others.

Language Arts Extension

- Create a group poem about the schoolyard ecosystem by coming up with words starting with each letter of the alphabet associated with the area (K, Q, X and Z are

Field Data Sheet

Date _____ Time _____ Weather _____ Air Temperature _____

Name(s) of field researcher: _____

Ecosystem Observations

Name of this ecosystem:_____

List or Sketch Biotic Factors
Plants

Total % Cover of Plants_____
% Trees and Shrubs_____
% Other Plants _____

List or Sketch
Abiotic Factors

Soil temperature _____

List or Sketch Biotic Factors
Animals

List or Sketch
HUMAN IMPACT
on this ecosystem

How would you rate the biodiversity of this ecosystem?
HIGH **MEDIUM** **LOW**

Name of this ecosystem: _____

List or Sketch Biotic Factors
Plants

Total % Cover of Plants _____
% Trees and Shrubs _____
% Other Plants _____

List or Sketch
Abiotic Factors

Soil temperature _____

List or Sketch Biotic Factors
Animals

List or Sketch
HUMAN IMPACT
on this ecosystem

How would you rate the biodiversity of this ecosystem?
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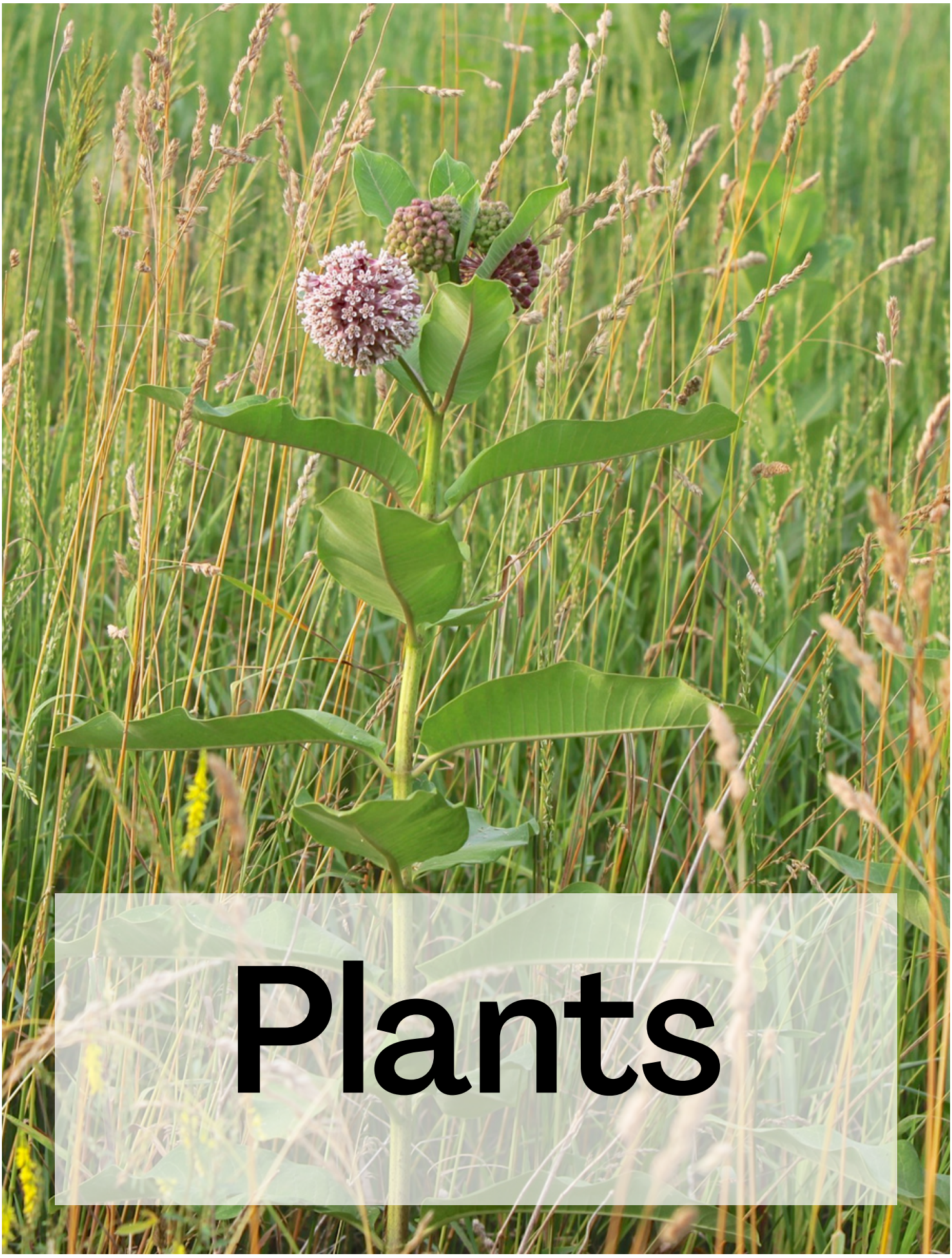


Plants

Fantastic Flowers

Grades 1 – 4

Objectives:

Students will be able to

- explain why a plant has flowers
- name at least three different parts of a flower
- describe how and why many plants depend on animals to move pollen from one flower to another
- list at least three different animals that pollinate flowers
- identify three different species of plants by looking at flowers

Vocabulary: flower, life cycle, pollen, petal, sepal, stamen, pistil, pollination, seeds, fruit, consumers

Age Level: Grades 1-4

Time Allotted: 45 minutes

Standards Addressed:

Disciplinary Core Ideas: ESS3.A, LS1.A, LS1.B, LS1.C, LS1.D, LS2.A, LS3.A, LS3.B, LS4.B, LS4.C, LS4.D, ETS1.B

Cross-Cutting Concepts: Patterns, Structure and Function, Cause and Effect, Systems and System Models

Cross-curricular Connections:

Math, Art

Materials:

- variety of craft materials such as tissue paper, construction paper, clay, pipe cleaners, pom-poms, straws, recycled materials like paper towel tubes
- scissors
- glue
- masking tape
- colored pencils
- markers
- science notebooks
- pencils
- wildflower field guides– simple ones based on flower color are available
- magnifying lenses
- paper plates or paper towels
- plastic knives
- toothpicks or Q-tips
- pictures/ poster of the parts of a simple flower
- *Flowers and their Pollinators* worksheet(included)

**If your schoolyard does not have flowering plants, carnations are an inexpensive flower for observation and dissection.*

Discussion & Activity 1: Flower Models

1. What do you think of when you hear the word **flower**? Make a list on the board or in science journals.
    - Are flowers living things or non-living things?
    - Where are flowers found?
    - What do plants, and therefore flowers, need to survive?
    - Plants need sun, air (oxygen and carbon dioxide), water, nutrients from the soil, and space to grow.
2. Individually or in small groups, use the craft materials to create a model of a flower.
    - What parts of a flower will you include in your model?
    - What materials do you think will work best for each part?
3. After about 15 minutes, each group presents their model to the class, describing the features they included.
    - These models can be revisited and/or revised in Activity #3.
4. Let's think about why plants have flowers. What are some ideas?
    - Without flowers, plants cannot make seeds, and no new plants would grow.
    - Flowers, seeds, young and adult plants are all parts of a plant's **life cycle**.

Activity 2: Looking for Flowers

Around schoolyards, flowers usually can be found in the landscaped areas near the front of a school, the edge of the playground, in the school garden, or under trees that grow along sidewalks.

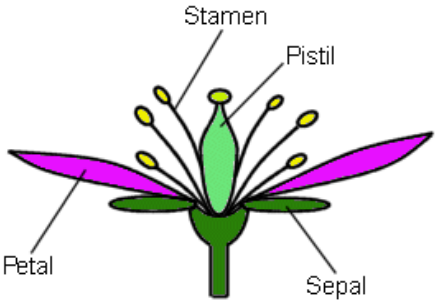
1. Outside in the schoolyard:
    - Set the boundaries for the activity.
    - Establish a rule about waiting to pick any flowers until the end when the whole class will collect some samples.
    - Give each small group magnifying lenses and field guides to share.
    - Science journals will help keep track of their findings.

2. Go on a flower scavenger hunt!
    - How many different kinds can you find?
    - What colors do you see?
    - What is the shape of each flower?
    - How many petals does each type have?
    - What is the shape of the petals? Are all the petals the same?
    - What other parts of the flower do you notice?
    - Can you find your flowers in the field guide?
    - Do you notice any insects on or around the flowers?

3. After the small groups have observed, counted and compared several flowers, have the class ***gently*** pick just ***one*** representative flower from at least 5-6 different plants. These samples will be used for the next activity.

Activity 3: Flower Parts

1. Each small group will need:
    - flower on a paper plate
    - cotton swab or toothpick
    - plastic knife
    - diagram/poster of a flower's structure
    - magnifying lens
    - science journals to keep track of observations



2. Review the flower parts on the diagram/poster as a large group, and then begin investigating the flowers.
    - Take a close look at the flowers. What parts of the flower can you find?
    - Look at the flowers through the magnifier. Do you notice other features?
    - Rub the flowers gently with the cotton swab/toothpick. What do you notice? (Pollen is often powdery and yellow and may come off on cotton swab.)
    - Use the knife to cut the flower in half. What parts do you see now?
    - How many of each part can you find?

Note: *There are many variations of flowers, and some are very complex, like sunflowers and dandelions. Students may not find some of the parts on all the flowers.*

3. Each small group reports on their findings.
    - What did all the flowers have in common?
    - What were the differences between the flowers?
    - How do these flowers compare to the flower models you created? How would you modify your models if you built them again?

4. What is the function of each flower structure?
    - The powdery pollen needs to travel from the **stamen** (male parts) of one flower to the **pistil** (female parts) of another flower of the same species before the plant can make a seed.
    - Once a flower is pollinated, the petals dry up and a seed or a fruit with seeds will form.
    - What might the flower petals be useful for?

5. How does the pollen get from one flower to another?
    - Wind can carry pollen (Those of us with allergies know when that happens!).
    - In some cases, pollen floats in the water.
    - The most common way for pollen to travel is by ***animal express***.
    - The colorful petals of the flower attract **pollinators** – animals that help move pollen from plant to plant.

6. Make a list of animals that might carry pollen from flower to flower.
    - Did you notice any of these animals near the flowers outside?
    - Why do the animals do this job for the plants – what do they get out of it? Energy!
    - Pollinators are **consumers** – they drink the nectar or eat some of the pollen, so they get food from the plant. The plants, in return, get help completing their life cycle.

7. Try out *Flowers and their Pollinators* matching worksheet
    - Who pollinates who?
    - Research each pollinator to determine what plant they pollinate.

The answers to the matching worksheet are as follows:

- Hummingbirds pollinate columbine.
- Beetles pollinate magnolias.
- Flies pollinate skunk cabbage.
- Butterflies pollinate clover, milkweed, & columbine.
- Bees pollinate clover & milkweed.

Extensions

Science Extensions

- Observe pollinators in the school yard.
  - What kinds of pollinators do you see?
  - Which flowers are being visited by each pollinator?
  - Are multiple pollinators visiting the same plants?
  - Is one pollinator visiting many types of flowers?

- Visit the schoolyard or garden weekly in the fall and/or spring to keep track of when different plants are flowering.
  - Each student or group could keep track of one plant or one type of plant.
  - Is it flowering?
  - Is it about to flower?
  - Have the flowers just died?
  - Does it have seeds where the flowers used to be?

Math Extension

Use rulers to measure the length of the flower stem, the length of the petals and sepals, the width of the petals and sepals, the length of the stamen(s) and pistil. Encourage students to look for patterns among the different flowers.

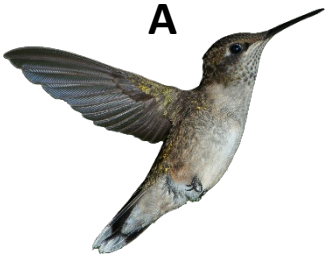
- How long is the flower stem compared to the petal length?
- Which is longer – the petals or sepals? Which is wider?
- Which is longer - the stamen or the pistil?
- How does one flower compare to the other flowers examined? Graph the measurements.

Flowers and their Pollinators

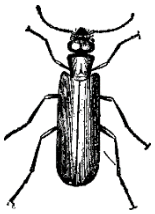
Match the animals in Column A with the flowers they pollinate in Column B.

NOTE: Some animals pollinate more than one kind of flower!

A



hummingbird



beetle

housefly

monarch butterfly

honey bee

B

magnolia

milkweed

clover

skunk cabbage

columbine

Adopt a Tree

Grades 3 – 6

Objectives:

Students will be able to

- observe and describe a tree in the schoolyard
- name and identify their tree
- explain how and why trees are important to the ecosystem
- list organisms that depend on trees for survival
- predict the age of the chosen tree by taking measurements and making calculations

Vocabulary: producers, consumers, ecosystem, tree rings, forestry, estimate, circumference

Age Level: Grades 3-6

Time Allotted: 50 minutes initially, then 10-15 minutes every month throughout the school year (or the duration of the science unit)

Standards Addressed:

Disciplinary Core Ideas: LS1.A, LS1.B, LS3.B, LS4.C, LS4.D, PS3.D, LS2.A, LS2.B

Cross-Cutting Concepts: Patterns, Cause and Effect, Systems and System Models, Energy and Matter

Materials:

- *Tree Observation* and *Tree Measurement* worksheets
- tree & shrub field guides
- pencils & clipboards
- science journals
- measuring tapes & yardsticks
- calculator (optional)
- tree stumps in the schoolyard or tree "cookies" = round slices of tree trunks

Discussion

1. In your journals, draw a tree with as much detail as possible.
2. What do you already know about trees?
    - Are they living or non-living? How do we know?
    - What do trees need in order to survive? Sunlight, water, carbon dioxide, oxygen and nutrients from the soil.
    - Are trees **producers** or **consumers**?
    - What do trees provide for animals and other organisms in the forest ecosystem?
    - Trees provide food, shelter, oxygen, nesting places and building materials.
    - Why do scientists study trees? How are trees important to humans?
3. Let's take a look at the *Tree Observation* worksheet. We will be choosing a tree(s) in the schoolyard to "adopt". We will visit this tree(s) several times over the course of the unit. This worksheet will help us record our observations of the tree.

Activity 1: Tree Observations

If there is poison ivy in the schoolyard, the first step is to make sure everyone is aware of what it looks like! Poison ivy can grow as a hairy-looking vine around the trunks of trees and its leaves grow in groups of three.

1. Each small group or individual will need the *Tree Observation* worksheet, science journals, clipboard and pencil. Field guides will help to identify the chosen tree.
2. As a large group, choose a tree. Should we give it a class name? (Alternatively, each small group could choose a tree to adopt.)
3. On the worksheet describe the tree in detail and draw a sketch of it as well.
4. Let's compare and contrast our descriptions and drawings. Feel free to add notes or details as you listen to others describe the tree.
5. Take a look through the field guides. Can you figure out what group of trees our tree belongs in? Can you narrow it down to species? Does everyone agree? Why or why not?

6. More research can be done on the Internet back in the classroom.
7. Visit the tree regularly and record more observations in detail. How does the tree change as the seasons change?

Activity 2: Tree Measurements

1. Take a quick survey of the groups' ages and heights. How do we determine our age and height?

2. How do you think we could figure out the age and height of a tree?

3. If there are tree stumps in the schoolyard, you can count the rings to determine the age of the tree when it died. If not, tree "cookies" can be used.
    - Each darker colored ring indicates the end of one year of growth.
    - *PBS NOVA website description (paraphrased):* 'A tree grows mostly during the spring, when there is usually rain and sun to nourish it. It starts its spring growth by dividing a layer of cells known as the cambium that lay between the old wood and the tree's bark. This first spring growth is light colored because these cells are large and have thinner walls. As the tree's growth rate slows and eventually stops in the late summer and fall, the cells are smaller, thicker-walled and denser, so this part of the ring appears darker. The darker ring marks the end of the growing season. Therefore, counting out from the center, each ring from the lighter colored cells to the darker colored cells marks one year of growth.'

4. Would this method be helpful to find out the age of living trees?
    - **Foresters**, scientists who study trees and forests, have instruments called **increment borers.**
    - They use these tools to pull out a thin tube or **core** of wood from living trees. This allows them to read the tree's rings while only making a relatively small hole in the tree, an injury from which the tree can easily recover.

5. Since we do not have an increment borer, let's try a different way to determine our adopted trees' ages.

6. Every small group will need a *Tree Measurement* worksheet, clipboard, and pencil. Yardsticks and measuring tapes will be needed as well.

7. If possible, find a tree standing out in the open in the schoolyard for the first analysis. Start with some predictions or estimates:
    - How old do you think the tree is?
    - How tall do you think the tree is?
    - What evidence are your estimates based on?
    - Record your estimates on the *Tree Measurement* worksheet.

8. Measure the first tree as a whole group. Measure and record the circumference of the tree trunk approximately 3 feet or 1 meter from the ground.

9. Measure and record the length of the tree's shadow. Then measure the length of the yardstick's shadow.

10. After the measurements from the first tree are taken, each small group should find another tree(s) to measure. Make sure to measure your adopted tree!

11. The calculations can be done back in the classroom, using a calculator if needed. If your measurement was done in inches, 1 inch =2.54 centimeters, so you do not need to divide by 2.5 to get your estimate. This formula assumes that a healthy tree will grow about 1 inch (or 2.54 cm) in circumference each year of its life.
    - Did your results surprise you?
    - Did your predictions match the results you calculated?
    - Are there any trends or patterns in which species of trees were older or taller than the others?
    - Graphing all the results will help everyone see the data visually.

Tree Observation

Naturalist's name: _____

Date of Observation: _____ Time of day: _____

Weather conditions: _____

Written description of the tree

(Include details about the bark, leaves, flowers or buds, seeds or nuts, branches or limbs, scars, cavities, and anything that is growing on or crawling on the tree):

Sketch of Tree and/or Parts of Tree

Tree Measurement

Naturalist's name: _____

Date of observation: _____Time of day: _____

Weather conditions: _____

Predictions

How old do you think the tree is?

How tall do you think the tree is?

What evidence are your estimates based on?

Measurement Data

Tree circumference (around the tree, measured 3 feet or 1 meter up the trunk):

Tree 1 _____ Tree 2 _____

Tree 3 _____Tree 4_____

Tree	Date	Time	Length of Meterstick/Yardstick Shadow	Length of Tree Shadow
1				
2				
3				
4				

Calculations

TREE AGE

Divide the circumference by 2.5 cm (or approximately 1 inch) to approximate the tree's age.

Tree 1 circumference _____ / 2.5 cm = _____

Tree 2 circumference _____ / 2.5 cm = _____

Tree 3 circumference _____ / 2.5 cm = _____

Tree 4 circumference _____ / 2.5 cm = _____

TREE HEIGHT

This ratio can help you calculate the height of the tree:

$$\text{Estimated Height of tree} = \frac{[\text{Shadow of tree} \times \text{height of stick}]}{\text{Shadow of stick}}$$

Show your work below:

Tree 1

Tree 2

Tree 3

Tree 4

Giving the Forest a Voice

Grades 3 – 6

Objectives:

Students will be able to

- describe several sounds they hear in nature
- describe the texture, smell and color of natural items like leaves and twigs
- create a nature poem in a diamonte format that describes the area they observe

Vocabulary: Seton sit, sound map, observation, diamonte, poem

Age Level: Grades 3 - 6

Time Allotted: 30 minutes

Standards Addressed:

Disciplinary Core Ideas: LS1.A, LS1.D, LS4.D

Cross-cutting concepts: Systems and System Models, Patterns, Energy and Matter, Science is a Human Endeavor

Cross-curricular Connections: Language Arts

Common Core ELA-Literacy: SL.2.5, SL.3.1.A, SL.3.4, SL.3.5, SL.4.1.B, SL.5.1.B,W.4.3.D, W.5.3.D, L.3.3.A, L.3.5.B

Materials:

- science journals
- writing utensils
- magnifying lenses
- tree and shrub field guides
- index cards

Activity 1: Seton Sit

*Historical note: this activity is called a **Seton Sit**, for the writer, artist and naturalist Ernest Thompson Seton, who used to go out and sit in nature to sketch and journal.*

1. Get ready to go outside and explore the schoolyard. Bring science journals and writing utensils for the first activity and magnifiers, field guides and index cards for the other activities.
2. To start, everyone will spread out and do a Seton Sit, i.e., a silent, solo sit for 3-5 minutes. Spread out in the schoolyard to find a spot away from everyone else where you can sit and observe with your senses.
3. Close your eyes and listen for a minute. What do you hear? What sounds are natural sounds, like a bird song or the wind through the trees? What sounds are made by humans?
4. Then sketch a sound map in your journal. Make a small circle or a dot to indicate yourself and use Xs for the sounds you hear. Put the Xs around the circle to show the direction you think the sounds are coming from.
5. As you listen to the sounds, try to think of descriptive words for each one. Jot these down in your journal. You don't have to know what is making the sound, just try to describe it – be creative! Examples: a constant whirr, a dry rattle, a musical trill, a soft whisper
6. Come back together as a group and share what you observed through the activity.
    - What sounds did you hear?
    - What was it like to sit by yourself, silently?
    - Was it easy to sit still for that long?
    - Did you observe any animal activity around you?

Activity 2: Observations of Leaves and Twigs

1. In this activity, we will test our observational skills. Everyone will need a magnifier.
2. Find a leaf and a twig that have fallen to the ground. (Please do not pick leaves and twigs that are still on the plant.)
3. Take a close look at your leaf and twig. Use the magnifier to look even closer.
    - Sketch the leaf or make a list of its details.
    - Feel its texture, smell it, and notice its color.
    - Feel it to see how heavy it is, and how warm or cold it is.
    - Name your leaf – be creative with what it looks like or what it reminds you of.
    - Repeat observations with the twig.
    - Older students can use a field guide and try to identify the tree or shrub where the leaf or twig came from using a taxonomic key.
4. After making these observations, form a circle and put all the leaves in a pile in the middle. All students should close their eyes, while the teacher gently mixes up the pile of leaves.
5. Can you spot your leaf? Take turns picking out your leaf from the pile.
    - How easy or difficult was it to find your leaf?
    - Share something about your leaf that helped you distinguish it from the others.
6. Repeat identification challenge with the twigs.
7. Challenge for older students: instead of everyone finding their own leaves or twigs, each person turns to a partner and describes their leaf or twig. Then the partner tries to find that leaf or twig.

Activity 3: Poem in the Diamonte Format

1. This poem will use the **diamonte** format to create a word picture of the schoolyard just observed.
2. Start and end this group poem with two nouns that name the area we just explored. Suggestions? (Example: the schoolyard and the playground)
3. Break into four groups. Each group gets 4 index cards to write the following:
    - 1 noun on one index card,

- 2 action verbs ending in *–ing* on two other index cards, and
- 1 adjective on the last index card.
- Each word written should have something to do with the habitat observed.

4. When all the groups are finished, the teacher collects the index cards and distributes them at random in a diamond-like shape on the ground using this configuration:

Line 1: Noun (title)

Line 2: Adjective Adjective

Line 3: Verb Verb Verb

Line 4: Noun Noun Noun Noun

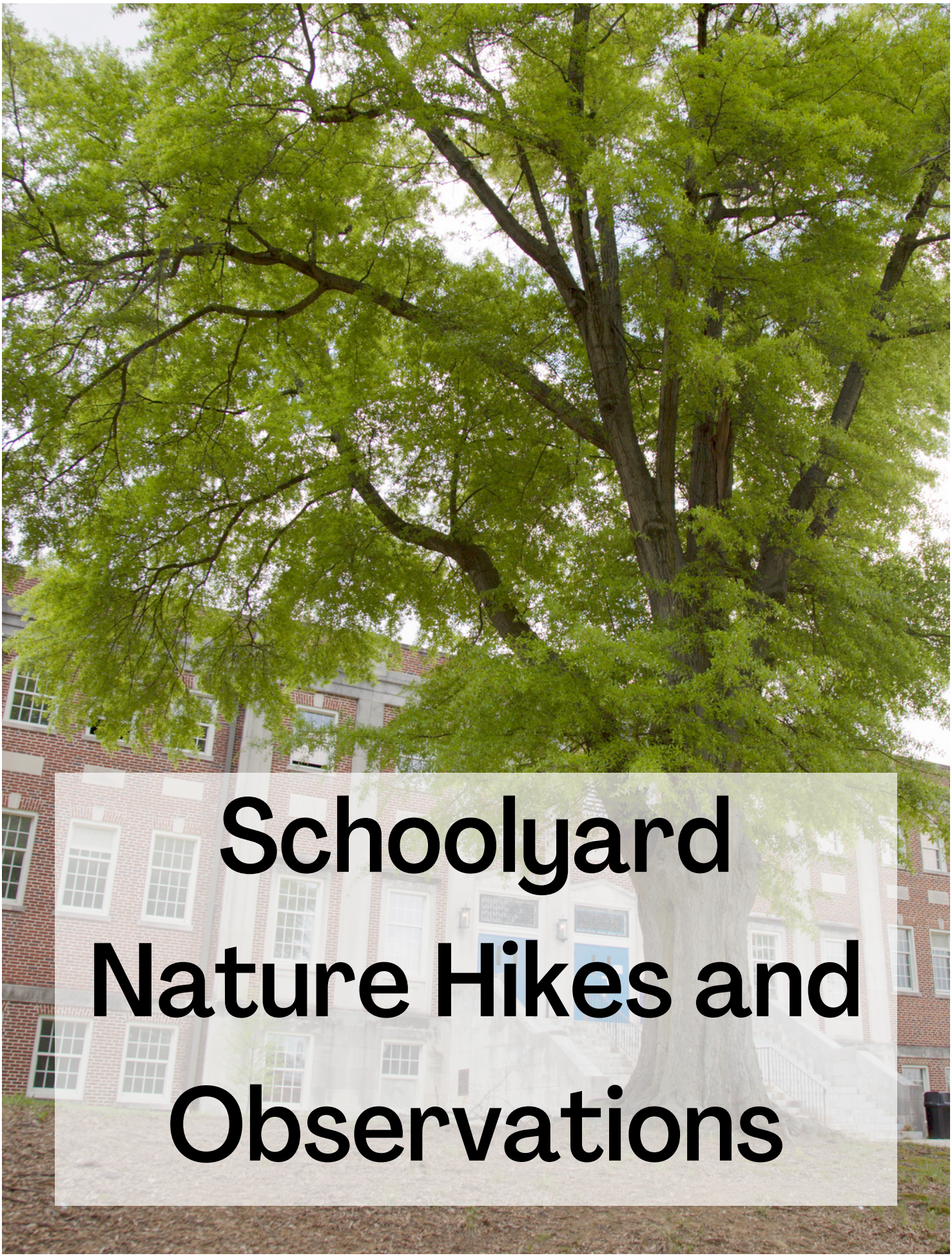
Line 5: Verb Verb Verb

Line 6: Adjective Adjective

Line 7: Noun (alternate title)

There will be a total of eight verbs available, but there may be repetition. If not, add them in or let the group decide which ones work best.

5. As a group, look at the random poem and make suggestions for how to move the cards around to make the poem flow better. Once the group is satisfied, take turns reading the poem aloud.
6. Bring the index cards back inside and display it on a bulletin board to share your experience with others.



Schoolyard Nature Hikes and Observations

Using Your Senses in Nature

Grades K – 1

Objectives:

Students will be able to

- name five senses
- describe textures found in nature
- match colors and shapes found in nature
- count a variety of natural sounds, and identify two of them
- distinguish smells of flowers from the smells of leaves or stems of plants found outside

Vocabulary: seeing, hearing, feeling, smelling, tasting, fruit, flowers, leaves, stems

Age Level: Grades K-2

Time Allotted: *Making nature journals*: 10-15 min

Sensory hikes: 15-20 minutes each

Standards Addressed:

Disciplinary Core Ideas: LS1.A, LS1.B, LS1.C, LS1.D, ESS3.A

Cross-Cutting Concepts: Patterns, Systems and System Models, Structure and Function

Cross-curricular Connections:

Math, Language Arts

Materials:

- nature journal or paper
- crayons
- pencils
- magnifying lenses
- color cards in a variety of colors
- shape cards (triangles, ovals, & hearts are common shapes in nature)
- clipboards
- spoons or garden trowels

Create a Nature Journal

1. Nature journals can help you remember what you observed outside.
2. A simple nature journal can be made with several sheets of construction paper or plain white paper folded together.
3. Decorate the cover!

Discussion

1. We use our senses to explore the world around us. Can you name five senses that humans use the most?
2. You can use your senses of sight, hearing, touch and smell to explore nature in the schoolyard.

Activity 1: Texture on the Trail

1. Bring journals, crayons and clipboards outside for a texture scavenger hunt.
2. Can you find various textures in nature, like smooth, rough, slippery and bumpy?
3. Make rubbings of your favorite textures!
4. To make a rubbing, place an item, such as a flower petal, leaf, or seed pod, on a flat hard surface like the clipboard. Place a page of paper of the journal on top of the item. Rub the crayon on the paper that covers the item. What happens?
5. To make rubbings of rocks or bark, put paper directly on the rock or tree. Can you find tree bark or rocks that are smooth? Rough? Very rough?
6. Label the rubbings with a descriptive word (adjective) for the texture.

Activity 2: Color & Shape Hike

1. Bring journals, pencils, hand lenses, and color and shape cards along on this hike.
2. First practice using the hand lenses. Hold it close to what you are looking at and slowly move it closer or farther away until the image is in focus. Try it on your own finger! Can you see your fingerprints up close?
3. Find some natural items to investigate up close. What do you notice when you look through the lens? Do you see things on a leaf/rock/flower that you didn't see with just your eyes?
4. Pass out the color cards. As you walk along, try to find natural items that match your color cards. Are some colors easier to find? What is the most common color?
5. Repeat with shape cards. What shapes do you find? How many different leaf shapes can you find? Can you sort different leaves into groups by shape?
6. During or after the hike, list, draw, or otherwise record colors and shapes in the nature journals.
7. If you tally up the number of colors and shapes you can create bar graphs with the information.

Activity 3: Sound Hike

1. Bring nature journals and pencils on this walk.
2. Walk very quietly and listen for different sounds. Can you be silent for 30 seconds? 60 seconds? Can you walk silently from one end of the playground/ball field to the other? What did you hear? What might be the advantage of walking quietly? What is the advantage of being quiet if you are a wild animal?
3. Stand in one place to listen. Close your eyes and hold up a finger for every sound you hear. How many different sounds did you hear? What kinds of sounds did you hear? Can you tell if the sounds were made humans? The wind? Animals?
4. Find a spot to sit and be silent. Use a page in your journal to draw a sound map. Make a small circle or a dot to indicate yourself and use Xs for the sounds you hear. Put the Xs around the circle to show the direction you think the sounds are coming from.

Activity 4: Use your Nose!

1. Bring journals, pencils and spoons on this walk. Get ready to sniff! This is a walk to find different smells in nature.
2. Here are some clues to the places and plants that may produce strong smells.
    - Smell the flowers and leaves of the plants in your schoolyard.
    - Smell the needles, cones and bark of evergreen trees and hedges.
    - Smell the fruits on a cherry, pear, or crabapple tree. Try crushing the fruit, does that smell different?
    - Scrape a bit of the bark of a cherry trees and smell it.
    - Dig in the soil. How does it smell?
    - Rub the outside of a hickory nut or acorn. How does it smell? (***CAUTION*:** if there is a nut allergy in your class, avoid this one!)
3. Record observations about the various smells and their sources. Did the flower and leaf from the same plant have a similar smell? Or were they different? Did you have a favorite smell?

Follow-Up Discussion

1. Which outdoor sensory experience did you like the best?
2. Did you find one sense easier to use than the others?
3. Do humans use one sense more than others?
    - Many mammals use their sense of smell most often, but humans tend to rely on their sense of sight the most.

Finding Patterns in Nature

Grades 2 – 4

Objectives:

Students will be able to

- identify patterns in nature
- describe what the Fibonacci numbers are
- find examples of the Fibonacci numbers in nature

Vocabulary: patterns, Fibonacci numbers, predator, prey

Age Level: Grades 2 - 4

Time Allotted: 45 minutes

Standards Addressed:

Disciplinary Core Ideas: LS1.A, LS3.B, LS4.D, ESS1.C, ESS2.B, ETS1.B, PS2.A

Cross-Cutting Concepts: Patterns, Structure & Function

Cross-curricular Connections:

Math, Physical Education, Art

Materials:

- clipboards
- pencils
- scavenger hunt (included)
- 4 Fibonacci numbers worksheets (included)
- pine cones
- snail shells (moon snail and whelk shells work well)
- magnifying lenses
- maps of the area or access to Google Earth to print out maps
- science journals

Discussion

1. What is a **pattern**? Can you give an example?
    - Patterns are repeated designs, shapes, features or structures.
    - Patterns are also regularly repeated actions or behaviors.
    - Patterns can be found indoors on fabric, wrapping paper, floor tiles, artwork, and more!
    - If we go to lunch every day at noon, that is a pattern.
    - We will be looking for patterns in shapes and designs in nature.
2. How do we detect patterns?
    - We see them with our eyes, but it's our brain that puts the pattern together.
3. Why would it be an advantage to be able to detect patterns?
    - People use patterns to solve math, engineering and design problems when inventing or building things.
    - People use patterns seen in clouds, temperature and air pressure to make predictions about weather.
4. Do animals have the ability to detect patterns?
    - Yes! One example is that dogs, cats and other pets know when they should be fed or taken outside. If you forget, they will remind you.
5. How can patterns be important to a wild animal?
    - A predator may use a prey's pattern of visiting a watering hole to determine the best time to hunt.
    - Prey species may detect a predator's pattern of hunting to know when to hide.

Activity 1: Shape & Pattern Scavenger Hunt

1. Let's go outside to look for shapes and patterns in nature! Each small group will need a scavenger hunt sheet, clipboard, writing utensils, and science journals.
2. Take a walk around the schoolyard to notice and record shapes. Look for the following:
    - Shapes of leaves, flowers, and trees.
    - Shapes and patterns in the clouds.
    - Patterns on the ground, in the soil, through the grass, and through the pine needles.
    - Shapes and patterns of mineral intrusions in rocks.
    - Patterns in the ripples in puddles or the way water ran after the last rainstorm.

3. On the back of the scavenger hunt or in your journal, record the number of each shape you found.
    - Which shape did you see most often?
    - Which shape did you see least often?
    - Did you find shapes or patterns that were not on the scavenger hunt sheet?

4. On the way back to the classroom, try out some walking patterns:
    - walk in a straight line
    - walk in a diagonal line
    - walk in a zigzag
    - walk in an "s" shape (try to do this as a big group!)
    - walk using right angled "L"s
    - walk in spiraling circles – don't get dizzy!

5. Back in the classroom, use the data collected to do some math! Some ideas are to calculate the frequencies or the percentages of how often the different shapes were seen.

Activity 2: Fibonacci Numbers

1. What are the Fibonacci numbers? To figure that out, do the first worksheet and then put the numbers up on the board.

2. Using our magnifying lenses, let's look for patterns on the pine cones. What do you notice?

3. Complete the pine cone Fibonacci worksheet and compare the patterns that emerge on the worksheet with your pine cone.

4. Look for patterns in the shells and do the accompanying worksheet. Compare the pattern of your shell to the pattern on the worksheet.

5. Look for shapes and patterns of landforms and waterways on maps of the schoolyard, town, state and more. What do you notice? Compare different rivers and streams—do they have similar shapes?

6. To extend the experience, look for more shapes and patterns at home. Keep track of how many Fibonacci numbers you find in your science journal. Make a tally like you did for the shapes and patterns scavenger hunt. Ideas:
    - Count petals on flowers.
    - Count leaves on plant stalks.

- Count veins in each leaf.
- Count the number of lines on a pumpkin.
- Look for the spiral on a pineapple and follow it the same way you did with the pine cone. How many spirals are there?

Extensions

Art Extension

- Draw a picture using just the shapes and patterns you found on the scavenger hunt.
- Add texture to the drawings by going outside and doing rubbings on various leaves, bark, rocks, etc. What texture is most common?

Science/Math Extension

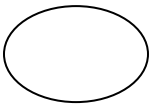
- Conduct shape and pattern scavenger hunts in different seasons. How do things change? Graph the results.
- Design your own scavenger hunt based on your own observations.
- Are there different patterns and shapes in different habitats?

Finding Patterns in Nature

Scavenger Hunt

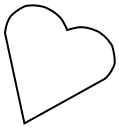
During our nature hike, how many things can you find that …

… are shaped like an **oval**?

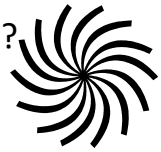


… are POINTY on the ends?

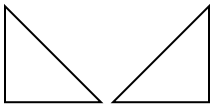
… are shaped like a **heart**?



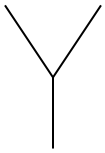
… show a **spiral** pattern?

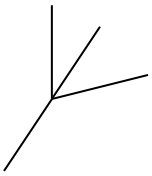


… have **angles** and **triangle** shapes on them?



… show a **forked** branching pattern?





… show a branching pattern that looks like your **hand**?

Which <u>shape</u> or <u>pattern</u> have you seen the most often? The least often?

What are the Fibonacci Numbers?

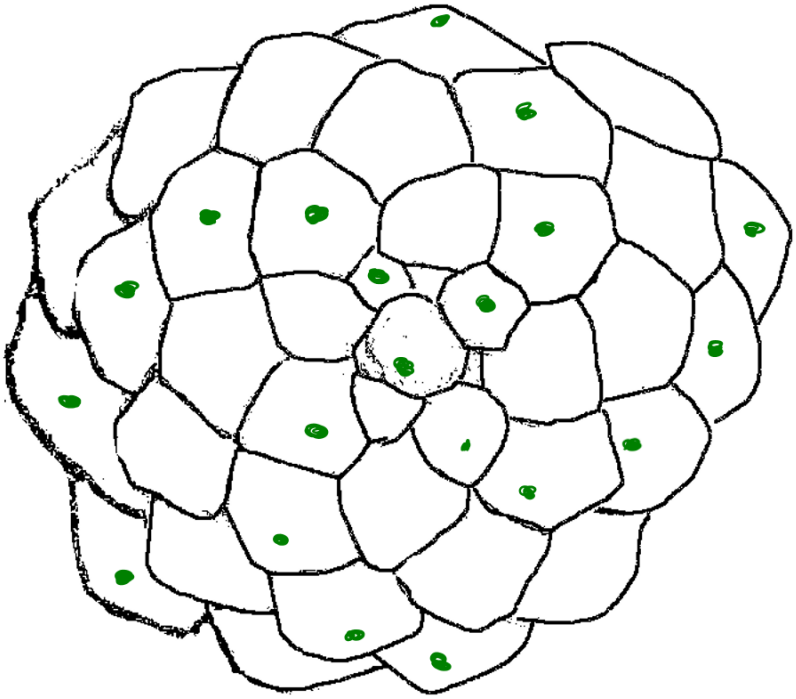
START with 0	=	0
Add 1 + 0	=	
Add 1 + 1	=	
Add 1 + 2	=	
Add 2 + 3	=	
Add 3 + 5	=	
Add 5 + 8	=	
Add 8 + 13	=	
Add 13 + 21	=	
Add 21 + 34	=	55

This is how we get the Fibonacci numbers.

They go on up as far as you can add!

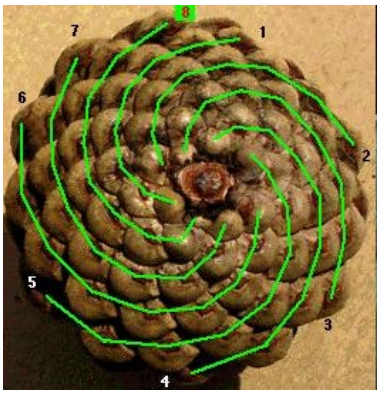
Color all the pine cone scales with a dot GREEN.

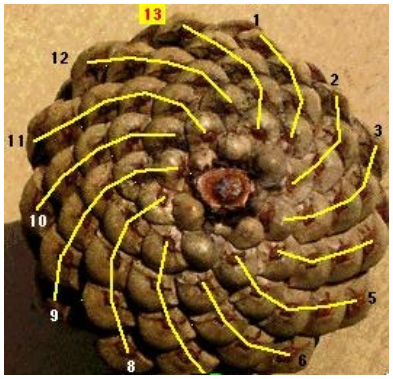
Color the scales other ORANGE.



How many SPIRALS do you see? _____

Fibonacci numbers can be seen in pine cone spirals, too!

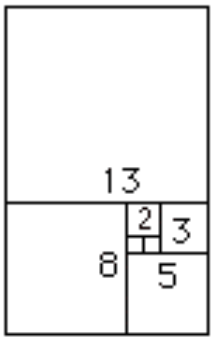




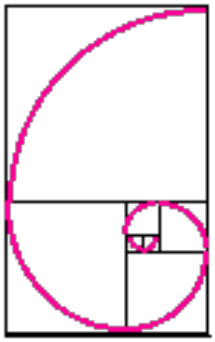
Spirals in Nature

(Fibonacci strikes again!)

These are called the **Fibonacci rectangles**:



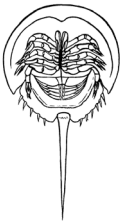
This is what you get by drawing a **curved line** through the *middle* of the rectangles:



Which of these **shapes** does the curved line look like?

Bonus question: What are the names of the other shapes?

Which of these plants and animals have that same shape as the one you circled above?

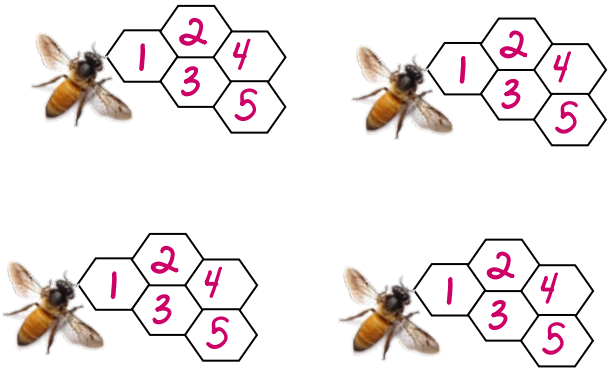


Making a BEE-LINE

How many different ways can your bee fly from Cell #1 in the hive to Cell #3?

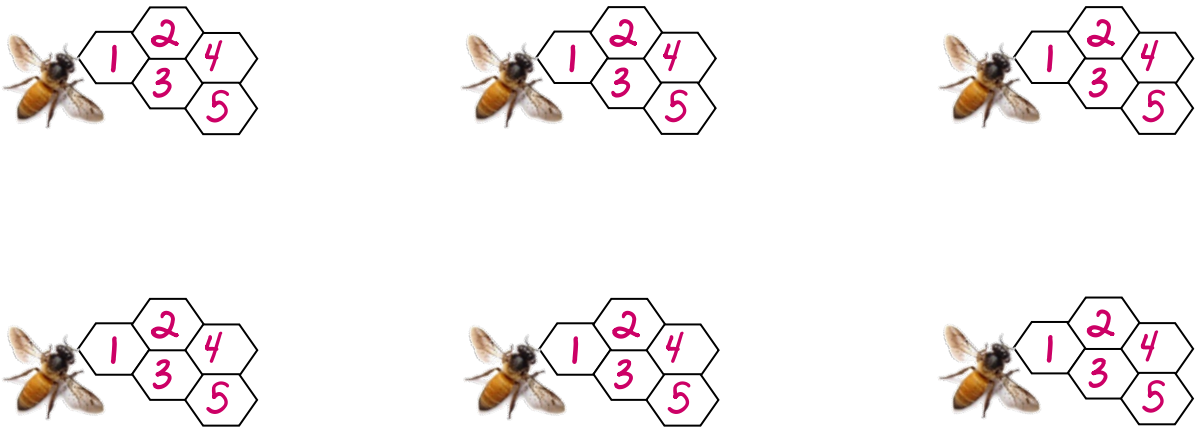
Number of different paths _____

How many different ways can your bee fly from Cell #1 in the hive to Cell #4?



Number of different paths _____

How many different ways can your bee fly from Cell #1 in the hive to Cell #5?



Number of different paths _____

Do these numbers look like the FIBONACCI numbers??

Weather, Water and Soils

Weather Watchers

Grades K – 3

Objectives:

Students will be able to

- list 3 things weather scientists or meteorologists measure
- define evaporation, condensation and precipitation as part of the water cycle
- explain how a raindrop forms in a cloud
- list two tools used to record information about weather

Vocabulary: meteorologist, condensation, precipitation, evaporation, thermometer, anemometer

Age Level: Grades K-3

Time Allotted: 25 minutes

Standards Addressed:

Disciplinary Core Ideas: ESS2.C, ESS2.D, ESS3.B, LS2.D PS2.A

Cross-Cutting Concepts: Patterns, Cause and Effect

Cross-curricular Connections:

Math, Art

Materials:

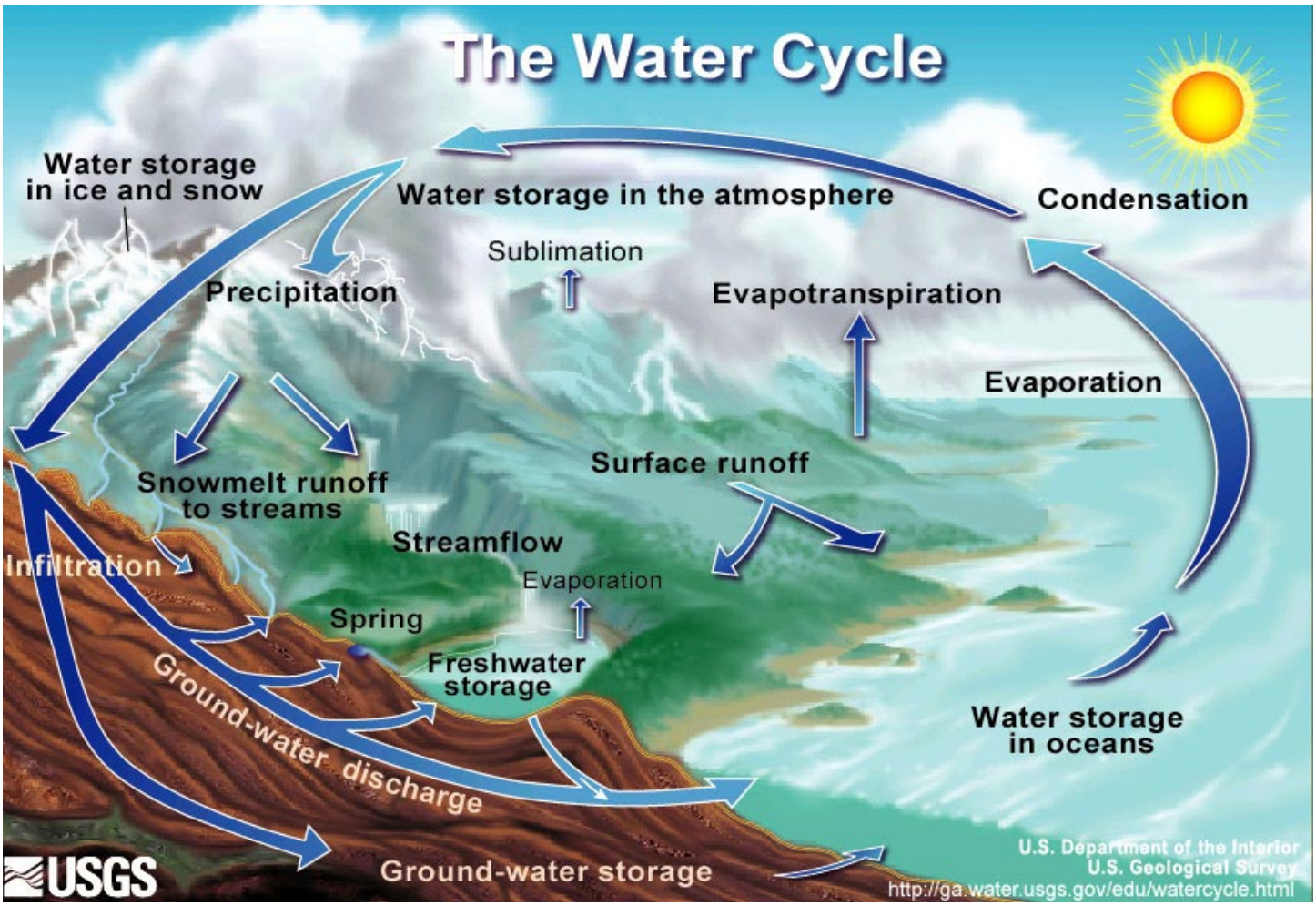
- cones or flagging tape
- based on age group either copies of *Discovering Weather* or *Weather Watchers* worksheets (included)
- clipboards
- pencils
- cloud charts
- copies of a Google Earth map of the schoolyard with compass directions on it
- Beaufort wind scale poster
- thermometers
- measuring tape or rulers
- anemometer to demonstrate how to measure wind

Discussion

1. A scientist who studies weather is called a **meteorologist.** What are some aspects of the weather that a meteorologist might observe and record?
    - temperature, clouds, **precipitation**, wind speed, wind direction

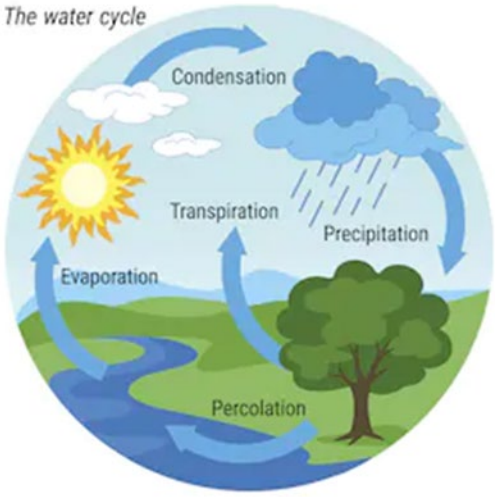
2. What are the ingredients that make up a cloud?
    - very tiny droplets of water or ice crystals

3. Review the parts of the water cycle.
    - **Evaporation**: when water gets warm enough it turns from a liquid into a gas called water vapor.
    - **Condensation**: when water cools it turns from gas into a liquid.
    - **Condensation** is very important in the formation of clouds. The tiny droplets of water in the cloud condense around a little piece of sand, dust, or salt to form bigger droplets. When the drops get heavy enough they fall to the ground as precipitation.
    - **Precipitation**: when water is released from the clouds as rain, freezing rain, snow, hail or sleet.



Activity 1: Raindrop Tag

1. In the schoolyard or gym, use the cones or flagging tape to set the boundaries for this game. The boundaries are the edges of the cloud!



2. To help us understand what's going on in a cloud, we're going to play a game called *Raindrop Tag*.
3. All the students are tiny little water droplets floating around in the cloud. To be able to precipitate, the water droplets must get bigger and heavier.
4. Two students will be the **condensation nucleus**, i.e., the little piece of sand, dust, salt, etc. on which the water droplets condense to form a rain droplet. The nucleus must stay attached, so hold hands or link elbows.
5. As the condensation nucleus, you want to get more water droplets to join you. Staying together, try to tag other "droplets". Once you tag them, hold hands or link arms with them.
6. Then continue to work together to tag other water droplets.
7. Once there are 4 of you, you can split into 2 pairs. Each pair then tries to tag more droplets and the process repeats.
8. When everyone is connected the teacher calls out "**RAINSTORM!**" and everyone falls to the ground.
9. How is the game like what is happening in a cloud? How is it different?

Activity 2: Discovering Weather

This activity is for younger students, grades K – 1.

1. Each small group will need a *Discovering Weather* worksheet, clipboard, pencil and rulers or measuring tape. Cloud charts and thermometers could be shared.
2. Take a minute to quietly observe the weather.
    - Do feel the sun on your face?

- Is a breeze moving the leaves? Is it moving the school flag?
- Is your nose cold?
- What do the clouds look like? Bright white? Gray?
- Looking at the cloud chart, which cloud type most resembles the clouds above us?
- Let's measure the air temperature using a thermometer.
- Are you dressed right for the outside temperature?

3. As a group, make a guess (prediction) of where the warm spots will be in the schoolyard.
4. Then test your guesses by placing your hands on each spot. Do you all agree which spot is the warmest? The coldest?
5. Try a wind experiment. Each group will need a leaf or small twig.
    - Set a starting point. On the count of 3, each group releases their object.
    - Measure the distance from the starting point to where the object landed. How far did it go? Record the distance on the back of your worksheet. Try again.
    - Can you choose another object that you think will travel farther on the wind? What is different about your second object? Try again.
    - Compare your results.

Activity 3: Weather Watchers

This activity is for older students, grades 2 - 3

1. Each small group will need a *Weather Watchers* worksheet, Google Map of the schoolyard, clipboard and pencil. The thermometers, cloud charts, Beaufort scale, anemometer and measuring tools can be shared by everyone.
2. Let's be METEOROLOGISTS! The worksheet will guide your group through the investigations.
3. Describe today's weather and record the temperature.
4. Sketch and describe the clouds in the sky. Use the cloud charts to identify the types of clouds you see.
5. Share your observations and conclusions about the clouds.
6. Next, measure the wind speed and direction. *If there is no wind outdoors, you could use a fan.*
7. To figure out the **wind direction**:
    - Turn around slowly until you feel the wind on your back. Stay in that direction as you do the next steps.

- Orient the map with the schoolyard.
- Notice the compass directions on the map. Where is north? Northeast?
- When you note wind direction, you note where the wind is coming FROM.
- Record it on your data sheet.

8. **Wind speed** is measured using the Beaufort scale.
   - This scale gives clues about how fast things, such as flags, leaves and branches, are moving to estimate wind speed.
   - Look around and compare how the flag or trees are moving with the scale.
   - How fast do you think the wind is blowing? Record your data.

9. The anemometer is another way to measure wind speed. Demonstrate.

10. Try a wind experiment. Each group will need a leaf or small twig.

    - Set a starting point. On the count of 3, each group releases their object.
    - Measure the distance from the starting point to where the object landed. How far did it go? Record the distance on the back of your worksheet. Try again.
    - Can you choose another object that you think will travel farther on the wind? What is different about your second object? Try again.
    - Compare your results.

Extensions

Math Extension

Graph the weather data and the results from the wind experiments. Try these experiments on different days throughout the season to compare results and look for patterns.

Engineering Design Extension

Challenge: Design a structure to prevent wind or hail damage during a thunderstorm. Test these designs by using a fan and by dropping ice cubes onto the structures from different heights.

Language Arts Extension

Write a story about what it would be like to be a water droplet going through the water cycle, floating around in a cloud, and precipitating back onto the earth.

Discovering Weather

Name (s) _____

What Season is it? SUMMER FALL WINTER SPRING

What is the weather like?

SUNNY 

CLOUDY 

WINDY 

RAINY or SNOWY 

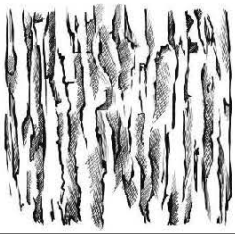
Guess WHERE the WARM spots in the schoolyard are!
TEST your GUESS by feeling with your hands.

Circle the WARM or the COLD to describe what you feel:

Grass

WARM or COLD

Tree Bark

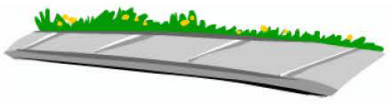


WARM or COLD

Shade

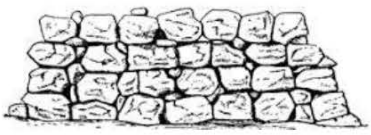
WARM or COLD

Sidewalk



WARM or COLD

Rocks



WARM or COLD

Metal Grate

WARM or COLD

Name:_____ Date:_____ Temperature:_____ Weather:_____

Weather Watchers Worksheet

Cloud Observations

Look at the cloud charts and compare them to the clouds in the sky.

Sketch the clouds you see:

Write the name(s) of the clouds you see today:

_____

_____

Wind Experiments Data

WIND SPEED (according to the Beaufort Scale) _____

WIND DIRECTION (using a schoolyard map) _____

Object	Distance Traveled Trial 1	Distance Traveled Trial 2

Sensational Soils

Grades 3 – 6

Objectives:

Students will be able to

- describe the differences between soil samples
- list the components that make up soil
- identify two animals that live in the soil

Vocabulary: soil, soil horizon, organic agronomist, sand, silt, clay, humus, decomposition

Age Level: Grades 3 - 6

Time Allotted: 30 minutes

Standards Addressed:

Disciplinary Core Ideas: LS2.A, LS2.B, LS4.C, LS4.D, ESS2.A, ESS3.B, ESS3.C, ETS1.B, ETS1.C, PS3.A, PS3.B

Cross-Cutting Concepts: Cause and Effect, Patterns, Systems and System Models, Energy and Matter, Scale, Proportion and Quantity

Cross-curricular Connections: Language Arts, Math

Materials:

- soil corer and/or gardening hand trowel
- air thermometer
- bottle of water
- rulers
- soil thermometers
- paper plates
- metal spoons or gardening hand rakes
- magnifying lenses & bug boxes
- field guides for insects, spiders, forests, bugs & slugs
- *Soil Science* data sheets
- clipboards
- pencils

Discussion

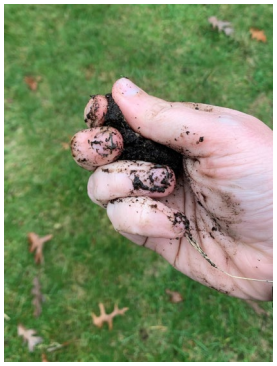
1. Have you ever played in a sand box or dug a hole in the yard? Planted a seed? Made a mud pie? If so, you have touched **soil**!
2. Brainstorm a "soil recipe" or list of what might be in soil. Later we can compare our recipe with what we find outside.
    - Do you think soil is a living thing or a non-living thing?
    - Are any living things found in the soil? What might they be?
    - Are there non-living things in the soil? What do you think they are?

Activity 1: Sorting Soil

1. Choose a few spots in the schoolyard and/or school garden where students can dig and compare soil types. *Examples include a grassy open spot vs. a spot in the school garden OR a spot in a school courtyard vs. a spot along the edge of the school.*
2. Small groups will need rulers, soil thermometers, paper plates, spoons, magnifying lenses, bug boxes, *Soil Science* data sheets, clipboards and pencils. The water, air thermometer, soil corer/ trowel and field guides will also be needed.
3. At the first site, use the soil corer/trowel to pull up a soil sample to show the students.
    - What colors do you see in the soil?
    - Can you describe the texture? Is the texture the same throughout?
    - Look for areas where the soil gets lighter or darker, or the texture changes.
    - The layers of soil are called **soil horizons.** These horizons are used by scientists to classify soils.
    - Soil scientists are called **agronomists**.
4. To determine types of soils, agronomists do a variety of tests.
    - To test soil texture, everyone will need a small handful of soil, just enough to cover your palm.
    - Rub the soil between your fingers. How does the texture feel?
    - There are 3 basic types of soil: **SAND**, **SILT** and **CLAY**. There may be different combinations of these in a given soil sample.

- If the soil feels gritty, like there are tiny little hard pieces in it, it has a lot of SAND in it.
- If the soil feels slippery and smooth, it has a lot of SILT in it.
- If the soil feels sticky and it forms a ball, it has a lot of CLAY in it.

5. We can do another test with that same handful of soil. This is called the "ribbon test".
    - Take a small handful of soil.
    - Add 2-5 drops of water and squeeze your soil together and see if you can form a ball. Does it hold together? How did it feel? Did it feel gritty (sand), silky (silt) or plastic/sticky (clay)?
    - Holding the ball in your hand, gently push the soil between your thumb and forefinger to make a hanging ribbon (shaped like a worm). How long is your ribbon? Use a ruler to measure.
    - If you can make a short ribbon, your soil is loamy, i.e., a mixture of sand and clay.
    - The longer your ribbon, the more clay is in your soil sample.


6. Soil also contains an organic component called **humus** which is made up of decomposing leaves and other plant material. Do you see any evidence of plants in your sample?
    - **Organic** components are the parts that used to be alive or part of a living thing, like leaves.
    - **Decomposition** is the rotting or decaying of material. Decomposers are the creatures that do the work of breaking things down. They include living things like bacteria, fungi, worms, snails and others.

Activity 2: Digging in the Soil

1. Now we are going to work in small groups to examine the soil in different spots.

2. Another test agronomists do is to measure the temperature of the soil. Record the air temperature first, so we can compare it to the soil temperatures later. Do you think the air will be warmer or cooler than the soil?

3. At each spot, BEFORE you start digging, put the soil thermometer in the ground. Then, just before moving to a new spot, check and record the temperature.

4. DIG!
    - Use the spoons and/or your hands to dig in the soil. You may want to put some soil on a paper plate to look at it closely. What do you notice about your sample?
    - Look at the soil through your magnifying lens. Can you see individual grains of soil?
    - Does your soil have a smell?
    - Try the ribbon test again. What type of soil do you have?

5. If you find any animals in the soil, gently put them in the bug boxes so you can see them up close. The field guides can help you figure out what kind of animals you find.

6. When you are done investigating, be sure to put the soil back in the holes and return the animals to their home.

7. Share your observations and temperature data.
    - Did the color of the soil change from site to site?
    - Did the texture change? Did you find sand, silt, clay and/or humus?
    - What kinds of things did you find in the soil?
    - If you found animals, were you able to identify them?
    - Did the temperature vary from site to site?
    - If so, what factors could be involved in making the soil in one place warmer or cooler than another?
    - How did the air temperature compare to the soil temperatures?

8. Remember the original recipe you made of the soil? Compare that with what you found outside.

Extensions

Arts Extension

- Draw one of the animals you found. Label the drawing with its name and the easily identifiable parts, like eyes, antennae, legs, etc.

Language Arts Extension

- Write a short essay on what it would be like to live in the soil or write as many adjectives as you can think of to describe the soil you investigated.

Science/Math Extension

- Bring back samples from each digging spot to weigh. Make sure each sample has the same volume.
    - Make predictions about the weight of each sample. Which will be the heaviest? Why do you think so?
    - Weigh the samples and graph the data.

Date: _____ Student names: _____

SOIL SCIENCE

Write or Draw your SOIL RECIPE here:	What did you find when you dug in the SOIL?

Write 2 adjectives to describe how the soil feels:

_____ _____

Which of these SOIL TYPES was in your soil?
(Circle the ones that match)

SAND **SILT** **CLAY**

How long was your SOIL RIBBON? _____ inches

_____ centimeters

TEMPERATURE:
Will the AIR or the SOIL temperature be higher? Why?

AIR TEMPERATURE	SOIL TEMPERATURE
_____ / _____ °F / °C	_____ / _____ °F / °C

Was your prediction correct?

Runoff Round Up

Grades 3 – 6

Objectives:

Students will be able to

- describe the water cycle
- define runoff and erosion
- explain how the material covering the ground affects runoff
- identify areas in the schoolyard likely to experience the greatest amount of runoff
- explain how plants reduce the amount of surface runoff

Vocabulary: condensation, precipitation, evaporation, runoff, weathering, erosion, gravity

Age Level: Grades 3-6

Time Allotted: 45 minutes

Standards Addressed:

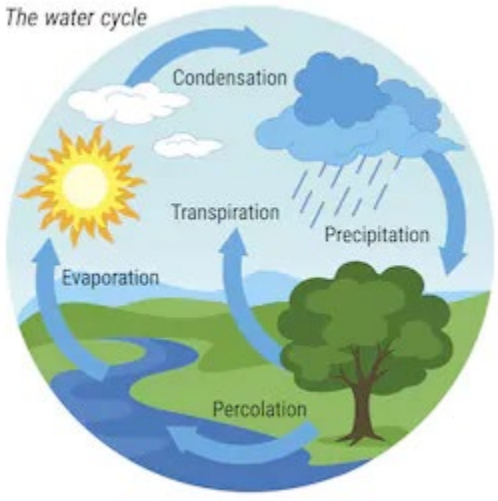
Disciplinary Core Ideas: PS2.A, ESS2.A, ESS3.B, ESS3.C, ETS1.A, ETS1.B, ETS1.C

Cross-Cutting Concepts: Patterns, Cause and Effect, Scale, Proportion and Quantity, Systems and System Models, Influence of Science, Engineering and Technology on Society and the Natural World

Cross-curricular Connections: Math, Art, Language Arts

Materials:

- copies of *Runoff Round Up* data sheets
- clipboards & pencils
- buckets or jugs of water
- measuring cups or graduated cylinders
- flags or flagging tape



Preparation

Prior to the lesson, locate at least two runoff study sites in the schoolyard or along a trail.

- Students will work in small groups, so each site should be big enough for everyone.
- Select one site prone to excessive surface water runoff during a rainstorm. *Paved areas along the edges of buildings or locations where downspouts empty into the schoolyard are good examples.*
- Select another site with little surface water runoff during a rainstorm. *Flat grassy areas around the schoolyard are often good sites.*
- Mark the site boundaries with flags or flagging tape.

Discussion

Draw a diagram of the water cycle on the board.

1. What is the water cycle?
   - The water cycle traces the continuous movement of water on, above and below the surface of the Earth.
2. Label the following processes on the diagram: **evaporation, condensation, precipitation,** and **runoff.**
3. Where can the water go after it falls to the ground as precipitation?
   - evaporate back into the atmosphere
   - be absorbed into the ground, i.e., infiltration
   - be absorbed by a plant's roots, then released back into the atmosphere, i.e., transpiration
   - be carried along the surface of the ground as runoff, eventually emptying into a body of water i.e., transportation

Activity 1: Measuring Runoff

1. Our challenge is to figure out what factors affect the runoff of precipitation in the schoolyard.

2. Each small group will need a clipboard, pencil, a *Runoff Round Up* data sheet, measuring cups/ graduated cylinders and jugs/buckets of water.

3. Each group should choose a spot within the Site #1 boundaries to analyze.
    - What do you notice about this site?
    - What are the physical characteristics of the site?
    - Record your observations on the data sheet.

4. Where do you think the water will go after a heavy rain? Record your predictions.

5. Work together to conduct the runoff test.
    - Measure out 2 cups or 500 ml of water.
    - Pour all this water over the EXACT same spot all at once and observe.
    - Record your observations on the data sheet.

6. Estimate what percentage of water was absorbed and what percentage of water ran off. Record these estimations.

7. Visit Site #2 and repeat the procedures.

8. After conducting the tests, complete the comparison section of the data sheet.

9. Share and discuss the results.
    - What causes the water to fall to the ground and then move along the ground the way it did? **Gravity!**
    - How does the slope of an area affect the amount of runoff? The steeper the slope, the greater the runoff.
    - How does the type of material covering the ground affect runoff? Runoff is much greater on surfaces like cement or asphalt because they don't allow water to be absorbed into the ground.
    - How does the amount of vegetation in an area affect the amount of runoff? Plants usually help slow the flow of water and allow the water time to soak into the ground, resulting in reduced runoff.

- Citing evidence, can you predict what kinds of areas are likely to experience the greatest runoff during a rainstorm? Steeply sloped, paved, and un-vegetated areas are likely to experience the greatest amounts of runoff.

10. Why are we concerned with runoff in our schoolyard, backyard, and neighborhood?
    - pollution, flooding, erosion, weathering

11. How might human activity affect runoff? What are some things people can do to help minimize runoff?

12. Runoff can result in **erosion**. What is erosion?
    - Erosion occurs when tiny bits of rock or dirt get transported elsewhere.
    - How is erosion different than **weathering**?
    - Weathering is what happens to rocks, buildings, sandy beaches, dirt roads, etc. that causes those things to get smaller or get grooves or ruts in them.

Extensions

Science/ Geography Extension

Print out a Google Earth map of the schoolyard. Color code the map with what ground covering is found in each location (ex. grass, concrete, etc.).

Art Extension

- Draw or paint the pattern that was created when the water flowed across the ground during the experiment.
- Can you recreate the patterns with watercolor paints on a tilted sheet of paper?

Science Inquiry and Engineering Extensions

- Try the runoff experiment in your neighborhood—are the results the same or different?
- Conduct the runoff experiments in various weather conditions and compare results.
    - after a rainstorm when the soil is saturated
    - after the ground has frozen in the winter
    - when there has been no precipitation
- Design other variations of the runoff experiment.

Runoff Round Up

Name: _____

At each site, complete a site description and predict how much runoff will occur.
Then test your prediction and record the results.

SITE 1 Description:

ELEVATION (circle one): flat slight slope steep slope
SURFACE (circle one): cement asphalt sand gravel soil grass other
VEGETATION (circle one): covered with plants few plants no plants
LOCATION (circle one): open/exposed shaded/protected

SITE 1 Prediction:

What do you think happens when heavy rain falls on this site?

SITE 1 Observations:

To test your prediction, pour two cups (or 500 ml) of water over the same spot in your site. Observe and describe what happens.

Observations:
How much water was absorbed by the ground? (all, none, some) **What percentage of water would you estimate was absorbed?**
How much water ran off the surface? (all, none, some) **What percentage of water would you estimate ran off?**
Was your prediction correct?

SITE 2 Description:

ELEVATION (circle one): flat slight slope steep slope
SURFACE (circle one): cement asphalt sand gravel soil grass other
VEGETATION (circle one): covered with plants few plants no plants
LOCATION (circle one): open/exposed shaded/protected

SITE 2 Prediction:

What do you think happens when heavy rain falls on this site?

SITE 2 Observations:

Test your prediction with 2 cups (or 500 ml) of water poured as before. Observe and describe what happens.

Observations:
How much water was absorbed by the ground? (all, none, some) **What percentage of water would you estimate was absorbed?**
How much water ran off the surface? (all, none, some) **What percentage of water would you estimate ran off?**
Was your prediction correct?

Comparison of the two sites:

Was the amount of runoff in the two sites different?
What factors can increase the amount of runoff in an area?

Schoolyard Temperature Surveys

Grades 3 – 6

Objectives:

Students will be able to

- predict which spots in the schoolyard are the warmest and coolest
- differentiate between surface temperature and the air temperature above surfaces
- name factors that contribute to different areas heating up or staying cool
- make connections between human-made surfaces absorbing heat as an energy transfer and the impact of that energy transfer on the atmosphere and the climate over time

Vocabulary: surface temperature, atmosphere, climate, global climate change

Age Level: Grades 3 - 6

Time Allotted: 10-15 minutes

Standards Addressed:

Disciplinary Core Ideas: ESS2.A, ESS2.D, ESS3.B, ESS3.C, ESS3.D, PS3.A, PS3.B, ETS1.A, ETS1.B

Cross-cutting Concepts: Patterns, Cause and Effect, Energy and Matter, Scale, Proportion and Quantity, Systems and System Models, Stability and Change

Cross-curricular Connections: Math, Engineering

Materials:

- laser thermometers
- air thermometers
- *Schoolyard Temperature Survey* data sheets
- clipboards & pencils

Preparation

- Be prepared to do both of the following activities in the same day.
- Find an area around the school where students can measure the temperature of various surfaces, such as grass, mulch, bare dirt, sidewalk, asphalt and leaf litter.

Activity 1: Surface Temperatures

1. Each group will need a laser thermometer, data sheet, clipboard and pencil.

2. Introduce the various surfaces within the study boundaries. The purpose of this activity is to predict and test which of these surfaces will be the warmest and which will be the coolest. Demonstrate how the laser thermometer works.

3. Split the students into two groups: Team WARM and Team COOL.
    - Team WARM will focus on predicting and measuring where two of the WARMEST places in the schoolyard will be. Record the data under Spot A and Spot B on the data sheet.
    - Team COOL will focus on predicting and measuring where two of the COOLEST places in the schoolyard will be. Record the data under Spot C and Spot D on the data sheet.

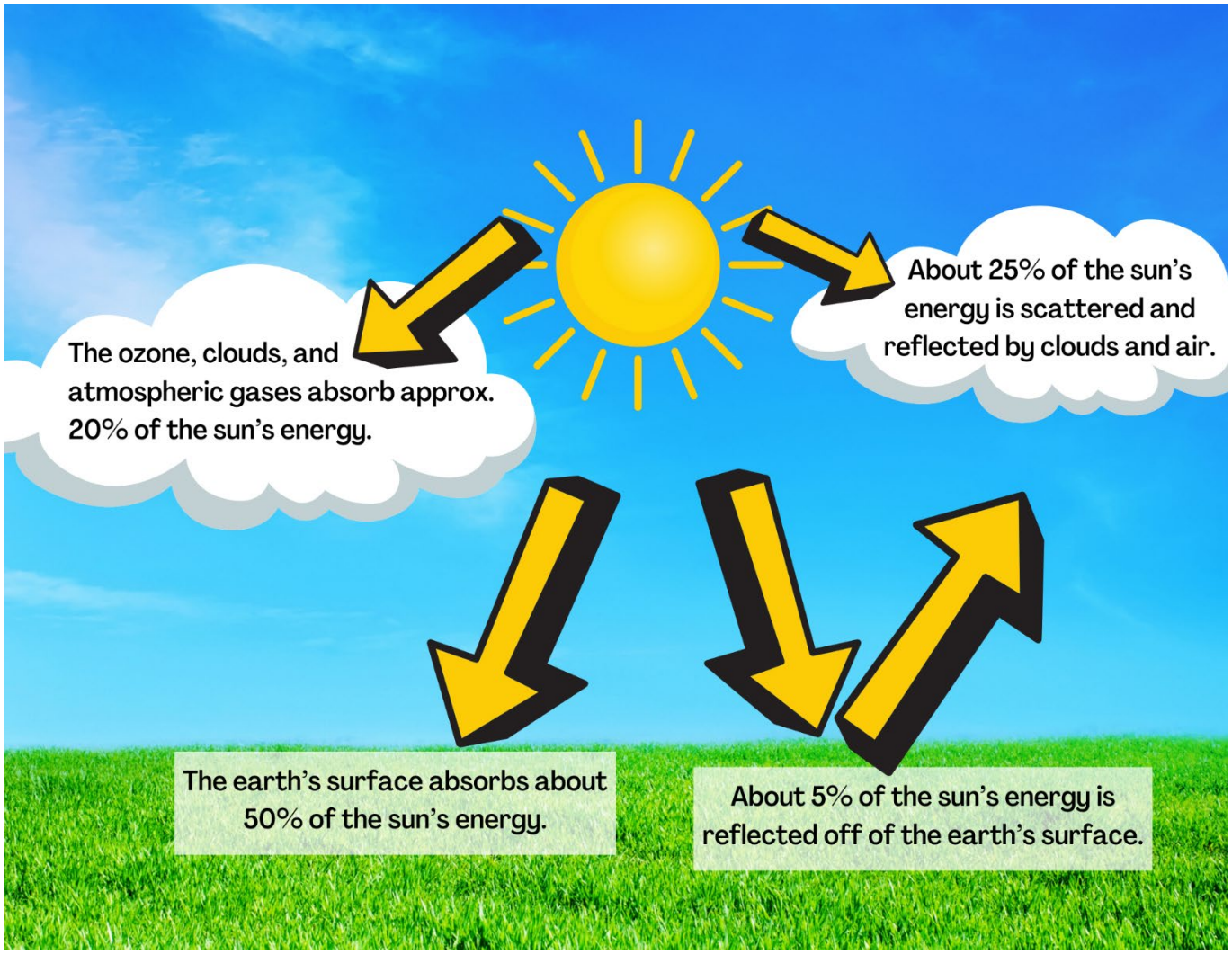
4. Work together as a team to make and record your predictions.
    - Take some time choosing your spots. Think about some of the factors that might be involved.
    - Describe or draw the location.
    - Record WHY you think that spot will be warm or cool before you test.

5. Share results. Were your predictions accurate? Did anything surprise you?

Activity 2: Surface Temperature vs. Air Temperature

This activity challenges the students to design a method for measuring air temperature.

1. Each group needs the same data sheet from activity 1, an air thermometer, clipboard and pencil.
2. Make a prediction whether the air temperature and surface temperature will be the same or different. If you think they will be different, which one will be warmer?
3. Each group needs to design a way to measure the air temperature above the same spots from activity 1 without simply holding the thermometer in your hands.
    - If you simply hold the thermometer in your hand, your body temperature could interfere with the reading. What else could you do?
4. Share the results!
    - What was your method for measuring the air temperature?
    - What was warmer? The surface or the air?
    - What are your theories for why you got those results?
5. Think about all the different surfaces around our town or city, in the state, in the country and around the world?
    - How might these surfaces affect temperatures on a large scale?
    - What are the implications of the way people change communities, build highways and housing, cut down forests and/or plant trees on a larger scale?
6. To gather information over time, repeat these experiments during different times of the day or different seasons. Graph the results to be able to compare the data over time.



Extensions

Engineering Extension

- Design challenge: Experiment with different materials that may not absorb heat as readily or that may even reflect heat.
- Can you construct a town or a city center in miniature using different materials and test the effectiveness of the materials in keeping the area cool on a sunny day?
- Can you find materials that will keep the area warm on a cold day?

Schoolyard Temperature Surveys

Name:_____ Date:_____

Predictions:

Where will be the **warmest** spot? _____

Where will be the **coolest** spot? _____

WHY?

Recordings:

SPOT A

Draw or describe spot: _____

Surface Temperature: ___/___ ºF/ºC

Air Temperature: ___/___ ºF/ºC

SPOT B

Draw or describe spot: _____

Surface Temperature: ___/___ ºF/ºC

Air Temperature: ___/___ ºF/ºC

SPOT C

Draw or describe spot: _____

Surface Temperature: ___/___ ºF/ºC

Air Temperature: ___/___ ºF/ºC

SPOT D

Draw or describe spot: _____

Surface Temperature: ___/___ ºF/ºC

Air Temperature: ___/___ ºF/ºC

Results:

Where was the **warmest** spot? _____

Where was the **coolest** spot? _____

Were your predictions correct? **YES** **NO**

WHY?

Nature Games

Who's Eating Who?

Objectives:

Students will be able to

- to list 5 predators and 5 prey wildlife species in Rhode Island
- define and give an example of herbivores, omnivores and carnivores, and decomposers
- construct food chains and food webs with common RI wildlife species

Vocabulary: predator, prey, herbivore, carnivore, omnivore, scavenger, decomposer, producer, consumer, food chain, food web

Age Level: Grades 1-5

Time Allotted: 20 minutes

Standards Addressed:

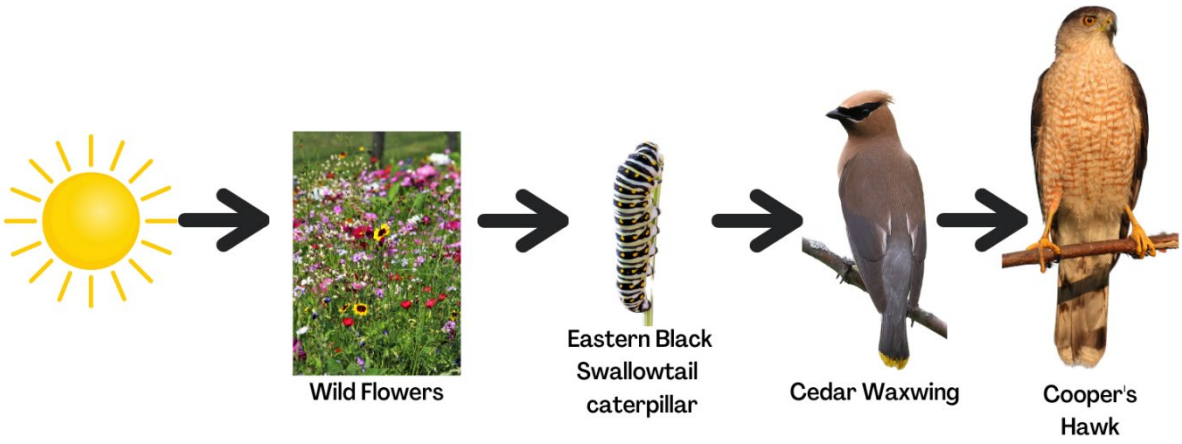
Disciplinary Core Ideas: PS3.D, LS1.A, LS1.C, LS2.A, LS2.B, LS4.D

Cross-Cutting Concepts: Systems and System Models, Energy and Matter, Patterns, Cause and Effect, Structure and Function

Cross-curricular Connections:
Language Arts, Arts, Physical Education

Materials:

- Who's Eating Who animal cards
- cones to mark boundaries
- science journals



Discussion

1. Let's review some terms before we play Who's Eating Who?
    - A **predator** is an animal that hunts other animals for its food. Can you give an example? (hawk, snake, fox, dragonfly)
    - **Prey** are the animals that are hunted. Example? (rabbits, squirrels, insects, mice)
    - Do you think an animal could be a predator and prey?

2. Animals can be sorted into categories based on the type of things they eat.
    - Animals that only eat meat are called **carnivores.** (hawks, snakes)
    - Animals that only eat plants are called **herbivores.** (deer, rabbits, woodchucks)
    - Some animals eat meat and plants; they are called **omnivores.** (foxes, robins, squirrels)
    - Are you a carnivore, herbivore or omnivore?
    - **Decomposers** and **scavengers** are animals that eat dead animals and plants. (Worms are decomposers; turkey vultures are scavengers.)

3. Plants and animals get their food in different ways.
    - Plants are **producers.** They make their own food using the sun's energy, water and carbon dioxide.
    - Animals are **consumers.** They have to eat or consume their food.
    - Why do we need food anyway? For ENERGY!

4. A **food chain** is a simple way to describe "who eats who" in nature. For example, in the ocean, a food chain might be the following: a shark eats a blue fish who eats a minnow who eats some tiny plants called phytoplankton.

5. How animals are connected in nature is often more complicated that a simple food chain demonstrates. A **food web** is a model that shows how animals, plants and the sun's energy are connected in a more complex way. For example, in a food web: a hawk might be connected to a rabbit, a mouse, and a snake which are then connected to a variety of other plants and animals. The plants need the sun to grow and are eaten by many different animals.

Activity: Who's Eating Who?

1. You will need enough outdoor space for students run around and tag each other.
2. This game will help us figure out "who eats who" in nature.
3. Split students into two groups and ask each group to stand in a shoulder to shoulder line facing each other. The two lines should be approximately 3 feet apart.
4. Place one set of cones about 10 - 15 feet behind one line, and the other set of cones 10 - 15 feet behind the other line. These define the "safety zone" for each team.
5. Hold up an example of a Who's Eating Who card. Each card has either two animals or an animal and a plant on it.
6. Everyone's job is to figure out which animal or plant gets eaten by the other.
7. The students in the left line will represent the animal or plant on the left side of the card and the students in the right line will represent the animal or plant on the right.
8. Once you figure out who eats who, the line that represents the **predator** chases the line that represents the **prey** and tries to tag them. Try to get away, prey!
9. Once the prey crosses into the safety zone, they can't be tagged. If you are tagged, you join the other group for the next round of Who's Eating Who.
10. There are sixteen cards, so you can play several rounds of Who's Eating Who.

Answers for the Who's Eating Who animal cards:

fox	eats	rabbit
hawk	eats	squirrel
warbler	eats	caterpillar
bat	eats	moth
dragonfly	eats	mosquito
robin	eats	earthworm
mummichog	eats	amphipod or scud
turkey	eats	acorns
ladybug	eats	aphid
butterfly	eats	milkweed flower nectar
spotted turtle	eats	tadpole
hognose snake	eats	toad
woodchuck	eats	clover
bullfrog	eats	damselfly
osprey	eats	perch
turkey vulture	eats	roadkill

Extensions

Science Extensions

- Investigate the schoolyard to see if you can find some of the animals featured on the Who's Eating Who cards and some of the things they might eat. Record your observations in your science journals.
- Include some of the plants and animals on the Who's Eating Who cards in a food web model.

Language Arts Extension

Children's literature about food chains and webs:

- *Pass the Energy Please!* by Barbara Shaw
- *Magic School Bus Gets Eaten* by Joanna Cole
- *Bugs for Lunch* by Margery Facklam

Since both *Pass the Energy Please!* and *Bugs for Lunch* are in rhyme, a nice follow up to reading those books would be to ask the students to create their own poetry or rhymes to express who's eating who.

Fox

Rabbit

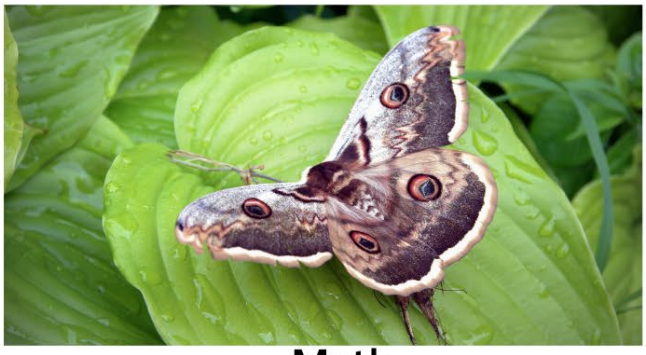
Squirrel

Hawk

Caterpillar

Warbler

Bat



Moth

Dragonfly

Mosquito

Earthworm

Robin

Scud

Mummichog

Turkey

Acorn

Ladybug

Aphid

Milkweed Flower Nectar

Butterfly

Tadpole

Spotted Turtle

Woodchuck

Clover

Toad

Hognose Snake

Bullfrog

Damselfly

Perch

Osprey

Turkey Vulture

Roadkill

Bird Migration Tag

Objectives:

Students will be able to

- list 3 animals that migrate in the winter
- explain why some animals migrate in the winter
- name some hazards or obstacles that face migrating birds
- discuss ways that humans can help migrating birds

Vocabulary: migration, hazards, adaptations

Age Level: Grades 2-6

Time Allotted: 20 minutes

Cross-curricular Connections:
Arts, Geography, Physical Education

Materials:

- "Migration Hazard" cards (see attached samples)
- cones to designate boundaries
- pictures of different birds that migrate
- science journals
- pencils or pens
- map of North and South America

Preparation

- The playing field should be a large rectangle, with the two short sides serving as NORTH and SOUTH.
- Mark the boundaries of the area with cones.
- Cut out the "Migration Hazard" cards.

Discussion

1. Behavioral adaptations are the things that animals do to help them survive. What are some of the strategies animals use to survive the winter?
    - **MIGRATION:** One strategy is to move south or **migrate** during the winter. (A map of North and South America will help here.)
    - Many songbirds, osprey and other hawks, sea turtles, whales, monarch butterflies and green darner dragonflies migrate south from New England in winter.
    - Harbor seals and a variety of ducks move from the north to our area for the winter.
    - **CHANGE OF DIET:** Cardinals, chickadees, blue jays, squirrels, foxes and deer stay around all year, but may change their diet in the winter.
    - **HIBERNATION:** Groundhogs or woodchucks are one of the true hibernators. They fatten up in the fall and then sleep all winter long.
    - **SLEEP:** Other animals sleep, but wake up periodically to eat. Bears, chipmunks, skunks, and raccoons use this strategy.

2. Why do animals need a strategy for dealing with the winter?
    - **FOOD** is one of the essential components animals need to survive and the primary reason that animals need a winter strategy for survival.
    - Many animals cannot find their food sources here in the winter, so they move to a place where they can find the food they eat. For example, if a bird only eats bugs, it needs to move south in the winter to find them.
    - Whales are an exception; they move south to have their babies. They eat all summer in the colder waters off the New England coast, and don't eat much or at all in the warm southern waters.
    - What are other basic needs of animals? Water, shelter, oxygen and space.

3. Do all animals eat the same things?
    - NO! If all animals had to compete for the same food sources, the food would soon run out no matter what time of year.
    - Some animals change their diet during the winter in order to survive. For example, deer and rabbits eat green vegetation in the warm months, and eat buds, twigs and bark during the winter.

4. Why do the birds and other animals migrate BACK to Rhode Island?
    - They build nests, lay eggs and raise their young in Rhode Island because there is lots of **FOOD** in the form of insects, fish, green plants, seeds and more during the warmer months.

Activity: Bird Migration Tag

1. Look at some pictures of birds that migrate. Birds have feathers and hollow bones that make them very light so they can defy gravity and fly! Some birds fly very long distances.
2. Let's head outside for a game of Bird Migration Tag!
3. Most of you will be birds who migrate from north to south to find food to survive the winter. Then you will migrate back from south to north to nest and raise young.
4. 1 or 2 students will be "taggers" who serve as the migration hazards or obstacles that birds face while migrating.
5. Birds line up on the "north" line. Let's call the area behind this line "Rhode Island".
6. Once the teacher says "MIGRATE" – the birds try to fly (run while flapping wings) to the south line without getting tagged.
7. If you are tagged, you have to stop and wait until the other birds reach the south.
8. Tagged birds will then receive a "Migration Hazard" card that explains what happened to that bird. Read this card aloud so everyone can hear what happened.
9. In the next round, the birds who have obstacle cards can also reach out to tag birds migrating past, BUT they have to keep their feet planted. Only the original taggers can run after birds.
10. Play several rounds with birds migrating north to south and then back to the north to find nesting sites and raise young.
11. Rotate the taggers, so everyone gets to be a bird.
12. Is it hard to be a migrating bird? Let's summarize some of the hazards.
13. What can we do to help birds overcome some of these hazards?

Extensions

Geography/ Science Extension:

Choose a bird that migrates and research where it goes. Create a map of the likely route the bird would follow on the way to the wintering grounds. Find out some facts about each place the bird has to travel through on its journey.

Language Arts Extension:

Write a story about what it would be like to migrate. Write it like a travel blog and talk about all the wonders you see and the experience you have on your journey, as well as some of the challenges you face on the trip.

Some Sample Bird Migration Obstacles (cut these out and paste on stock paper or laminate)

ATTACKED BY A FERAL CAT

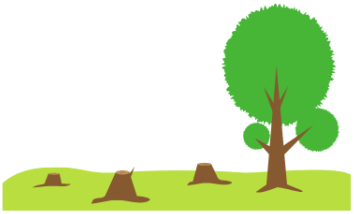
CAUGHT IN A STORM AND BLOWN OUT TO SEA

CONFUSED BY BRIGHT LIGHTS AT NIGHT

DRANK POLLUTED WATER

GOT HIT BY A CAR

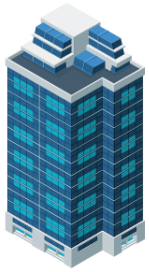
FOOD SOURCE POISONED BY PESTICIDES



WINTERING GROUNDS DEFORESTED

HABITAT DESTROYED TO BUILD A SHOPPING PLAZA

EATEN BY A PREDATOR



FLEW INTO A TALL BUILDING

Signs of Succession

Objectives:

Students will be able to

- state the importance of producers in an ecosystem
- describe the process of succession
- explain how succession happens in a field and a forest

Vocabulary: succession, climax community, ecosystem, producers, consumers, biotic, abiotic

Age Level: Grades 3-6

Time Allotted: 30 minutes

Standards Addressed:

Disciplinary Core Ideas:

LS1.A, LS2.C, LS4.C, LS4.D, ESS2.E

Cross-cutting Concepts:

Cause and Effect, Systems and System Models, Patterns

Cross-curricular Connections:

Physical Education, Arts, Math

Materials:

- an open space in the schoolyard
- cones to mark boundaries
- science journals
- pens or pencils
- pictures of oak, hickory, maple and beech trees

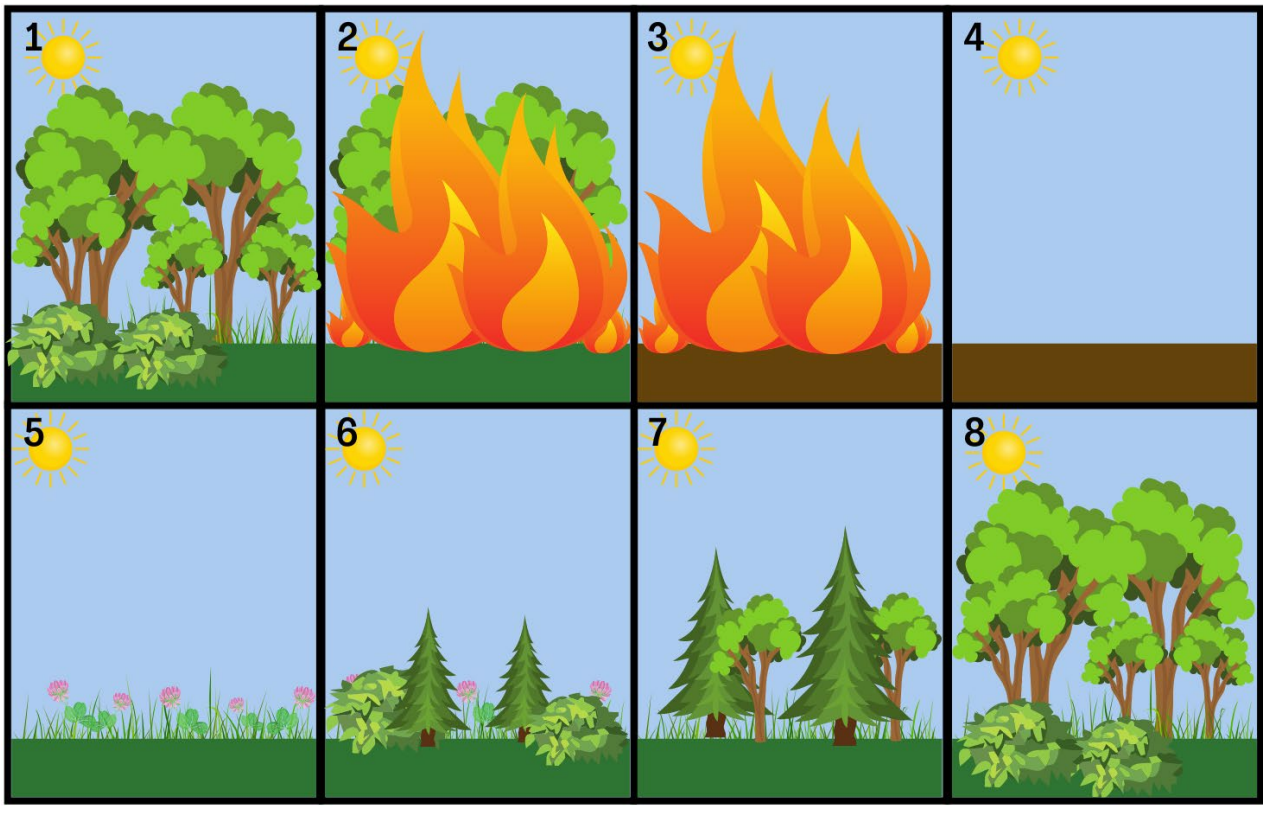
Discussion

1. What are the components of an **ecosystem**?
    - Let's list some of the living (**biotic**) and non-living (**abiotic**) things in an ecosystem.
    - Are plants biotic or abiotic components of an ecosystem?
    - What evidence tells us that plants are biotic components?
    - The focus of this activity is on plants, the **producers** in many ecosystems.
    - Producers use the sun's energy to convert carbon dioxide and water into food through a process called photosynthesis.
    - **Consumers** eat their food and many consumers eat plants.

2. Do you think that ecosystems stay the same or change over time?
    - Ecosystems change all the time. The plant communities change over time and therefore the animals that live in those communities may change too.

3. Have you heard the term **succession**?
    - The concept of succession explains that when an ecological community goes through a disturbance, the changes it then undergoes will follow a more or less orderly and predictable pattern.

Visual Example of Succession:



Written Example of Succession:

1. A stable deciduous forest community is present.
2. - 4 . A wildfire burns the forest to the ground, but the soil remains.
5. Grasses and other herbaceous plants grow back first.
6. Small bushes and trees begin to colonize the area.
7. Fast growing evergreen trees develop to their fullest, while shade-tolerant trees develop in the understory.
8. Eventually the shade intolerant evergreen trees die as the larger deciduous trees overtop them. The ecosystem is now similar to where it was before the fire.

4. Let's think about ecosystems in our state and the primary plants that grow in them.
    - **Field/ meadow** ecosystem: **grasses** and **wildflowers**
    - **Forest** ecosystem: **trees** and **shrubs**
    - **Pond/ lake** ecosystem: **lily pads**, **duckweed**, **pickerel weed**, **cattails**, etc. (All plants whose leaves either float or stick out of the top of the water.)

5. In every region of the world, there is one plant community that is called the **climax community**. This is the final stage of succession that will remain fairly stable and in balance until disturbed by fire or human interference.

6. In the Northeast region of the United States, the climax community is a *forest with deciduous trees* (ones that lose their leaves) featuring oaks & hickories, or even maples & beeches. Check out the pictures of these trees.

Activity: Succession Tag

1. This game is like a combination of tag and rock, paper, scissors.
2. Each team will need enough space to run and a "safe zone" designated with the cones.
3. Split group into two teams and ask each team to stand in a shoulder to shoulder line facing each other. The two lines should be approximately 3 feet apart.
4. There are 3 different plants in this game: **trees, shrubs** and **grasses**.
5. There is a symbol you make for each plant type:
    - Trees = put both hands straight up over your head.
    - Shrubs = put arms out in front of you in a circle.
    - Grasses = hold your hands waist high, with elbows in, and wiggle your fingers.
    - Let's practice each motion!
6. To start, each team has a quiet huddle to decide which of the three plant types they will represent that round. Then line up facing the other team.
7. Both teams chant "grass, shrubs, trees!" three times, making each symbol as the plant type is chanted.
8. After the third chant, each team makes the symbol decided upon in the huddle.
9. Who gets to chase whom? It works like succession:
    - **Trees** chase **shrubs** because trees will grow and take over (by out-shading) an area where shrubs grow.
    - **Shrubs** chase **grasses** because shrubs will grow and take over (by out-shading) an area where grasses grows.
    - **Grasses** chase **trees** because when a tree dies and falls over, grasses grow in the spot the trees used to be (because they are no longer out-shaded!).
10. Anyone who gets tagged will join the other team in the next round.
11. Play a number of rounds and you will always remember the order of succession!

Extensions

Science Extension:

- Explore the schoolyard for signs of succession. Record what you discover in your science journals.
- Search for signs of succession at home in your backyard, neighborhood and/or a local park. Record what you discover. How does these areas compare to the schoolyard?
- Research what kinds of trees used to be part of the typical New England climax community forest. Can you find out what happened to trees like chestnuts and elms? Are any species of trees today threatened by disease, fungus or invasive insect pests? Share what you learn with others.

Math Extension:

- Think of the schoolyard as a whole, or 100%. How much of the schoolyard is covered by plants (this is called % cover)?
- If the schoolyard was a big pie chart, what percentage of the pie are grasses? Shrubs? Trees? Sidewalks? Graph your estimates.

Nature Game Recommendations from other Resources

There are many other great games that Audubon educators did not create, but highly recommend.

Oh Deer! (Grades 2-6) is found in Project WILD's K-12 Curriculum Guide published by the Council for Environmental Education. This is an active simulation game that focuses on what deer need to survive. This game also covers yearly changes in animal populations and limiting factors that cause changes in population.

Turtle Hurdles (Grades 3-6) is found in Project WILD Aquatic Curriculum Guide published by the Council for Environmental Education. This is an active game that goes through the life cycle of a sea turtle. Life cycles, predator/prey relations, migration, human interactions, and more are covered in this game.

Hazardous Links (Grades 2-6) is found in Project WILD's K-12 Curriculum Guide published by the Council for Environmental Education. This is an active game that focuses on food chains and how pesticides can affect a food chain. Topics covered include predator & prey, trophic levels, pesticides and bioaccumulation.

Maple Seed Mix Up (Grades K-2) is found in Ranger Rick's NatureScope, *Trees are Terrific!* by the National Wildlife Federation. Maple Seed Mix up is an active game about what a maple seed needs in order to grow into a maple tree.

If you are interested in workshops on Project WILD and Project WILD – Aquatic activities, please contact the Audubon Society of Rhode Island at education@asri.org. All participants in these workshops receive these excellent guides at no extra cost.

Resources for Creating Outdoor Classrooms and Schoolyard Lessons

Articles About Schoolyard Lessons and connections to curriculum:

- Using the Outdoors to Teach STEM: https://www.edutopia.org/article/using-outdoors-teach-stem
- Taking the Learners and Technology Outdoors: https://usergeneratededucation.wordpress.com/2013/04/18/taking-the-learners-and-technology-outdoors/

Creating Outdoor Classrooms:

- U.S. Fish and Wildlife Service's planning guide for creating schoolyard habitat and outdoor classroom projects: https://www.fws.gov/northeast/cpwn/pdf/HabitatGuideColor.pdf
  Spanish version: https://www.fws.gov/northeast/cpwn/pdf/USFWSHabitat-Guide-Spanish.pdf
- Boston Schoolyard Initiative: http://www.schoolyards.org/index.html
- https://outdoorclassroomproject.org/about/the-outdoor-classroom/
- https://natureexplore.org/about-us/nature-explore-classrooms-look-like/

Apps and Websites:

- ***iNaturalist*** – Record nature observations and share them with the online community of naturalists. Students can also keep a log of the wildlife they discover and the biodiversity they experience while being outdoors. https://www.inaturalist.org/
- ***Shark Tracker*** – App and website to see where the tagged sharks, turtles, alligators, seals, and whales are in the world. https://www.ocearch.org/
- ***Seek by iNaturalist*** – This app will help you identify wildlife, plants and fungi.
- ***Cornell Lab of Ornithology: All About Birds***–Website full of articles, bird guides, bird cams and more. https://www.allaboutbirds.org

Community Science:

- **Project Feeder Watch:** http://www.birds.cornell.edu/pfw/index.html
  Cornell Lab of Ornithology
  Project FeederWatch is a winter-long survey of birds that visit feeders at backyards, nature centers, schools, and other locales in North America. Feeder Watchers periodically count the birds they see at their feeders from November through early April and send their counts to Project FeederWatch. FeederWatch data help scientists track broad scale movements of winter bird populations and long-term trends in bird distribution and abundance.

- **Project Bud Burst:** https://budburst.org/
  National Ecological Observatory Network and the Chicago Botanical Garden
  Project Bud Burst is a network of people across the United States who monitor plants as the seasons change. We are a national field campaign designed to engage the public in the collection of important ecological data based on the timing of leafing, flowering, and fruiting of plants (*plant phenophases*).

Project BudBurst participants make careful observations of these plant phenophases. The data is collected in a consistent manner across the country so that scientists can use the data to learn more about the responsiveness of individual plant species to changes in climate locally, regionally, and nationally.

- **FrogWatch USA:** https://www.aza.org/frogwatch
  Association of Zoos and Aquariums (Roger Williams Park Zoo is the local coordinator)
  FrogWatch USA is a citizen science program that allows individuals and families to learn about the wetlands in their communities and help conserve amphibians by reporting the calls of local frogs and toads. For over ten years, volunteers have been trained to enter their FrogWatch USA information and ongoing analyses of these data have been used to help develop practical strategies for the conservation of these important species.

- **RIDEM HerpObserver App**: http://www.dem.ri.gov/programs/bnatres/fishwild/pdf/herp-observer-fs.pdf
  This app, developed by the Rhode Island Division of Fish and Wildlife, allows you to submit your own observations of any reptile or amphibian in the state. The data is submitted to our secure database, and is only viewed by our state herpetologist. This is a great way to help contribute to conservation and monitoring work right in your own backyard!

- **Project Noah**: https://www.projectnoah.org/
  Engage students in documenting local wildlife by uploading photos via mobile phone or tablet as part of a classroom or school-wide mission. A global community can help I.D. their "spottings" which in turn help scientists uncover and track wildlife populations.

Free or Low-Cost Science Resources:

- Free native seeds for planting from URI Master Gardeners: https://web.uri.edu/mastergardener/freeseeds/
- Free/small donation for milkweed seeds as a host plant for monarchs - can also do a free adopt-a-butterfly online program: http://www.livemonarch.com/teaching/
- Free Science Education Resources: https://scienceconnected.org/
- Free Maps, Lesson Plans, Posters from US Geological Survey: https://www.usgs.gov/science-support/osqi/yes/resources-teachers/
- Free software for Tree ID, Ecology, Climate Change and Related topics: https://www.itreetools.org
- Free Climate Change Education Tools/Software: https://www.climateinteractive.org/tools/en-roads/ and https://www.climateinteractive.org/tools/en-roads/en-roads-trainings/

SCHOOLYARD SCIENCE TOOLBOX

Recommended items for you and your students to get the most out of outdoor lessons

Item	Suggested Quantity	Estimated Cost	Seller	Notes
Handheld Magnifiers	30	$2 for 12+	Electro Optix	We recommend the dual lens EM 3x6x.
Neon Shoelaces	30	$6 for 12	Amazon	Use these so your students can wear their magnifiers around their necks.
Folding Magnifier	4	$15 each	Forestry Suppliers	These can easily be shared
Magnifying Bug Jars	10	$11 for 10	Oriental Trading	These can easily be shared
Magnifying Bug Loupe	optional	$11 each	Optics Planet	
Soil Thermometer	1 or 2	$13 each	Grow Organic	
Soil Corer	1 or 2	$23 each	Amazon	
Anemometer	1 or 2	$30 each	Global Test Supply	A good tool for measuring wind speed
500 ml graduated Pitcher	1 or 2	$7 each	Zoro	
Laser Thermometer	1 or 2	$36 each	Home Depot	Handheld infra-red surface thermometer
Binoculars	4 to 10	$18 each	Amazon	We recommend the 8x21 Bushnell binoculars.
Transect square/Hula-hoop	1 to 3	Transect squares can be made with cardboard, wood, even tent pegs and string, or hula-hoops can work.		Use to focus attention in on one small area
Peterson's Field Guides		$8 each	Amazon	Recommend titles: Urban Wildlife, Birds, Insects, Trees, Rocks and Minerals, Clouds and Weather, Mammals, Animal Tracks
Pocket Naturalist Guides		$8 each	Audubon Society of Rhode Island Nature Shop	Recommend titles: Urban Wildlife, Weather, New England Wildlife, Bugs and Slugs, New England Birds, New England Trees and Wildflowers, Geology

CHILDREN'S LITERATURE LIST

TOPIC, Book Title and Author	Grade Recommendations
SCHOOLYARD NATURE HIKES & OBSERVATIONS (SENSES AND PATTERNS)	
Bird Calls (a Hear and There book) by Frank Gallo	Gr K-1
The Snail's Spell by Joanne Ryder	Gr K-1
Two Blue Jays by Anne Rockwell	Gr 1-2
Magic School Bus Explores the Senses by Joanna Cole	Gr K-2
Swirl by Swirl: Spirals in Nature by Joyce Sidman	Gr 1-3
Take a City Nature Walk (Take a Walk series) by Jane Kirkland	Gr 3-6
The Kids Guide to Exploring Nature by the Brooklyn Botanic Garden Educators	Gr 3-6
ANIMALS	
Insects	
The Very Quiet Cricket or *The Very Lonely Firefly* by Eric Carle	Gr K-1
Have You Seen Bugs? by Joanne Oppenheim	Gr K-2
Waiting for Wings by Lois Ehlert	Gr K-2
On One Flower, Butterflies, Ticks and a Few More Icks by Anthony Fredericks	Gr K-2
Insects are My Life by Megan McDonald	Gr 1-3
Ladybug at Orchard Avenue by Kathleen Weidner Zoehfeld	Gr 1-3
Life and Times of the Ant by Charles Micucci	Gr 1-4
Joyful Noise: Poems for Two Voices by Paul Fleischman	Gr 3-6
Squirrels	
Scaredy Squirrel by Mélanie Watt	Gr K-1
Those Darn Squirrels (one in a series) by Adam Rubin	Gr K-2
About Rodents: A Guide for Children by Cathryn Sill	Gr 1-3
Ozette's Destiny by Judy Pierce	Gr 3-6
Enjoying Squirrels More (or Less!) by Howard Youth	Gr 3-6
Birds	
Birds Build Nests by Yvonne Winer	Gr K-2
Owl Moon by Jane Yolen	Gr K-2
City Hawk by Meghan McCarthy	Gr K-3
Screech Owl at Midnight Hollow by C. Drew Lamm	Gr 1-3
She's Wearing a Dead Bird on Her Head! By Kathryn Lasky	Gr 1-4
Beauty and the Beak: How Science, Technology and a 3D-Printed Beak Rescued a Bald Eagle	Gr 3-6
Take a Backyard Bird Walk (Take a Walk series) by Jane Kirkland	Gr 3-6
Camouflage	
Where's that Fish? or *…Spider?* (Hide and Seek Science) by Barbara Brenner & Bernice Chardiet	Gr K-3
How to Hide a Meadow Frog or *Butterfly* or *Crocodile* all by Ruth Heller	Gr K-3
What Color is Camouflage? by Carolyn Otto	Gr 1-3
Claws, Coats and Camouflage by Susan Goodman	Gr 2-5
Pollinators	
Flowers are Calling by Rita Gray	Gr K-2
The Bumblebee Queen by April Pulley Sayre	Gr K-3
What is Pollination? by Bobbie Kalman	Gr 1-3

Flower Talk: How Plants Use Color to Communicate by Sara Levine — Gr 1-4
Bees: A Honeyed History by Piotr Socha — Gr 2-5
The Clover & the Bee: A Book of Pollination by Anne Ophelia Dowden — Gr 5-6

PLANTS

From Seed to Plant by Gail Gibbons — Gr K-2
Dandelion Adventures by L. Patricia Kite — Gr K-2
A Log's Life by Wendy Pfeffer — Gr K-3
The Dandelion Seed by Joseph Anthony and Cris Arbo — Gr K-3
The Big Tree by Bruce Hiscock — Gr 1-4
In a Nutshell by Joseph Anthony & Cris Arbo — Gr 1-4
How do Plants Defend Themselves? by Ruth Owen — Gr 2-5
Take a Tree Walk (Take a Walk series) by Jane Kirkland — Gr 3-6
DK Eyewitness Books: PLANT by David Burnie — Gr 3-6

HABITATS AND ECOSYSTEMS

In the Woods, and *Around the Pond, Who's Been Here?* by Lindsay Barret George — Gr K-2
Over and Under the Pond by Kate Messner — Gr K-2
Songs of the Water Boatman and Other Pond Poems by Joyce Sidman — Gr K-5
Save our Stream! by Colin Polsky and Jane Tucker — Gr 2-5
Pass the Energy, Please! by Barbara Shaw McKinney — Gr 2-5
What are Food Chains and Webs? by Bobbie Kalman and Jacqueline Langille — Gr 3-5
Seeking the Wolf Tree by Natalie Cleavitt — Gr 3-6
A Beach for the Birds by Bruce McMilllan — Gr 3-6

Human Impact

The Lorax by Dr. Seuss — Gr K-4
Wump World by Bill Peet — Gr 1-4
Rachel Carson and Her Book that Changed the World by Laurie Lawlor — Gr 2-5
Heroes of the Environment: True Stories of People Who are Helping to Protect our Planet — Gr 4-6
by Harriet Rohmer (this book has short stories, and one features a teenager from Rhode Island!)

WEATHER, WATER AND SOILS (AND SEASONS)

Rabbits and Raindrops by Jim Arnosky — Gr K-1
Who likes Rain? (Exploring the Elements) by Etta Kaner — Gr K-2
The Story of Snow by Mark Cassino — Gr K-3
Snowflake Bentley by Jaqueline Briggs Martin — Gr 1-3
The Cloud Spinner by Michael Catchpool — Gr K-3
Cloud Dance and *Water Dance* by Thomas Locker — Gr 1-4
One Well: the Story of Water on Earth by Rochelle Strauss — Gr 3-6
Energy Island: How One Community Harnessed the Wind & Changed Their World — Gr 4-6
by Allan Drummond
The Boy Who Harnessed the Wind (children's edition) by William Kamkwamba & Bryan Mealer — Gr 4-6

Up in the Garden and Down in the Dirt by Kate Messner — Gr K-2
Dirt: The Scoop on Soil by Natalie Myra Rosinsky — Gr 1-4
Everybody Needs a Rock by Byrd Baylor — Gr 2-5
Soil (Rocks and Minerals) by Rebecca Hirsch — Gr 3-6

Sunshine Makes the Seasons by Franklyn Branley — Gr K-2
The Reasons for Seasons (New and Updated) by Gail Gibbons — Gr K-3
Our Seasons by Ranida McKneally (introduces haiku) — Gr 1-4
Discover the Seasons by Diane Iverson — Gr 1-4

“An environment-based education movement--at all levels of education--will help students realize that school isn't supposed to be a polite form of incarceration, but a portal to the wider world.”

-Richard Louv, No Child Left Inside