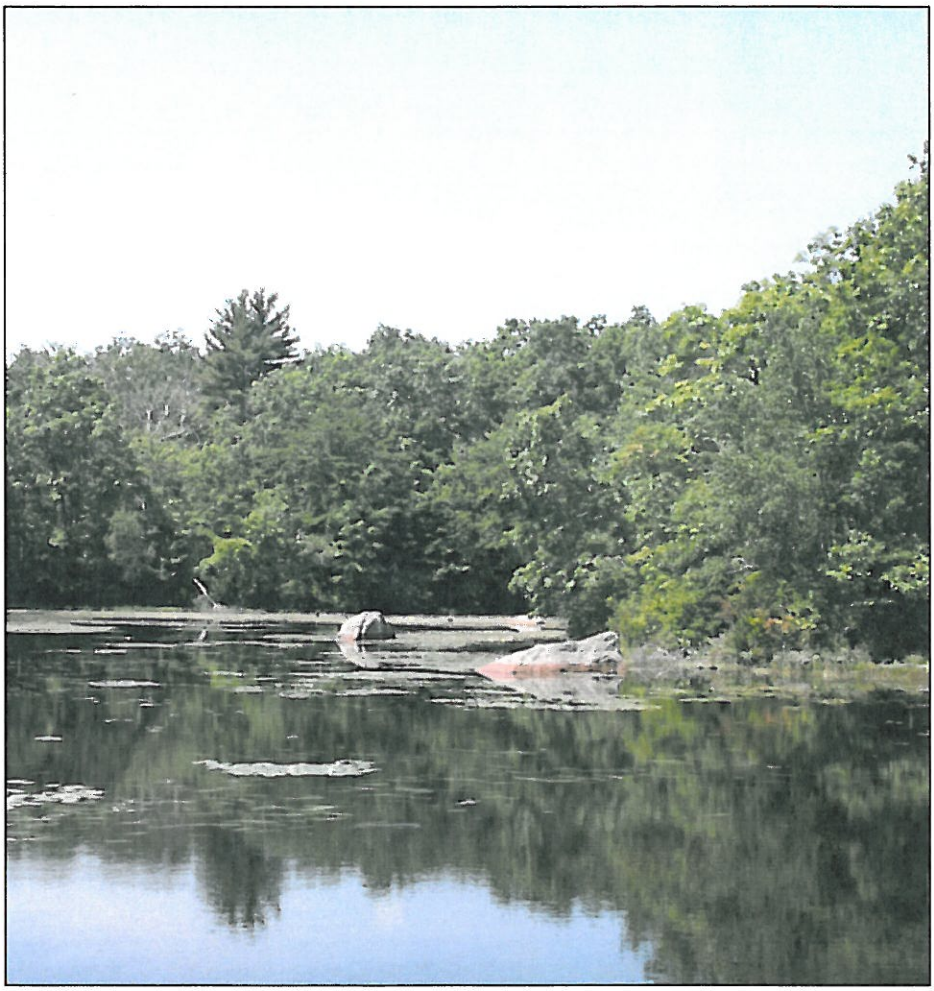
Audubon Society of Rhode Island

Maxwell Mays Interpretive Trail and Outdoor Curriculum



The Maxwell Mays Interpretive Trail was funded through a generous grant from Centreville Bank

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depend on us.

INTRODUCTION

Welcome to Audubon's Maxwell Mays Wildlife Refuge in Coventry. The Maxwell Mays Wildlife Refuge contains over 295 acres of diverse wildlife habitat consisting of upland forests, wetlands, streams, ponds and open meadow. The 11-acre Carr's Pond, situated entirely within the bounds of the property, is the centerpiece of the preserve. It is home to river otters as well as many types of freshwater fish and aquatic invertebrates. The land is comprised of a relatively mature and undisturbed closed-canopy forest and forested wetlands as well as developed understory - creating ideal conditions for migratory and forest interior birds. A 10-acre field near the head of the trail also provides excellent meadow wildlife habitat.

Thanks to a generous donation from Centreville Bank, Audubon has developed an interpretive trail with accompanying lessons and activities for teachers, homeschoolers, and scouts. The curriculum addresses different ecological concepts utilizing particular natural features, and specific flora and fauna found along the Carr Pond Trail. The curriculum includes multi-disciplinary lessons and activities related to a variety of science and nature topics. The activities are to be used for grades K-8 and the lessons are designed to be hands-on, engaging, and inquiry-based. It is important to point out that all the outdoor classroom lessons are designed to enhance and align with the state's current science curriculum.

The Maxwell Mays Interpretive Trail includes seven select investigative sites along the Carr Pond Trail. Each site is clearly marked by a numbered post. The Carr Pond trailhead is located to the left of the parking area. We encourage teachers, homeschoolers, and scout leaders to implement the lessons and activities as they investigate the natural world with their students.

Audubon Society of Rhode Island:

The Audubon Society of Rhode Island (ASRI) is a non-profit organization founded in 1897 whose mission is to protect birds, other wildlife and their habitats through conservation, education, and advocacy for the benefit of people and all living things. Audubon independently protects or owns almost 9,500 acres of woodlands and coastal property embracing diverse natural habitats.

Maxwell Mays:

Maxwell Mays, a leading figure in the state's cultural life for over half a century was best known as a folk artist who painted scenes from his beloved Rhode Island. He began painting seriously while serving in the U.S. Air Force in Brazil during World War II. In the ensuing years he became notable for a number of highly successful art shows and magazine covers, including Yankee Magazine, featuring traditional New England scenes and was a highly sought after speaker and storyteller.

He was Past President and Director Emeritus of the Providence Art Club where the main gallery is named in his honor. Mays was also a lay minister for over four decades at the Green United Methodist Church in Greene, RI.

Mays was also a well-known philanthropist, whose generosity benefited numerous organizations, including the Rhode Island Foundation and the Audubon Society of Rhode Island.

SECTIONS OF THE GUIDE

TEACHING OUTDOORS

- Tips that will make your experience teaching outdoors a positive one.
- Things to be aware of on your hike.

TRAIL MAP

STATION 1 – SUCCESSION

Overview of Succession

- Bug Relay	Grade PreK-3
- Seeds on the Move	Grades 1-4
- Insect Bingo	Grades 2-5
- Signs of Succession	Grades 3-4
- Succession Field and Forest Study	Grades 5-8

STATION 2 - THE FORST EDGE

Overview of Forest Edge Habitats

- Meet a Tree	Grades 1-8
- The Edge of Home	Grades 2-8
- Wildlife Real Estate	Grade 4
- Oh Deer!	Grades 3-5
- Adopt a Tree	Grades4-5

STATION 3 - DECOMOSING LOG

Overview of Decomposition

- Whooo Lives in a Rotting Tree?	Grades K-4
- The Fallen Log	Grades 2-8
- How Fast Does a Tree Decompose?	Grades 4-5
- Rotting Tree Habitat	Grades 3-5
- Life Cycle of a Tree	Grades 4-5

STATION 4 – GEOLOGY

Overview of Geology

- Human Rock Cycle	Grades 4-12
- Investigating Rocks	Grade 4 -5
- Geology Scavenger Hunt	Grades 4-12
- Glacial Geology Scavenger Hunt	Grades 5-12
- Taking a "Lichen" to a Gravestone	Grades 5-12

STATION 5 – THE POND

Overview of Pond Ecosystems

- Are you Me? Grades K-2
- Investigating Water Critters Grades 4
- Water Survey Grades 4-5

STATION 6 – CLUES TO THE PAST

Overview of Clues to the Past

- Forest Forensics Grades 4-12
- Land Use Sequencing Activity Grades 4-12
- Stonewall Observations Grades 4-12
- Where Stones Talk Grads 4-12

STATION 7 - VERNAL POOL

Overview of Vernal Pools

- Observing Vernal Pools Grades 2-12
- Oh, Wood Frog! Grades 3-5
- Mapping Vernal Pools Grades 5-12
- How Could You Live in a Vernal Pool Grades 3-8

Tips for Teaching Outdoors

Positive Attitude, Enthusiasm, Respect, Adaptability

As you embark on your outdoor learning adventure here are a few helpful tips to make for an enjoyable and safe experience.

- 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.
- Try to connect discoveries and activities with the themes of the trip. Set aside times during the activities to pull your group together to provide such a focus.
- It's *okay* to not know what something is. Say so. Encourage observation and inquiry. Discover things about the object together. Look it up later.
- Explore together. Let children discover the answers for themselves.
- When you stop to address a group, note where the sun is and position yourself so that you face it.
- When leading a group down a trail, stop and step back to the middle of the group in order to talk about an object.
- Project your voice to everyone.
- Talk when you have something to focus on; this will allow children 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.
- Give positive reinforcement and recognition for discoveries, no matter how small.
- Be receptive. Listen. Every comment, question, and exclamation is an opportunity to communicate.
- Model the behavior you expect. Interested enthusiasm is contagious.
- Avoid lecturing. Simple explanations are fine.
- Sometimes a child or two will stay near you to ask a lot of questions. Gently encourage this enthusiasm, but do not allow one child to monopolize the group.
- Be sure to bring a cell phone or two-way radio and a first aid kit (band-aids, ice packs, tweezers, sunscreen, bug spray, etc.)

Things to Be Aware of on an Outdoor Hike…

POISON IVY


Poison ivy

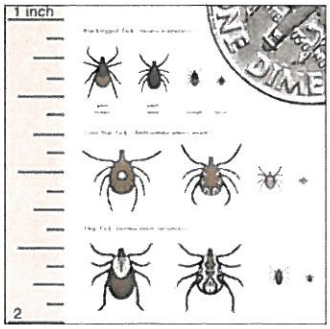
During any walk through an overgrown area, students and unwary adults are likely to encounter vines with interesting growth characteristics and shrubs that bear fruit. It is sometimes difficult to determine which plants are safe to touch.

In dealing with vines, it is helpful to remember that poison ivy is hazardous to touch. Poison ivy occurs in many forms, so teachers need to be aware of several characteristics of this fascinating vine. 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 groups of three's. 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.
Hair on a rope, don't be a dope.

TICKS



Ticks are generally found in wooded habitats 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 into 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.

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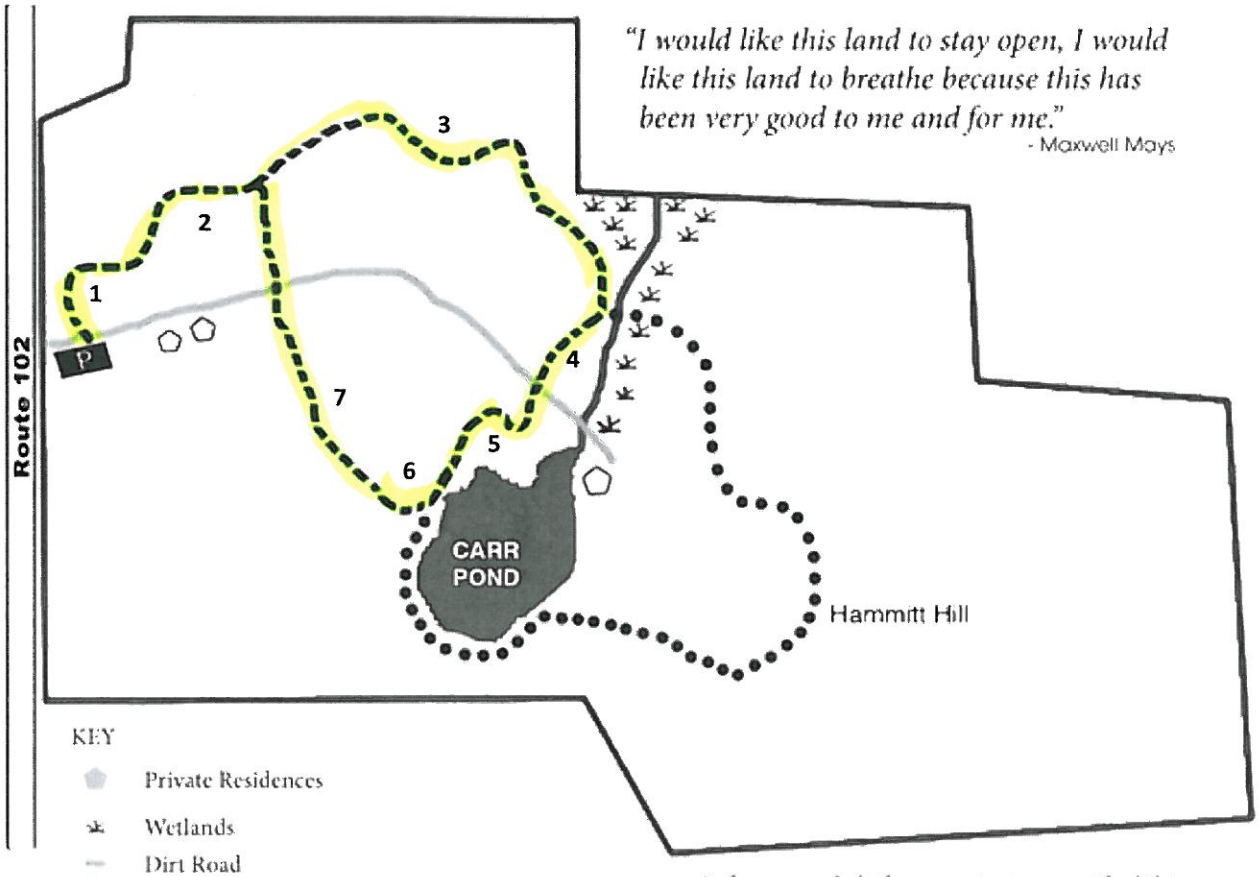
Maxwell Mays Wildlife Refuge

Trail Map



PLEASE...
Stay on marked trail.
Respect the privacy of the residents on the property.
Be aware of poison ivy and always check for ticks.

Refuge open daily from sunrise to sunset for hiking, observing and photographing wildlife; quiet contemplation, cross-country skiing and snowshoeing.

Please! No dogs, bicycles, horses, jogging, picnicking, hunting, fishing, trapping, motorized vehicles, camping or littering.

Thank you for your cooperation.

STATION 1

SUCCESSION

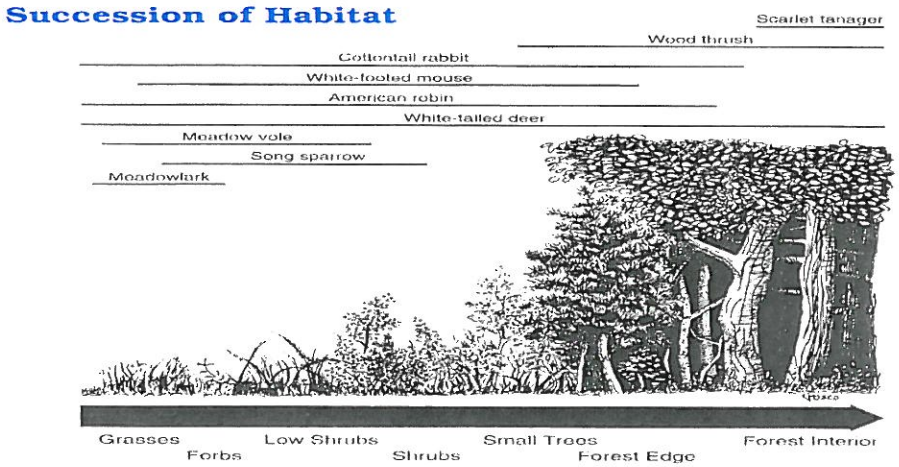
1. SUCCESSION

Located in the first field after trailhead/kiosk
GPS Coordinates: North 41°40.301', West 71°41.642'
Elevation 541 Feet

You are now standing in an old field or pasture. It likely was once used for livestock such as sheep. As you can see, today this area is no longer a cleared and open pasture, but rather quite overgrown. This is the result of **succession**, or more specifically in this case, old field succession.

Old field succession occurs when a pasture or farmland is abandoned and new species of plants colonize the area. While there is an abundance of sunlight at the old field, it can be a stressful habitat for many plants, as the soil may be stripped of nutrients and may not hold water well. Additionally, there is little or no escape from the sun and wind. Due to this, the first species to take root – the **pioneer species** – must have seeds that can survive tough conditions and can spread widely. These plants must also have the ability to grow and reproduce quickly. Common pioneer species include ragweed, crabgrass, foxtail, and, after a year or two, asters. When these species die, they become plant litter, adding nutrients to the soil and helping it to hold water. Eventually, perennial grasses, herbs, and shrubs, such as goldenrod and milkweed, are able to grow in this improved soil replacing the pioneer species. Over time, small trees like sassafras begin to grow among the shady shrubs and eventually larger trees, such as oaks and maples, will take root.

Look around – can you identify any signs of succession? The field is also a great habitat to find insects. How many different insects can you find?



Bug Relay

Objectives:

- Students will be able to divide bugs into categories based on how many legs they have.

Vocabulary: Head, Thorax, Abdomen

Grade Level: Grades Pre K - 3

Time Allotted: 20 minutes

Standards Addressed: LS1 (3-4) 1a, 1b, 1c, 1d, 2a, 4a, 4b, LS2 (3-4) 5a, 6a, 6b, 6c
LS1 (5-6) 1a, 3a, 3b, LS2 (5-6) 5a, 6a, 7b

Science Topics: Correlates with the science topics Physical Properties, and Insects

Materials Needed:

- 3 Transect hoops
- Laminated numbers (6, 8, and "more than 8")
- Plastic bugs

Procedures:

1. Introduce students to the different types of bugs that you might find in the field, such as grasshoppers, beetles, spiders, crickets, butterflies, etc. Show students examples of the different types of bugs.

2. Go over the body parts of an insect with students. Insects have 3 body parts (head, thorax and abdomen), antennae used for feeling and smelling, 6 legs, some with 2-4 wings and all have 2 eyes.

3. Teach students the difference between spiders and insects. Spiders have 8 legs, 6-8 eyes, fangs, no antennae and 2 body parts (cephalothorax and abdomen).

4. Explain how centipedes and millipedes are different. They have many body parts, many legs, antennae and 2 eyes.

5. Place the transect hoop at one end of the field. Take the 3 laminated signs and place one in each transect hoop.

6. Divide the children into two teams and have them stand on the other end of the field. In the middle scatter the plastic bugs.

7. One at a time each team sends one child out to find a bug. Once they find a bug and count its legs the child has to put the bug in the correct transect hoop.

8. Keep the activity going, one student at a time, until everyone has a turn.

9. As a group, go over the bugs in the transect hoops and make sure they are all in the correct hoops.

Extensions:

1. Science Extension
   Explore for animals in the field and forest. Are there different animals found in each habitat? Why?

Seeds on the Move

Objectives:

- Students will be able to sort found seeds according to similarities and differences.
- Students will be able to use observed features of seeds for classification.
- Student will be able to explain how and why seeds disperse from their parent plants.

Vocabulary: Seed, Fruit, Dispersal

Grade Level: Grades 1 - 4

Time Allotted: 45 minutes

Standards Addressed: LS1 (K-4) INQ +POC -1, LS1 (K-4) SAE – 2, LS1 (K-4) POC -3, LS1 (K-4) FAF -4, PS1 (K-2) INQ – 1a, 1c, 1d

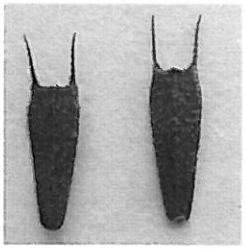
Science Topics: Correlates with the science topics Plants and Physical Properties

Materials Needed:

- 1 adult sock for each child
- 1 piece of paper for each child
- Plant/seed field guides
- Magnifying glasses

Procedures:

1. Have the students put an adult sock over their shoe. Take the class on a walk through the weedy area on the edges of the field. Various seeds will stick to the socks that have been placed over the students' shoes.



2. After the trek through the weedy patch, conduct a quick critter check with the students. Then have students sit and pick the seeds off their socks and place the seeds onto a piece of paper.

3. Next, pass out the magnifying glasses. Allow students to observe the seeds with the magnifying glasses and group them together according to observable similarities and differences.

4. Ask students why they think some seeds have structures that help them stick to people (or animals) passing by. Can seeds move on their own?

5. Explain that this part of a plant's life cycle is very important. If the seeds do not move away from their parent plant, they will have to compete with that same adult plant for resources.

6. Review the needs of all plants for growth and development:
   a. Sunlight
   b. Water
   c. Soil (nutrients in the soil)
   d. Air (carbon dioxide)

7. Ask students if they can think of other ways plants could move their seeds away from the parents (wind, water, seeds inside an edible fruit, etc.) This movement away from the parent plants is called ***seed dispersal***.

8. Invite students back to the weedy patches to see if they can find seeds that use these different dispersal methods. Have students create a chart to display the seeds by using labels such as "blown by wind", "eaten by animals", or "stuck on fur or clothing".

9. If the students want a challenge, have them refer to seed/plant reference books to identify the seeds.

Extensions:

1. Science Extension:
   Students can predict what each seed would grow into. Students can also try to plant the seed to see if their prediction was correct.

2. Art Extension:
   Students can create a field guide for the plants along the edge of the field and forest by drawing them, as well as researching information about them. If they cannot identify the plants with the field guides, they can at least make a guide to the different dispersal methods the plants use. This information can be presented to other classes in the school.

3. Physical Education Extension:
   Students can remember the different seed dispersal methods by playing an active game similar to "Simon Says". Students can come up with a different motion for each dispersal method. Have the students do the motion as quickly as they can after the leader calls it out. *For example:*

MOTION		DISPERSAL STRATEGY
Arms out and twirl in place	=	float in the wind
Pretend to eat an apple	=	eaten by an animal
Link hands or arms with a partner	=	stick to an animal's fur
Make swimming motions with arms	=	float in the water

Insect Bingo

Objective:

- Students will be able to locate, identify and sort insects.
- Students will be able to identify insect predators, insect homes, insect food, and other relationships.

Vocabulary: Thorax, Abdomen, Exoskeleton

Grade level: Grades 2-5

Time Allotted: 20 minutes

Standards Addressed: LS1-1, LS2-2

Science Topics: Correlates with science topics Insects, and Physical Properties

Materials Needed:

- Bingo Cards
- Collection Jars
- Magnifying Lenses
- Pencils

Background:

What is an insect? Insects belong to a large group of animals called arthropods. Arthropods include crayfish, spiders, millipedes, centipedes, ticks, mites, etc. Arthropods have jointed legs and bodies that are divided into segments. Insects are one group or class of arthropods.

The following are characteristics of insects:

1. They have an exoskeleton on the outside of their bodies. The exoskeleton is made out of a chitin. It is tough like armor and protects them, and keeps them from drying out.
2. All insects are made up of 3 body segments: the head, thorax, and the abdomen.
3. Most insects have 6 legs.
4. Only adult insects have wings.
5. Most insects have two kinds of eyes: compound and simple.
6. Most insects have a pair of antennae that they use to feel, smell, and even hear.
7. Insects are covered with thousands of hairs all over their body, which they use to feel, smell, and hear.

There are 26 different groups of insects called orders.

1. Beetles and Weevils
2. Butterflies and moths

3. Ants, bees, and wasps
4. Flies
5. Grasshoppers and crickets
6. True bugs

Procedure:

1. Divide Students into small groups, and give each group a bingo card, collection jars, and magnifying lenses.

2. Ahead of time, copy and paste the squares from the Bingo card **provided** into different arrangements, so that every group has a different card.

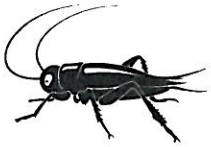
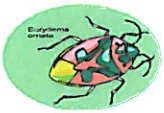
3. Students must try to find five in a row that they have collected or shown evidence of. Each time they match a square on their card, they put an x on it.

4. First one to group to get five in a row wins a prize!

Extension:

1. Science Extension:
   Have students keep track of the number of each species (on the board) they witness.

INSECT BINGO

Ant 	Insect Food 	Insect Predator 	Insect Home 	Beetle 
Insect Relative 	Bark Beetle F 	Insect Flying 	Butterfly 	cricket 
Cocoon or Chrysalis 	Insect on a Flower 	**Free Square**	Woodpecker hole 	A true bug 
Beetle larva 	Hornet, Wasp or Bee 	Gall 	Caterpillar 	A spider (non insect) 
Insect eggs 	Fly 	Grasshopper 	Dragonfly or Damselfly 	Water Insect 

Signs of Succession

Objectives:

- Students will be able to state the importance of producers in an ecosystem.
- Students will be able to describe the process of succession.
- Students will be able to explain how succession happens in a field and a forest.

Vocabulary: Succession, Climax Community, Ecosystem, Producers, Biotic

Grade Level: Grade 4

Time Allotted: 30 minutes

Standards Addressed: LS1 (3-4) 1.1.1, 1.1.2, LS1 (K-4) INQ+POC -1, LS1 (3-4) 1.3.1, 1.4.1, 1.4.2, 1.4.4, LS2 (3-4) 1.5.1, 1.5.2, 1.5.3, 1.6.1, 1.6.2, 1.6.3, 1.6.4, 1.6.5, LS2 (K-4) SAE -5, 6, LS3 (K-4) SAE -7

Science Topics: Correlates with science topic Ecosystems

Materials Needed:

- Cones or boundary markers
- Paper and pencils
- Pictures of oak, hickory, maple and beech trees

Procedures:

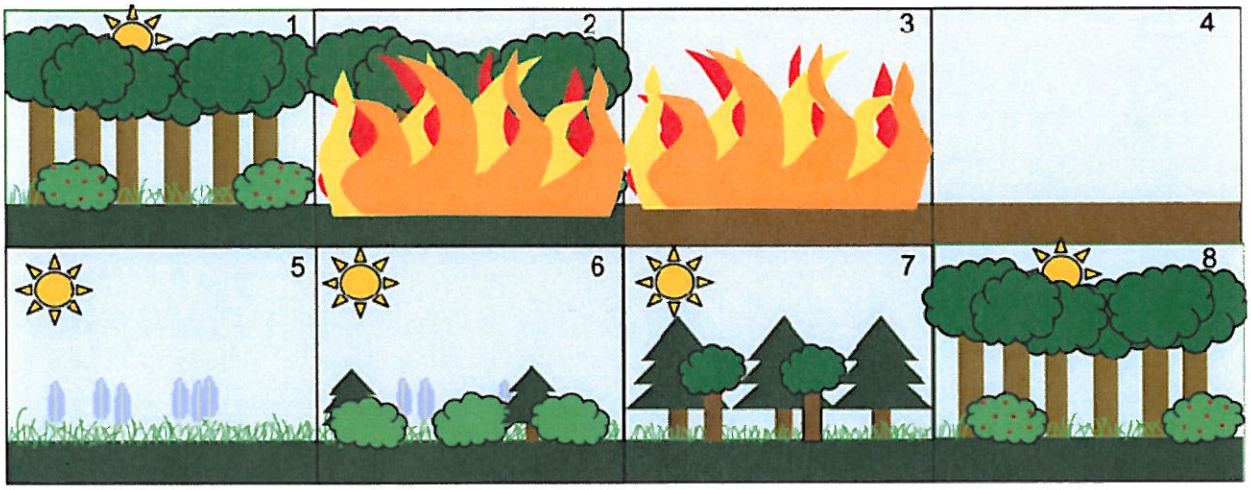
1. Review with students what an **ecosystem** is.
   a. Have them list some of the living and non-living things in an ecosystem.
   b. Are plants a living or non-living part of an ecosystem?
   c. Ask them to give evidence explaining why plants are living (**biotic**) factors in an ecosystem.
   d. In this lesson we will focus on the plants, **producers**, in an ecosystem.

2. Ask students if they think that ecosystems in nature stay the same or are always changing. Not only do they change all the time, the community of plants that will grow together changes through time. This means that the animals that live in the plant communities also changes through time.

3. Ask the students if they know what **succession** is.
   a. The concept of succession covers when an ecological community undergoes more or less orderly and predictable changes following a disturbance or initial colonization of new habitat.

b. Why are we concerned about the plant communities in an ecosystem? Because plants are producers. They convert the sun's energy into food for the consumers to be able to use.

Visual Example of Secondary Succession:



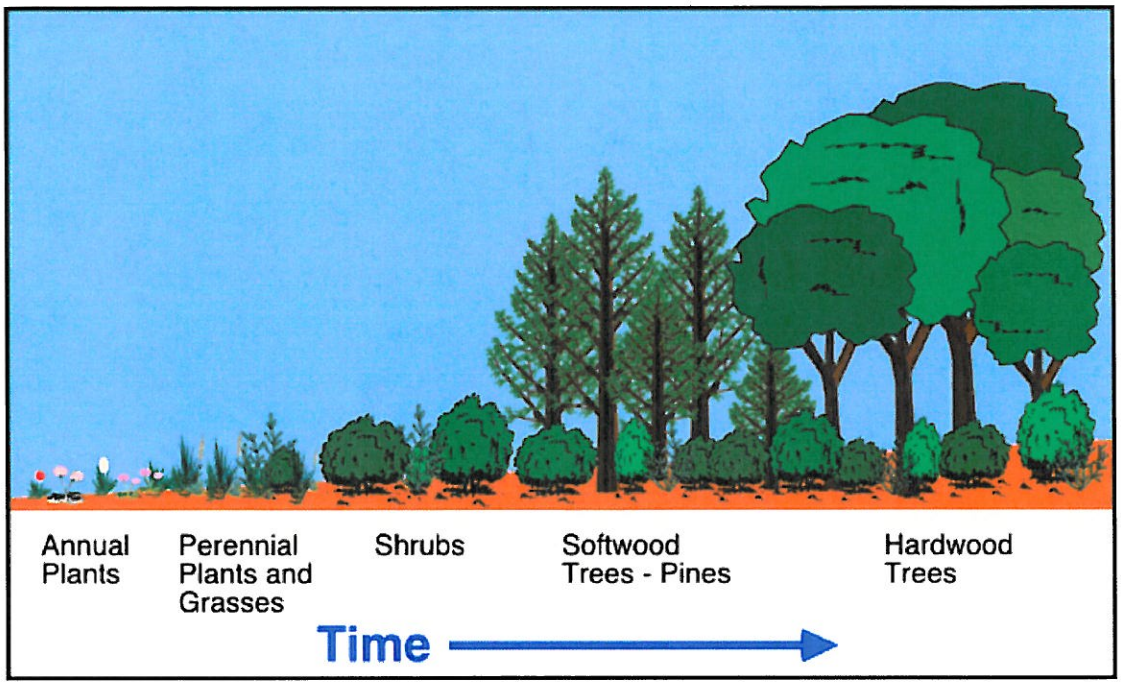
An example of Secondary Succession by stages:

1. A stable deciduous forest community
2. A disturbance, such as a wild fire, destroys the forest
3. The fire burns the forest to the ground
4. The fire leaves behind empty, but not destroyed, soil
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. The short-lived and shade intolerant evergreen trees die as the larger deciduous trees overtop them. The ecosystem is now in a similar state to where it began.

4. Explain this further by discussing the most common ecosystems we find in RI. Have students name an ecosystem the producers that grow in those ecosystems:
   a. in a **field/ meadow** ecosystem, the main producers are **GRASSES** & **wildflowers**
   b. in a **forest** ecosystem, the main producers are **TREES** and **shrubs**
   c. in a **pond/ lake** ecosystem, the main producers are **lily pads**, **duckweed**, **pickerel weed**, **cattails**, etc. (All plants whose leaves either float or stick out of the water).

5. In every region of the world, there is one plant community called the **climax community**. This is when an ecosystem goes through succession and eventually becomes more stable with fewer changes – it then becomes a climax community.

6. Here is the Northeast of the US, the climax community is a *forest with deciduous trees* (those which lose their leaves) featuring oaks & hickories, or even maples & beeches.



7. Next bring students along the trail so that they can do an activity to help them remember some of the stages of succession, from a typical field ecosystem to a climax community forest ecosystem here in RI.

8. This activity is done like a tag game. Designate boundaries to the area that the class will need for the activity.

9. Have students form 2 teams and line up, shoulder to shoulder, across from each other.

10. Explain the 3 different plant (producer) types that are in this game: trees, shrubs and grass.

11. There is a symbol the students will make for each plant type:
    a. Trees = students put both hands straight up over their heads
    b. Shrubs = students put arms out in front of them in a circle
    c. Grass = students have their hands waist height, with elbows in, and wiggle their fingers. Have students practice each motion.

12. The activity will work like this: each team does a little huddle to decide which of the three plant types they will be for that round. Students then line up facing the other team.

13. As a group, both teams and the teacher chant "Trees, shrubs, grass!" 3 times, making each corresponding symbol with their arms.

14. After the 3rd chant of the plant types, each team makes the symbol they decided upon in their huddle.

15. To figure out who gets to chase who, they learn the way succession works:
    d. ***trees** chase **shrubs** - because trees will grow & take over (by out shading) an area where shrubs grow
    e. ***shrubs** chase **grass** - because shrubs will grow & take over (by out shading) an area where grass grows
    f. ***grass** chases **trees** - because when a tree dies & falls over, grass grows in the spot the tree used to be (no longer out shaded!)

16. Each team has a space behind them in which to run and a safe spot they will try to reach without getting tagged (designate this safe spot with a set of cones or other markers).

17. Anyone who gets tagged will join the other team for the next round.

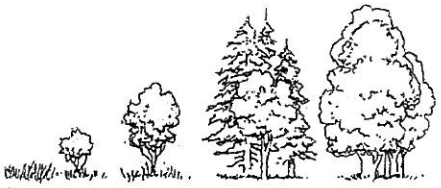
18. Play a few rounds so that the students will remember the order of succession.

Extensions:

1. Science Extension:
   Ask the students to do a search for signs of succession at their own homes/backyards or neighborhoods. Have them record what they discover there. How does it compare to the refuge?

2. Science Extension:
   Students can research what kinds of trees used to be part of the typical New England climax community forest. See if they can discover what happened to trees like chestnuts and elms. Are any species of trees today threatened by disease, fungus or invasive insect pests? They can write reports or make posters about their findings.

3. Math Extension:
   Have the students think of the trail system as a whole, or 100%. Have them decide how much is covered by plants (this is called % cover). If the trail system was a big pie chart, what percentage of the pie are grasses? Shrubs? Trees? Rocks? Have students make a graph of their estimates. They can repeat this activity for different sections along the nature trail by breaking up the trail, such as the open area, along the trail and near the pond.



Succession:
Field and Forest Study

Objectives:

- Students will be able to understand and explain succession by comparing the field and forest habitats.

Vocabulary: Succession, Transect, Non-woody plant, Small woody plant, Tall woody plant, Adaptation

Grade Level: Grades 5 and above

Time Allotted: 45 minutes

Standards Addressed: LS1 (K-4) INQ + POC -1 & SAE -2, LS4 (K-2) 8a, PS1 (K-4) INQ 1a

Science Topics: Correlates with science topics Plants and Physical Properties

Materials Needed:

- Transect hoops
- Succession field study worksheets
- Pencils
- Clipboards
- Air thermometer
- Soil thermometer
- 10 foot transect line

Procedures:

1. Introduce the topic of succession with the group. Succession is a natural pattern of change that takes place over time, where one plant species, better suited to that environment, replaces another.

2. Tell the students that they will be studying succession in the field and forest.

3. Ask the students; "What would happen if they stopped mowing a field?" Have them brainstorm what that environment would look like 5, 20 or 50 years from now.

4. What would happen if there was a fire in the forest, etc? Again, have students brainstorm what the environment would look like.

5. Review with students the differences between grasses, non-woody-plants, small woody-plants, and tall woody-plants, so that students can identify them on the trails.

6. Explain to students what a transect hoop is, along with a transect line. Tell students how scientists also use this process while doing their research.

7. Review the rules for proper etiquette while on the trails. Then take students outside.

8. In the field, divide students into groups of 2-3. Give each group a transect hoop and clipboard with worksheet and pencil.

9. Have students toss their transect hoop anywhere in the field. Emphasize to students that it is important to be cautious of plants and animals while conducting this experiment.

10. Students should fill out their worksheets by counting the types of each plant located in the hoop. (Students are not required to know the names of the plants, just whether they fall into the categories of grasses, non-woody plants, small woody plants or large woody plants.)

11. Once everyone is finished, regroup everyone into a large group. As a group, take the air and soil temperatures in the field. Have students record the data on the worksheets as well.

12. Walk students along the trails, to the forest habitat. Have students use the transect line instead of the transect hoops, while in the forest. Again, remind students to be careful not to damage plants or animals.

13. Again, have students fill out the worksheet.

14. Once everyone is finished, regroup everyone into a large group. As a group, take the air and soil temperatures in the forest. Have students record the data on the worksheets as well.

15. Have the group compare the temperatures in the field to those in the forest, and brainstorm why there is a difference. Discuss how shade from the forest trees affects the temperature at each location.

Succession: Field and Forest Data Sheet

Recorder's Name:_____

Date:_____

Time:_____

Field Soil Temperature:_____ Field Air Temperature:_____

Forest Soil Temperature: _____ Forest Air Temperature:_____

Procedure

- Count and record the number of different plant types inside the hoop in the field.
- Count and record the number of different plants types which cross the transect line in the forest.

Plant types are broken down into 4 categories:

- **Grasses**
- **Non-Woody Plants** - Plants other than grasses which are not woody, including flowers, moss and ferns.
- **Small Woody Plants** - Plants with a woody stem less than 10 feet tall, such a shrubs and saplings.
- **Large Woody Plants** - Plants with a woody stem over 10 feet tall, including trees.

Plant Type	# of Types in Field	# of Types in Forest
Grasses		
Non-Woody Plants		
Small Woody Plants		
Large Woody Plants		

STATION 2

THE FOREST EDGE

2. THE FOREST EDGE

Located at the edge of the second field
GPS Coordinates: North 41°40.329', West 71°41.567'
Elevation: 566 Feet

The forest edge is a boundary where two different habitats meet: mature forest and open field. The boundary can be straight and abrupt, like the edge of a clear-cut, or it can be **feathered** - more gradual and multilayered. Feathered edge environments include smaller trees and shrubs that would normally be part of an **understory,** but can also thrive in the sunnier, less competitive edge environment. Vines such as Poison ivy, Virginia creeper, and the invasive Oriental bittersweet tend to grow easily here. The diversity and abundance of plants at the edge provide food and shelter for a number of animals - birds, deer, and rabbits. Animals from both types of habitats frequent edge habitats as they move between the two habitats (see diagram above).

Forest edges can be highly beneficial to wildlife, but having too much edge is actually harmful. Many species depend on large tracts of unbroken forest that they can disappear into and use as travel corridors. When human expansion fragments the forest into smaller parcels, different populations become isolated from one another and lose genetic diversity. Some species may also become more vulnerable to predation by larger animals coming in from the edge and reaching areas that were previously deep enough in the forest to be secure. There needs to be the right balance between wooded and open areas to create enough edge without fragmenting the forest.

How does this edge habitat look to you? Is it feathered or straight? What kind of animals do you think use this habitat at the Maxwell Mays refuge?

Meet a Tree

Objectives:

- Students will be able to explain how trees are diverse and unique.

Vocabulary: Diversity

Grade Level: Grades 1 - 8

Time Allotted: 30 minutes

Standards Addressed: LS1 (k-2)- 1b, LS1(k-2)-1c

Science Topics: Correlates with the science topic Plants

Materials Needed:

- Blindfolds

Procedures:

1. Pair students together. One student is blindfolded and the partner will carefully lead him/ her to a tree. Stress the importance of being careful and responsible while guiding someone who is blindfolded, as well as being careful as the blindfolded one.

2. Demonstrate, using a volunteer, how to carefully guide your partner to a tree. You should be the guide and have your partner close their eyes.

3. Then by having them hold your arm, lead them to a nearby tree, being careful to point out any dangers along the way such as "duck down here, lift your leg here, etc."

4. Have your partner feel the tree. Have them determine how big around it is, what the bark feels like, feel at the bottom if there are any plants nearby. *Be sure everyone knows what poison ivy looks like.*

5. When the partner feels that they know the tree, bring them back to the starting area, spin them a few times carefully, and then remove the blindfold.

6. They will then attempt with guidance, to find their tree using the clues they gathered while blindfolded.

7. Then have partners switch roles.

Extensions:

1. Science Extension:
   As a follow-up, ask students to describe the different characteristics and uniqueness of each tree. Ask them to explain how were they able to tell which tree was their tree. Explain that trees are diverse and unique. There are different species or kinds of trees, different ages of trees, and each tree looks and is shaped differently based on many factors in the life of that tree- just like each person on earth. Encourage them to look for that uniqueness and diversity all around them.

The Edge of Home

Objectives:

- Students will be able to identify the characteristics of ecotones, or overlapping ecosystems, in the wildlife habitat on the Maxwell Mays Refuge.

Vocabulary: Ecosystem, Interactions, Area, Ecotone, Edge

Grade Level Grades 2 - 8

Time Allotted: 45 minutes

Standards Addressed: LS1 (k-2) -1b, LS1 (3-4) – 1b, LS1 (3-4) -1c, LS1 (5-6) – 1a, LS1 (7-8) – 1a

Science Topics: Correlates with the science topic Ecosystems

Materials Needed:

- Poster paint or water colors
- Pencils
- Paper
- Long rope or string for marking intervals in 1 foot segments
- Clipboards
- Cameras

Procedure:

1. In the classroom, before the field trip, ask the students to paint two large spots. One each of two different colors on a single piece of paper. Make sure the paints are quite wet to insure blending. Blue and yellow are good choices.

2. Invite them to enlarge the spots until they "touch" each other but do not overlap. Have them note what happens when the wet paints touch.

3. Ask them to repeat the process on a separate piece of paper so that the colors not only touch but overlap. With blue and yellow the overlap produces green and is thus highly visible.

4. Tell the students that they are going on a field trip to the Maxwell Mays refuge where there are places that overlap like their paintings did. Tell them they are going to investigate these places. Including the areas where there is some kind of overlap. Their paintings are a metaphor for an important biological concept in nature called an ecotone.

5. As further preparation before the trip- draw two overlapping circles on the chalkboard. Put a large number of squares and triangles in one circle (avoiding the overlap). In the second circle draw many circles and stars. Again, avoiding the overlap area.

6. Ask the students to predict what kinds of things they would expect to find in the overlapping area. Draw circles, squares, triangles and stars in the overlap area.

7. Ask the students where the greatest diversity exists. Label the whole area of overlap and ecotone. An ecotone is where two ecosystems come together and interact. The process and results of this coming together or interaction are called the edge effect.

8. On the Maxwell Mays trail, choose the Forest Edge Area as located on the map. Divide students into teams of two or three and have them explore and list the things they find on either side of the edge.

9. At this point they will not be looking at the edge where the two systems meet and overlap. They can list different kinds of plants and animals they observe, and tally what they find- including direct and indirect evidence of life. Ask them to discuss similarities and differences.

10. Next, ask them to carefully examine the edge. NOTE: It may help the students organize a more systematic approach by stretching a length of rope or string at one foot intervals. Have student's record observations for every foot along the line. It helps to mark the string or rope at one foot intervals.

11. Compare what is inside the eco tone and what is outside.

Extensions:

1. Science Extension:
   Continue the quest for ecosystem edges and create an ecosystem map or model. Indicate the ecotones. Assess the overall health of the ecotones that seem important to the quality of life of species.

2. Language Arts Extension:
   Have students write a paragraph about the characteristics of ecotones. Write at least two more paragraphs to describe two ecosystems and an associated ecotone.

Wildlife Real Estate

Objectives:

- Students will be able to define habitat.
- Students will be able to state the things that animals need from their habitats to survive.
- Students will be able to evaluate which parts of the nature trail provide what wild animals need to live.

Vocabulary: Habitat, Biotic, Abiotic

Grade Level: Grade 4

Time Allotted: 25 minutes

Standards Addressed: LS1 (3-4) 1.1.1, 1.1.2, 1.2.1, 1.2.3, LS1 (K-4) SAE -2,
LS2 (3-4) 1.5.2, 1.5.3, 1.6.2, 1.6.3, 1.6.4, 1.6.5, (K-4) SAE -5, 6

Science Topics: Correlates with science topic Ecosystems

Materials Needed:

- Magnifying lenses
- Paper and Pencils (or Science Journals)

Procedures:

1. First, ask students what all animals need from their habitats to survive. They should come up with food, water, shelter, space and air. Students will often mention sunlight as another habitat requirement (sunlight is more important for plants than it is for animals, but it is okay if they mention it because all animals need plants in some way to live).

2. Have the students make a chart on their paper with each of these requirements listed, and room to write comments, descriptions, draw pictures and tally what the students find.

3. Query the students about whether non-living (abiotic) factors play as much of a role as living (biotic) factors. Air and space and light are all abiotic factors. Soil is an abiotic factor. Do animals have to be concerned about these factors?
(All animals ultimately rely on plants for survival, and soil, air and light are essential to plants, so abiotic factors do seem to be important)

4. Next, bring students onto the trails. Pass out the magnifying lenses.

5. Explain that the students are going to pretend that they are animals looking for a new place to live and they need to explore the nature trail to see if they can find a place that

suits their needs. They can pretend that one of their animal neighbors needs to move and their real estate agent said this would be a good spot, so the students are checking it out.

6. As they go along they can record all the things they see that are necessary in their habitats to survive.

7. As they walk along, ask them to breathe deeply. Does this spot have good air? Students should write down their opinions.

8. Have them use their ears and their eyes to see if they can find any water. They can also look for puddles or snow and ice in the winter. Walk them all the way to the edge of the pond. Is there clean water nearby? Students can write what they notice.

9. Encourage them to look carefully for places they could hide or places they could go to get out of rain or snow, or even a place to find shade in the summer. Does this place have enough shelter for protection? Have students list or describe some of the different types of shelter available (ex. up in a tree, in a hole in the ground, under a log, etc.). They can tally how many of these different types of shelters they observe.

10. The most difficult thing will be to find food, since there may not be what the students recognize as human food on the trail. There are raspberries, and blueberries but those are only noticeable in the summer and fall.

11. To find out whether there is enough food for wildlife they can look for these items (have students make a list) in the different seasons:
    a. **Fall**: berries on trees and shrubs, chewed acorns and hickory nuts, insect galls (egg cases) on leaves
    b. **Winter**: pine cones, acorns, holes in trees, buds on trees, snow fleas at the base of trees on the snow on the ground
    c. **Spring**: holes in leaves, flowers, insect egg cases (like praying mantises and tent caterpillars), ant holes in the ground
    d. **Summer**: spider webs, tent caterpillar webs, insects and caterpillars on leaves, chipmunk holes in the ground

    Many animals eat berries, seeds, or insects, so finding evidence of any of these things is evidence that there is food available.
    How many different signs of food are visible in different parts of the trail? Students tally how many different kinds of food are available as they walk along.

12. Ask students if they feel that they are at all cramped as they walk along.
    Is there enough room for animals to move in and raise their families here?

13. Ask each student to share an opinion about the land everyone was exploring today. Would they recommend this as a good place to live if they were wild animals?

14. Encourage students to go home and evaluate their own backyards and neighborhoods the same way to see if they live in places that wild animals might also like to live.

Extensions:

1. Science Extension:
   Students could bring out their notes and keep track of what they see back in the schoolyard over a period of time – a week, a month, a season, etc. They can then notice if there are any things that could happen during a year that affect whether a piece of land will remain good habitat for animals or plants (were there any big storms, fires, floods, or human impacts to the land that might affect its potential as wildlife habitat?).

2. Art Extension:
   Students could take a different perspective and be the real estate agent trying to "sell" the plot of nature as a place where wild animal families might want to move. They can design advertisement posters with drawings of the best features (from a wildlife point of view) of the trail highlighted.

Oh Deer!

Objective:

- Students will be able to state that food, water and shelter are three essential components of wildlife habitat.
- Students will be able to describe the importance of a good habitat for animals.
- Students will be able to define limiting factors and give examples.
- Students will be able to explain why fluctuations in wildlife populations are natural.

Vocabulary: Habitat, Limiting Factors

Grade level: Grades 3-5

Time Allotted: 30 minutes

Standards Addressed: LS1 (K-4) –INQ+POC -1d, LS1 SAE-2a, LS2(K-4) SAE -5a, 6b, 6c, LS3 (K-4) SAE -7a, 7b, LS1 (5-8) –POC -3a, 3b, LS1 (5-8) –INQ+SAE – 1a, LS2 (5-8) –INQ+SAE -5a

Science Topics: Correlates with the science topics Structure and Survival, Interdependence in Ecosystems, and Ecosystems

Materials Needed:

- Paper (or Science Journals)
- Markers or pencils
- Cones (or other boundary markers)

Procedure:

1. Describe the fundamental necessities of animals: food, water, shelter and space in a suitable arrangement. Can any of us survive without these essential components? NO!

2. We are going to do an activity in which the students will become deer, having to get their fundamental needs from the habitat in which they live.

3. Before beginning the activity, do a quick review:
   a. What kind if an animal is a deer? (mammal)
   b. How do we know it is a mammal? What are its characteristics?
   (Fur or hair, has live birth, mother feeds babies milk, warm blooded, is a vertebrate)

4. Bring students to an open area on the nature trail.

5. Have students count off in fours, with all those sharing the same number gathering together. This will help make the proportions work for the activity.

6. Mark off two parallel lines on the trail that are about ten to twenty yards apart.

7. Have all the "ones" behind one line and all the rest behind the other line. The "ones" will begin as deer.

8. The other students (all the twos, threes and fours) will become the components of habitat: food, water, shelter and space.

9. The deer will be looking for the one of the essential components of its habitat each round.
    a. When a deer is looking for food, it should clamp its hands over its stomach.
    b. When a deer is looking for water, it puts its hands over its mouth.
    c. When a deer is looking for shelter, it holds its hands together over its head.
    d. When a deer is looking for space, it should hold its arms straight out at its sides.
    e. A deer can choose to look for ANY ONE of these needs during each round, but it *cannot change* what it is looking for in the middle of that round. It can change in the next round if it survives.

10. The students who are the components of habitat may choose which component they will be at the beginning of each round. They will display that component using the same actions as the deer.

11. The game starts with all players lined up shoulder to shoulder on their respective lines and with their backs to the students at the other side.

12. The teacher asks all students to pick which habitat component they are going to display and they make their sign.

13. When all students are ready, count, "One...two...three." At the end of the count, the students turn and face each other showing the sign of the habitat component they choose.

14. The deer run towards the other line where the students displaying the habitat components are standing. Deer are looking for a habitat component that matches the one they are displaying.

15. If a deer successfully finds a match for what it is looking for, it gently takes the student representing that habitat component back to the deer side of the line.
    This represents the deer successfully meeting its needs and reproducing as a result.

16. Any deer that fails to find a match of the component it was seeking dies

(students are welcome to swiftly but dramatically act this out). That deer becomes part of the habitat, joining the students on the habitat side.

17. Have everyone line up again and begin the next round.

18. The teacher keeps track of the number of deer at the beginning and end of each round. Continue play for several rounds, so that you begin to see some fluctuations in the deer population.

19. At the end of all the rounds, discuss the activity. Encourage the students to talk about what they experienced and saw.
    a. Did they notice the herd growing, and then some deer ending up dying as the habitat was depleted?
    b. Does this happen in nature? Yes, this fluctuation is a natural process unless there are other limiting factors that affect the habitat.
    c. Some of the limiting factors could be things like drought, fires, deforestation, uncontrolled hunting. Can the students think of any others?
    d. Do deer only search for ONE of their habitat components every year? No, so this activity is just an approximation of what might happen in nature.
    e. Is it difficult for a deer to find all the habitat components it needs to be able to survive? Sometimes. People can often provide habitat without realizing they are doing it, like by planting a garden in their yards, or by keeping their lawns cut and surrounded by an area with trees. (Deer prefer a habitat on the edge of a field and a forest.)
    f. Why did the deer get to take a habitat person back to the deer side with them if they found a match? If a deer has all the food, water, shelter and space in which to find all those things, then it is healthy, and healthy individuals in nature are usually the ones that reproduce. In nature, a species of wild animals cannot survive if it cannot reproduce.

20. Next, make a line graph of the number of deer alive at the end of each round to show that it is naturally cyclical. Have the students copy the numbers and/or the graph on their own papers.

21. Have the students summarize what they have learned from the activity.

22. Give the students an opportunity to do this activity again (either on the same day, or on another day). The next time, be sure to include the limiting factors. For example, if there is a drought during one round, no student on the habitat side can choose water as their symbol in that round.

23. A new graph can then be made to show the difference made in the natural cycles, and compared to the first graph.

24. Before heading back inside, have students walk around the trail to evaluate if this would be a habitat with all the components that deer need to survive. Is there any way to tell if deer have visited this trail? (look for tracks or scat – deer poop)

Extensions:

1. Science / Language Arts Extension:
    A. Students can research online to try to find data on deer populations in the state or even in the New England area over the last few decades. Many State Departments of Environmental Management (DEM in RI, DEP in CT, DCR in MA) collect data on the deer population so that they know how many hunting licenses they can issue each year.
    B. If students find data on deer populations, they can graph that and compare the results to what they found when doing the Oh Deer! activity. Does the population fluctuate? What other factors might contribute to the increase or decline in population numbers?
    C. They can prepare a report on their findings, and/or present their findings to the rest of the class.
    D. Some students can choose other common wild animals, too, and see if their populations have similar ups and downs.

Adopt a Tree

Objectives:

- Students will be able to name, identify, and describe a tree on the nature trail that they have observed.
- Students will be able to explain how their tree is important to the ecosystem.
- Students will be able to list organisms that depend on the tree for survival.
- Students will be able to predict the age of their tree by taking measurements and making calculations.

Vocabulary: Producers, Consumers, Ecosystem, Tree Rings, Forestry, Estimate, Circumference

Grade Level: Grade 4

Time Allotted: 50 minutes

Standards Addressed: LS1 (3-4) 1.1.1, 1.1.2, LS1 (K-4) INQ+POC -1, LS1 (3-4) 1.4.1, 1.4.2, LS2 (3-4) 1.5.1, 1.5.2, 1.5.3, 1.6.3, 1.6.4, 1.6.5, LS1 (K-4) SAE -6

Science Topics: Correlates with the science topics Ecosystems and Plants

Materials Needed:

- Tree Observation and Tree Measurement worksheets
- Tree and shrub field guides
- Pencils, clipboards, paper (or Science Journal)
- Measuring tapes
- Yardsticks
- Calculator (optional)

Procedures:

Part I: Tree Observations

1. In the classroom, ask students to draw a tree with as much detail as possible.

2. Discuss what students know about trees. Ask some questions to guide the discussion:
    a. Are they living or non-living? How do we know?
    b. What do trees need to be able to survive?
    (sunlight, water, carbon dioxide, nutrients from the soil)
    c. Are trees producers or consumers?
    d. What do trees provide to animals and other organisms in the forest ecosystem?
    (they provide food, shelter, oxygen, nesting places and materials)
    e. Why do scientists study trees? Are they important to humans? How?

3. Introduce the Tree Observation worksheet. Students will be choosing a tree located in the forest along the nature trail, and they will use this worksheet to record their observations about the tree.

4. Bring students out onto the trails to find the tree they will "adopt". Make sure to point out or remind students to be careful of poison ivy, which grows as a hairy-looking vine around the trunks of some trees, and whose leaves grow in groups of three.

5. Encourage students to describe their tree in detail and draw it as well. They can come up with a name for it to help them remember it.

6. If they would like to discover what species of tree they are adopting, they can look at the field guides, and record any information they learn. If they cannot identify the tree with the guide, they may be able to use the Internet later to help them.
(This is why it is important for them to make a detailed description with a drawing.)

7. After each student has had some time to make their detailed observation, gather the group to share. This will allow students to compare and contrast their trees.

8. If possible: Come back to the trails with the students so they can visit their tree regularly and record more observations in detail. Ask them to particularly notice how the tree changes with the seasons.

Part II: Tree Measurements

1. Take a quick and informal survey to see how many students know their age and height. How do we know our age and height?

2. Ask students to share some ways they think we could learn the age and height of a tree.

3. Look around on the nature trail for tree stumps, and then discuss how counting the rings can approximate a dead tree's age (each darker colored ring indicates the end of one year of the tree's growth). Have students practice.

   (*Here is a quick description of why the tree rings are light and dark, and how that helps us know the age of the tree, paraphrased from the PBS NOVA website:*
   '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. Ask students if this method of counting tree rings would be helpful to find out the age of living trees. (Not so much.) Foresters (scientists who study trees and forests) have

instruments called increment borers that they use to pull out a thin tube (called a core) of the wood of a living tree. 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, we will try a different way to determine our adopted trees' ages. Discuss what it means to estimate, and give some examples.

6. Lead the class to a sample tree along the trail to demonstrate how to take the measurements (a tree in the open would be the best choice for this demonstration). First, we make predictions:
    a. How old do they think the tree is?
    b. How tall do they think the tree is?
    c. What have they based their predictions on?
    d. Responses to these questions will be recorded on the Tree Measurement worksheet.

7. Introduce the Tree Measurement worksheet and go over the steps the students will need to follow on their adopted trees to be able to estimate age and height.

8. Instruct students to measure the circumference of the tree trunk approximately 3 feet or 1 meter from the ground.

9. Next, show students how to measure the length of the tree's shadow and length of a meter stick's or yardstick's shadow.

10. Once students understand how to make the measurements, have them work together in group of at least four to share the equipment and make the measurements on their adopted trees. They will record data for FOUR trees.

11. Some students may run into an issue if their tree is in the forest and they cannot easily find its shadow because of other trees and shrubs surrounding it. In that case, they can practice by helping another student, or maybe finding a tree along the trail that looks similar to their adopted one.

12. The calculations can be done back in the classroom, using a calculator if needed. Discuss what the students found.
    a. Did their results surprise them?
    b. How did the students' predictions match the results they calculated?
    c. Are there any trends or patterns in which species of trees were older or taller than the others?
    d. Students can graph their results to be able to see everyone's data visually.

Extensions:

1. Dramatic Arts/ Physical Education and Science Extension:
   Note: The following activity is an adaptation of "Build a Tree" from Sharing Nature with Children by Joseph Cornell, pp 62-66

   A. Announce that you are going to build a tree out of people.

   B. Choose one student to be the heartwood in the very center. Have the student cross his or her arms and stand in the center of the group. They say "I'm big, I'm strong, I'm heartwood."

   C. Next, have one student lay down at the base of the heartwood facing outward. This student is the taproot, which can reach straight down for up to 15 feet! It draws water and anchors the tree. In addition to the taproot, you need 2-3 lateral roots. They lie with their feet up against the taproot. Have them spread their fingers and hair on the ground. Have the taproot and lateral roots say "slurp, slurp!"

   D. Next, have 3-4 students standing surround the heartwood. They will be the sapwood, made of cells called xylem. The sapwood carries water and minerals throughout the tree. They will say "Up with the water!" and move their hands up toward the sky.

   E. Next, choose 3-4 students to stand around the sapwood, facing inward. They are the cambium layer and the phloem layer. The phloem's job is to carry sap from the leaves down to the roots for storage. They say "sap down to the ground!" and bring their hands from the sky down towards the earth.

   F. The cambium is a tiny layer (one cell thick!) between the xylem (sapwood) and phloem. The cambium creates new cells. Have them say, "Make new cells!" and move their hands and arms back and forth.

   G. The rest of the students will be the bark. They will be the outer layer, surrounding the cambium/ phloem folks. They will say "we protect, we protect!" and make protecting motions with their hands.

   H. Once everyone has learned their part, have them do all their roles and chant their phrases all at the same time.

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 have you based your predictions 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 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

STATION 3

THE DECOMPOSING LOG

3. THE DECOMPOSING LOG

Located at the beginning of the woods after the second field
GPS Coordinates: North 41°40.363', West 71°41.418'
Elevation: 567 Feet

When a healthy tree dies it is called a snag. When a snag falls to the ground it becomes a "rotting log" and begins to break down or **decompose.** A rotting log is a prime example of how a once-living organism replenishes the soil with nutrients and is recycled back into nature. If nutrients were not recycled in our environment they would not be available to other organisms.

The rotting log, while looking lifeless on the surface, is actually full of life and an essential part of the cycle of nutrients in the forest ecosystem. It is a micro-habitat within a macro- habitat that supports thousands of organisms. These organisms are part of an interrelating food web of **producers, consumers and decomposers.**

Insects and other arthropods, bacteria, and fungi all help with the process of breaking down the log. There is an interesting story in the way each of these plants and animals attacks the rotting log. The boring beetles, for instance, chew up the wood but the digestion is done by hosts of microscopic animals (protozoa) packed in their intestines. Earthworms have ferments in their saliva which convert the woody substances into sugar. Fungi release enzymes that help to break down the wood, and Isopods, which are in the crustacean sub-phyla, have strong jaws to chew through the wood cellulose.

Decomposers are vital components of the nutrient cycle. Without decomposers, nutrients would not cycle back into our environment and waste would accumulate at an alarming rate. If decomposers did not exist, within a month the earth would be covered in a layer of dead flies almost twenty feet deep!

Take a close look at the decomposing log. Can you find holes or tunnels that a beetle larve may have made? Are there any mushrooms?

Who Lives in a Rotting Tree?

Objectives:

- Students will be able to describe some of the inhabitants of a rotting tree habitat.
- Students will be able to identify clues that these creatures live or visit a rotting tree.

Vocabulary: Animal Tracks, Animal Signs, Habitat, Decompose

Grade Level: Grades K - 4

Time Allotted: 20 minutes

Standards Addressed: LS1 (k-2) -1b, LS1 (3-4) – 1b, LS1 (3-4) – 1b, LS1 (5-6) – 1 a, LS1 (5-6) -2 a, LS1 (3-4) – 4a

Science Topics: Correlates with science topics Life Sciences, Observation, Sorting/ Classifying, and Plants

Materials Needed:

- Rotting Tree Residents Clue Sheets
- Clipboards
- Pencils or crayons
- Magnifying lenses

Procedures:

1. Hand out the Rotting Tree Resident Clue Sheets, along with clipboards, and pencils or crayons to groups of two or three students.

2. Walk students out to the Decomposing Tree station.

3. Have the groups look for the clues mentioned on the clue sheets and determine who might have left these behind. Students can draw or write their observations, depending on their age.

4. Pass out magnifying lenses to the student groups to help with their investigations.

5. Go over some of the signs of animal activity the student groups found.

6. If time permits, allow student groups to expand their area of investigation to include other sections of the nature trail.

7. Ask them to compare what they find at the Decomposing Tree station to what they find at the other stations.

8. Repeat this activity in different seasons to learn who uses the rotting tree during other times of the year. Winter is a particularly good time of year to look for tracks in the snow.

Extensions:

1. Science Extension:
   For older students, use a Field Guide to Tracks and Signs (such as a Peterson's Guide) and have them try to identify the clues left behind by animals without using the Rotting Tree Resident Clue sheets.

Rotting Tree Residents Clue Sheet

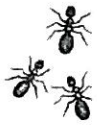
Can you find any of these signs of life in the rotting tree?

White, stringy strands,
inside the wood of the tree?

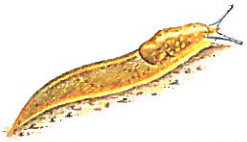
There's a FUNGUS among us!

Dirt or Sawdust at the

base of the tree?
ANTS have been at work!



Leafy nests at the
top of the tree?
Clear, slimy trail on
the outside of the tree?



SLUGS have crawled by!

Large Holes near the top of the tree?

WOODPECKERS
are moving in!

Leafy nests at the
top of the tree?

SQUIRRELS have joined
the neighborhood!

Stick nests near the
top of a tree?

ROBINS are raising a family!

Small holes or tunnels in the
bark or trunk of the tree?

BARK BEETLES are
carving that they were here!

Small holes in a ring around the
tree trunk?

YELLOW-BELLIED
SAPSUCKERS
are looking for insects!

The Fallen Log

Objectives:

- Students will be able to identify some of the organisms that live in, on and under fallen logs.
- Students will be able to explain how those organisms depend on dead wood for survival.
- Students will be able to describe the process of decomposition.

Vocabulary: Decomposition, Fungi,

Grade Level: Grades 2 – 8

Time Allotted: 45 minutes

Standards Addressed: LS1 (3-4) – 1b, LS1 (5-6) – 1 a, LS1 (5-6) -2 a, LS1 (3-4) – 4a

Science Topics: Correlates with science topics Decomposition, Biodiversity, Observation, Organizing Information, Analyzing and Plants

Materials Needed:

- Paper
- Pencils
- Clipboards
- Field guides on insects and spiders as well as non-flowers plants
- Magnifying lenses
- Bug boxes

Procedures:

1. Conduct this activity at the decomposing log on the Maxwell Mays trail, or any area with fallen logs, dead trees or stumps. Optimally, these pieces should be at least 8 inches across, and should be in various stages of decomposition.

2. Begin by asking the students why forests are not piles high with fallen leaves, branches, and trees. What happen to the trees after they die? Tell the students they are going to examine dead logs (or tree stumps) to find answers to those questions.

3. Divide the students into teams and each team will examine a rotting log. Team members will need to keep track of each different kind of plant or animal they found, where it was found, what it looked like, and what it was doing. Each team should record this information in the Fallen Log Investigation Sheet.

4. Discuss with the students the following questions based on their findings:
    a. What similarities and differences were there between each of the logs? What might explain the differences?
    b. What animals and plants were found both on the log and in nearby areas and leaf litter? What do those areas and the log have in common?
    c. How do the animals you found on the log interact with it?
    d. Why is it important that logs like the ones you studied decompose?
    e. How does the forest ecosystem benefit from a fallen log or dead tree?

Extensions:

1. Science Extension:
   Talk about human waste and garbage in places where humans live. How do humans deal with waste? How do decomposers play a role with our garbage? Study worms and start a worm bin back at the school. Talk about recycling and reusing materials.

FALLEN LOG INVESTIGATION SHEET

1. Is there bark on the log? What is its condition? In your journal make a sketch of it.

2. What kinds of plants are growing on the log? (Examples are young trees, young shrubs, wildflowers, mosses, fungi, slime molds, and lichens.)

3. What kinds of animals are on the bark? Inside the log? Under the log?

4. What do the animals you found appear to be doing? What do you think each one eats? Why do you think that?

5. What evidence of animal activity do you find on or around the log? (Examples are insect holes, spider webs, woodpecker holes, animal dens, animal tracks, plies of sawdust, or patterns in the wood under the bark.

6. How might the tree have died? What evidence do you have to support your ideas?

7. Has the tree been dead a long time or a short time? What makes you think so?

How Fast Does a Tree Decompose?

Objectives:

- Students will be able to recognize evidence that indicates a tree is dying.
- Students will be able to name two animals that get their energy from a decomposing tree.
- Students will be able to predict the rate of decomposition of a dead or dying tree.

Vocabulary: Decomposition, Snag, Decomposers, Producer, Consumer

Grade Level: Grades 4 - 5

Time Allotted: 60 minutes total
(Two sessions of 30 minutes each approximately 1 month apart)

Standards Addressed: LS1 (3-4) 1.1.1, 1.1.2, 1.1.3, 1.1.4, 1.1.5, 1.1.7, LS1 (K-4) –INQ+POC -1, LS1 (3-4) 1.2.1, 1.3.1, 1.3.2, LS1 (K-4) POC- 3, LS2 (3-4) 1.5.1, 1.5.2, 1.5.3, LS2 (K-4) SAE- 5, 6, LS3 (3-4) SAE-7, ESS1 (5-6) 2.2.3, PS1 (5-6) 3.2.1, 3.2.2

Science Topics: Correlates with science topics Ecosystems, Weather, and Properties of Matter

Materials Needed:

- Decomposing Tree Observation worksheet
- Pencils & Clipboards
- Paper (or Science Journals)
- Air thermometer
- Soil thermometer
- Measuring tape
- Calculator
- Magnifying lenses
- Field guides to invertebrates, mushrooms, bugs & slugs

Procedures:

1. Walk students outside to look for a dead tree that on the edge of the nature trail.

2. Ask students what is going on with this tree. Look for evidence that it is still alive or dead. Such as a lack of leaves, or a lack of bark on all or part of the tree. Would this be categorized as a living thing or a non-living thing?

3. Since this tree is in the process of dying/ decomposing, it is an excellent opportunity to learn how long it will take to decompose. This is all part of the life cycle of a tree.

4. Pass out the attached worksheet to groups of 2-3 students, along with pencils and clipboards or other hard surfaces on which to write. (They can also clip or paste this sheet into their science notebooks and work on it in there.)

5. Student groups should write the date, their names and the current weather on the top. Weather can be simply "sunny", "cloudy", or "windy". To record more detailed weather information, check the internet for information on temperature, humidity, wind speed and/or air pressure.

6. Students will be recording some measurements about the tree that will help them learn this tree's story and predict its future. Each group should make and record the following observations:
    a. Use the soil thermometer at two spots near the tree and record.
    b. Take two readings of the air temperature and record.
    c. Try to get a temperature reading inside of a hole in the rotting part of the tree – if possible. This spot should be warmer than the air or soil; can the students figure out why? (The process of decomposition releases heat!)
    d. If students can safely reach into a hole in the tree, analyze what they see and feel: is the inside a solid, liquid or a gas? Describe its properties – color , texture, smell.

7. Discuss why the students are taking two readings with the thermometers: scientists don't want to base their predictions on just one piece of data. By taking more than one reading, they minimize mistakes.

8. Discuss these results. How would these differ in different seasons? How would these differ in differing weather situations? Is this tree in direct sunlight, or is it in the shade? Would the readings be different in the morning and in the afternoon?

9. Next students will find the diameter of the tree. If students can SAFELY reach around the tree, they can find the circumference (around the trunk) with the tape measure.

10. Measure the circumference of the tree and record. Use the formula on the worksheet to find the diameter of the tree and record.

11. This information will be used to predict how long the tree will take to decompose, if these readings are taken on *two separate visits* to the tree. Students repeat these measurements approximately one month after the 1st set of measurements are taken and recorded and compare their results. Since there may not be many noticeable changes to the decomposing tree in a month, students can choose to wait longer between their first and second visit. They just need to adjust the worksheets accordingly.

12. The worksheet will be used to calculate how many inches per year the tree will decompose, and then figure out how many years it will be before the tree has completely decomposed into soil. Have students follow the step by step instructions on the worksheet. These calculations can also be converted back and forth into metric.

13. In the "Comments" section on the worksheet, students can record other observations. This is a good time to gently dig under one part of the tree (if it is on the ground) to see what organisms are living in and around the decomposing tree. Have students make predictions about what they might find, then search to test their predictions. The organisms that are getting their energy from the rotting tree are called decomposers; these are often things like fungi, insects, bacteria, and worms.

14. Students can record things like
    a. holes on the bark,
    b. small animals climbing on the bark or around the tree
    c. piles of sawdust or dirt at the bottom of the tree
    d. any animals up in the branches of the tree
    e. any visible nests of leaves or twigs in the tree.

15. *After two visits* to the tree to take measurements and make predictions, here are some follow-up questions for discussion:
    a. What factors might make this tree decompose faster? Do you think it would decompose faster or slower if it were wet all the time? Why or why not?
    b. Is there any way to tell what caused this tree to die?
    c. Is this dying tree valuable to the wild animals around here?
    d. How do you balance the importance of this *snag* (a standing dead tree is called a *snag*) to wild animals that use it for food and for shelter with the safety concern of this tree falling over and hitting someone or damaging property?
    e. Why is a rotting tree a good habitat for the decomposers that live there? What survival requirements does it meet (food, often shelter and even water). A tree is a producer, so therefore the decomposers are... consumers. Ask students to create a food web incorporating the organisms found living on and around a rotting tree habitat.

16. Once students have learned how to take the measurements and make the calculations for the rate of decomposition, they may want to find other trees to observe. There are many good choices in the forest, in the open area and along the trail edges. There are even some rotting logs on the ground that it might be interesting to study.

17. Students can make comparisons between the rates of composition of different trees. If they can identify the trees, they may be able to research information on how well each type of tree withstands the weather.

18. They can also compare and graph the differences in the communities of decomposers that live in and around the rotting trees (how many organisms and what kinds they are).

Extensions:

1. Language Arts Extension:
   Students can write a story or act out the story of the decomposing tree, by telling or showing what happens between the times they visit the tree. They can expand their stories or acting to show the beginning of the tree's life, what happened to it that caused it to die, and what will happen to it as it is decomposing.

   Example: "An ant family came to visit today and they are chewing tunnels into my wood to make theirhome. They will be moving in a couple of weeks after their construction work is done. They will have to watch out for that hungry woodpecker that visits me from time to time to probe into my bark with its strong, sharp beak."

Decomposing Tree Worksheet

Date _____ Names of Investigators _____

_____

Today's Weather

_____

What season is it? (circle one)

Fall Winter Spring Summer

Temperature (take two readings for each)

Air temperature	_____	_____
Soil temperature	_____	_____
Temperature in tree cavity	_____	_____

Tree Measurements

First, find the CIRCUMFERENCE by **measuring** around the trunk with the tape measure
Write circumference in inches here: _____

Second, find the DIAMETER (or WIDTH) by **dividing** the circumference by 3.14

$$\text{Diameter (width) of tree} = \frac{\text{Circumference of tree}}{3.14}$$

Write the diameter in inches here: _____

***If this is your FIRST time measuring this decomposing tree, STOP calculating here.*
*If this is your SECOND time measuring, continue on the back.***

Comments

_____

_____

_____

_____

Tree Measurements (continued)

Third, find the CHANGE in DIAMETER by **subtracting** the diameter from today *from* the diameter from last month.

diameter last month _____ - diameter this time _____ = Change in diameter

Write the Change in diameter here: _____

Fourth, figure out what the DIAMETER CHANGE will be over a YEAR by **multiplying** the change in diameter by 12 (for the 12 months in a year)

Change in diameter _____ X 12 = Diameter Change over a year

Write Diameter Change over a year here: _____

Fifth, predict the NUMBER of YEARS it will take the tree to decompose by **dividing** the diameter last month by the diameter change over a year

$$\frac{\text{Diameter last month}}{\text{Diameter Change over a year}} = \text{Number of Years for tree to decompose}$$

Write Number of Years for tree to decompose here: _____

Rotting Tree Habitat

Objectives:

- Students will be able to describe how different kinds of animals use a rotting tree to get their food or find shelter.

Vocabulary: Scavenger, Adaptations, Habitat

Time Allotted: 30 minutes

Standards Addressed: LS1 (3-4) – 1b, LS1 (5-6) – 1 a, LS1 (5-6) -2 a, LS1 (3-4) – 4a

Grade Level: Grades 3 – 5

Science Topics: Correlates with science topics Life Science, and Adaptations

Materials Needed:

- 2-3 pieces of scrap wood
- tools from a toolbox:
  - crowbar
  - screwdriver or chisel
  - scissors
  - pliers – regular
  - wood file or sandpaper
- full water bottle
- newspaper or butcher paper

Procedures:

1. This activity should be conducted near a decomposing tree.

2. Ask the students if they can name any kinds of animals that use rotting wood to find their food or to get shelter. Ants, termites, bark beetles, millipedes and centipedes, slugs and snails, isopods (also known as pillbugs), spiders, salamanders, woodpeckers, bears, raccoons, foxes, and earthworms all look for their food or make their homes in rotting trees and logs.

3. Today the students will try out a variety of tools to see how animals manage to break apart or tunnel into rotting trees and logs.

4. Break students into smaller groups. Three to five students for each piece of scrap wood would be ideal. Spread out the pieces of scrap wood on the grass near the decomposing tree.

5. Explain that students will be rotating around to try out the different tools on the pieces of scrap wood, then, after they have tried the different tools, they will have to guess which animal has teeth or jaws or claws that work like the tools they used.

6. Place one or two tools with each piece of scrap wood then have the groups of students each begin at one piece of scrapwood. They will try out the tool there on the wood, making sure everyone in the group has a turn.

7. After a few minutes, give a signal for the groups of students to rotate to a new piece of scrap wood to try the tool(s) there.

8. Continue until all the groups have tested all of the tools. Gather up the tools and scrap wood and bring students together in big group to discuss.

9. First ask the students which tools they thought were the most effective at ripping apart or tunneling into the wood. Were some tools easier to use than others?

10. Next, students should try to match the tools to animals that may have adaptations that are like the tools they used. Name the animal and let the students guess the tool. Examples:
    a) **bear claws** (to search for grubs or honey in a tree beehive) = crowbar
    b) **woodpecker beak** (to search for insects in the wood) = screwdriver or chisel
    c) **bark beetle or termite jaws** (to eat and tunnel into wood) = scissors
    d) **isopod (pillbug) jaws** (to crunch bits of wood) = pliers
    e) **slug or snail tongue** (to scrape algae off wood) = file or sandpaper

11. Discuss how many of these animals aren't actually dining on the wood itself. Some are looking for a place to burrow (like an ant), some hide under the wood for protection and shelter (like salamanders), some are looking for insects that live in the wood (like a woodpecker), and some are interested in things growing on the wood (like the snails and slugs). A rotting tree or log provides food and shelter, two key requirements for any animal to get from its habitat.

12. If time permits and the pieces of scrap wood aren't totally in pieces, use the water bottle to wet the scrap wood pieces. Wait a few minutes for the water to soak in and then have students repeat the process of using the different tools. Was the wet wood any easier to break apart?

Extensions:

1. Science Extension:

Have students search the nature trail for some large sticks or small branches that have fallen to the ground around the trees. Bring one inside and place it inside a glass or plastic terrarium tank (preferably one with a top with holes in it). Monitor the stick or branch over a week or month, to see what happens. Water it a little every week to keep it moist. Are there any animals on or in the wood? Is there any fungus growing on the wood?

Life Cycle of a Tree

Objectives:

- Students will be able to state the different stages in a tree's life.

Vocabulary: Seed, Seedling, Sapling, Snag

Grade Level: Grade 4

Time Allotted: 20 minutes

Standards Addressed: LS1 (K-4) INQ + POC-1, LS1 (K-4) POC -3

Science Topics: Correlates with science topic Ecosystems

Materials Needed:

- Examples of tree seeds
  - An acorn, a pine cone, or a maple seed
- Magnifying lenses

Procedures:

1. Explain that the students will be learning about what a tree's life cycle is like.

2. Bring students out to the nature trail to a spot with lots of different aged trees, but room to play a game.

3. First describe the tree life stages and demonstrate the motions for each stage. Have students practice these motions:
   a. **Seed** (show acorn, cone or seed) = curl up in a ball on the ground
   b. **Seedling** (a baby tree, usually 1 year old or less) = crouch on ground with hands sticking out like tiny branches
   c. **Sapling** (a teenager tree) = kneel with arms sticking out
   d. **Adult tree** = 2-3 students holding hands together in a ring
   e. **Snag** (a dead standing tree) = stand straight with one arm up and one arm down
   f. **Rotting Log** (a dead tree laying on the ground) = lay down on ground

4. This will be played a bit like Simon Says. Begin telling a story about visiting a forest and describing the different tree life stages there. Every time one of the life stages is mentioned, students do the motion as quickly as possible.

5. Begin with a practice round and then call out the life stages faster and in a random order.

6. If doing this activity as an elimination game (the last to do an action each time is eliminated), students who do get eliminated can become the story-tellers and help call out life stages.

7. After a few active rounds, walk along the nature trail looking for examples of these tree life stages. Two kinds of trees that should be easy to find on this part of the trail in their various life stages are *oak trees* and *pine trees*. Refer to pictures included with this lesson to help with identification.

8. Call the tree life stages out as before but instead of doing the motion, students need to run over and tag (gently!) an example of the life stage.
    a. *****IMPORTANT note**:*** make sure to be careful of poison ivy on the trees on the nature trail. Students should NOT be tagging trees that have a hairy-looking vine (the poison ivy vine) or plants with 3 leaves growing on or around the trees.

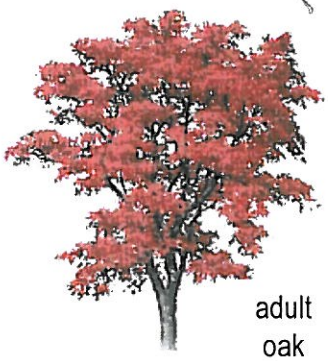
9. Some discussion questions to wrap up this activity:
    a. Which stage(s) is/are the most important stage of the tree's life?
    b. Which stage(s) is/are the most important to the animals that live on and around a tree?
    c. Which stage was the easiest to find on the nature trail? Which was the most difficult? Why?
    d. How long does it take for a tree to go through all these stages? Do you think the length of its life depends on the kind (or species) of tree?
    e. What other factors affect how long a tree will live?

Oak

oak seedling

oak leaves

oak sapling



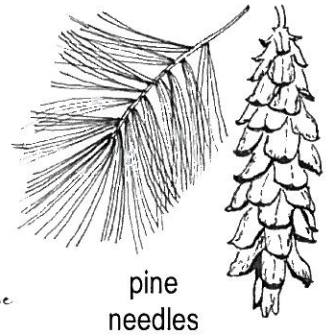
adult oak

oak snag

Pine

Pine seedling

adult pine



pine needles and cone

Extensions:

1. Language Arts Extension:
   Before or after this activity, read a story about a tree's life. Read the story under a tree on a nice day! Here are some suggestions to tie in with the theme:
   The Gift of the Tree by Alvin Tresselt
   A Log's Life by Wendy Pfeffer
   The Big Tree by Bruce Hiscock

2. Math Extension:
   Do a simple calculation of the ages of the pine tree saplings on the trail by following these steps:
   a. Point out to students that young pine trees grow by sending out a whorl of branches every year. A whorl looks like a circle of branches encircling the stem of the sapling (see picture of a whorled leaf pattern at left).
   b. Have students find a sapling about as tall as they are and look for these whorls of branches.
   c. Now have students notice that there are several whorls along the stem of the sapling, starting from where the stem comes out of the ground up to the top of the sapling.
   d. If they count the whorls starting from the base of the sapling to the topmost whorl, that will tell them how old the sapling is.
   e. Once they get the hang of the counting, challenge them to find a tree as old as they are, ½ as old as they are, twice as old, as old as their siblings, etc.

3. Arts Extension:
   Have students draw pictures of each of the stages in the life cycle of the tree. They can make a landscape picture including the different stages and the whole, and label the stages, or they can draw individual stages. They can even make a bark or a leaf rubbing of the adult stages of the trees to enhance their sensory experience.

STATION 4
GEOLOGY

4. GEOLOGY

Located at the junction of Carrs Pond Trail and Hammond Hill Trail by the glacial deposits
GPS Coordinates: North 41°40.324', West 71°41.191'
Elevation: 587 Feet

Two principal forces shaped the landscape at the Maxwell Mays property - ancient tectonics, and more recent glaciation. The bedrock here is Scituate granite from the Middle Devonian (362-408 Ma), part of a large **batholith**, a mass of magma that rose up through the earth but cooled and solidified before it ever reached the surface. This particular batholith makes up most of central western Rhode Island and is visible at the surface today because erosion has worn away the rock that once covered it.

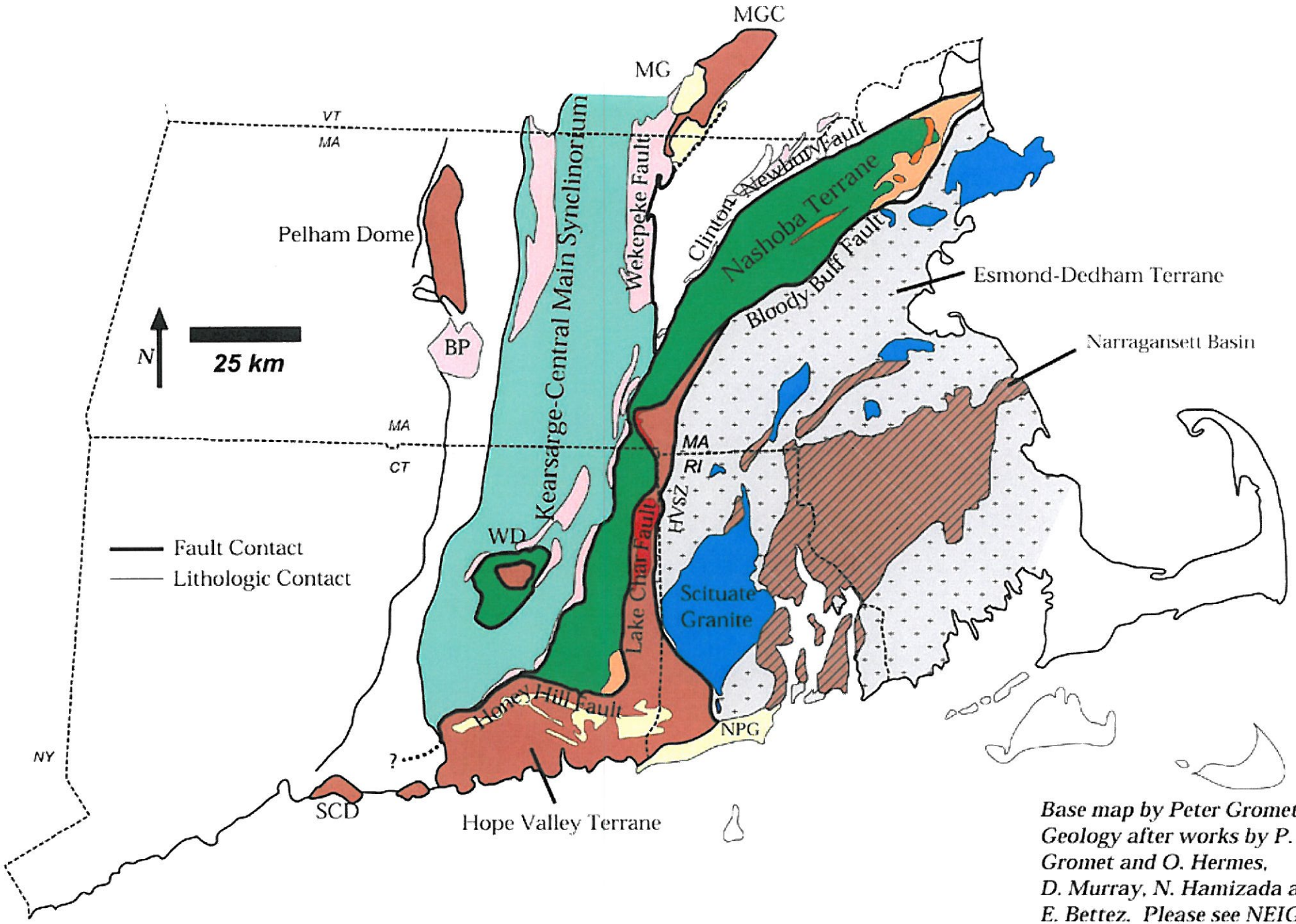
While the batholith was still below ground, it experienced some metamorphism. New England formed as a series of small offshore microcontinents slammed into North America, compressing, deforming, and folding the local rocks. All this tectonic activity had some effect on the Scituate granite, metamorphosing it slightly to various degrees in different locations.

Much later, during the Pleistocene, glaciers moved back and forth across the land grinding down bedrock and bulldozing sediment into new shapes. 21,000 years ago, during the **last glacial maximum**, when the most recent glacier was at its largest, ice reached all the way to Long Island. When the ice retreated, it left behind the many rocks that make New England fields notoriously difficult to plow, the odd-looking boulders known as **erratics**, and the piles of sediment that now make up Block Island, Martha's Vineyard, Nantucket, and Cape Cod.

On this refuge, the trails pass over outcrops of Scituate granite that sometimes show evidence of the massive tectonic forces that shaped the region. Some rocks contain large, rectangular chunks of a pale mineral that the rest of the rock seems to have flowed around, giving it the appearance of stretched taffy. This texture is a result of the different minerals making up the granite reacting differently to **stress** (pressure acting in a distinct direction, instead of uniformly all around an object). Granite is made up mostly of three minerals: **quartz**, **feldspar**, and **mica**. Feldspar has a very strong, but brittle, crystal structure that breaks more easily along certain planes, while quartz and mica can stretch more easily. As a result, when granite undergoes stress, feldspar sometimes breaks into blocks as quartz and mica flow around it – it is as if someone wrapped a stick of chalk in silly putty and then dropped a book on it. The silly putty flattens out but the chalk just breaks into pieces.

Rocks left by the last glacial ice sheet are visible along the trail. Large boulders sitting in the middle of fields or woods, or seemingly precariously balanced on hilltops, were dropped there as the ice that once picked them up and brought them there slowly melted away. The ice left smaller rocks as well, that often ended up in the many stone walls crisscrossing the landscape.

To learn more about the geology of the area, check out the excellent and accessible book *Roadside Geology of Connecticut and Rhode Island*, by James W. Skehan.



Base map by Peter Gromet. Geology after works by P. Gromet and O. Hermes, D. Murray, N. Hamizada and E. Bettez. Please see NEIGC field guides for more detailed information.

Figure 1. Paleozoic Terranes of Southeastern New England

Human Rock Cycle

Objective: Students will learn about the rock cycle, through a fun interactive game.

Vocabulary: Igneous, Metamorphic, Sedimentary, Magma, Sediments

Grade Level: 4- 12

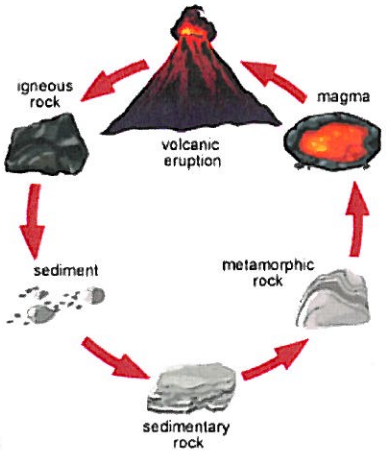
Time Allotted: 15 minutes

Standards Addressed: ESS1(5-6) -5a, ESS1 (5-6) -1b

Science Topics: Geology, Classifying, Sorting, Cycles

Cross- Curricular Connections: Creative Writing (Extension)

Materials Needed: Rock Cycle Process cards, Rock Cycle Product Station Label



Procedures: The three rock types are connected to each other by how they are formed. Igneous, sedimentary and metamorphic rock are constantly being recycled because the earth is a very active planet going through constant change.

At the Geology Station or at a field along the nature trail set up the Human Rock Cycle game:

1. Place the Rock Cycle Product Station Labels at 5 locations around the area.
2. Place an envelope with rock cycle process cards at each station. Place Igneous Rock Cards at that Station, Magma Cards at that station, etc.
3. Position groups of students at each station.
4. Instruct each group to pick a process card randomly out of the envelope at their station, and write down on their science journals where they started, what happened and where they go next (if anywhere). After reading a card, it should be placed back in the envelope.
5. Students go from station to station recording their journey along the way.
6. After playing the game for awhile, ask the students whether there is the same amount of each product in the rock cycle?

Extensions:

1. After playing the game awhile and using the Process cards, read the card aloud, but do not tell them where they would go next- see if they can guess what rock type they would turn into next. For example the card that says Igneous Rock- Heat and Pressure- ask them what type of rock they would become with heat and pressure. The answer would be metamorphic.

2. <u>Creative Writing</u>**:** Have the students write a story based on their journey.

Rock Cycle Process Cards

Sediments Deposition, Compression, Cementing Go to Sedimentary rock	Metamorphic rock Melting Go to Magma	Sediments Stay as Sediments
Metamorphic rock Weathering and Erosion Go to Sediments	Sediments Deposition, Compression, Cementing Go to Sedimentary rock	Sedimentary rock Weathering and Erosion Go to Sediments
Sedimentary rock Stay as Sedimentary rock	Igneous rock Heat and Pressure Go to Metamorphic rock	Magma Cooling and Crystallization Go to Igneous rock
Igneous rock Weathering and Erosion Go to Sediments	Magma Stay as Magma	Igneous Rock Stay as Igneous rock

Metamorphic rock

Stay as
Metamorphic rock

Sedimentary rock

Heat and Pressure

Go to
Metamorphic rock

Metamorphic rock

Heat and Pressure

Stay as
Metamorphic rock

Rock Cycle Product Station Labels

Sediments
Sedimentary Rock
Metamorphic Rock
Igneous Rock
Magma

Investigating Rocks

Objectives:

- Students will be able to sort rocks according to size, shape and texture.
- Students will be able to compare the properties of different rocks.
- Students will be able to list 3 ways scientists sort rocks.

Vocabulary: Rocks, Minerals, Gravel, Pebbles, Cobbles, Boulders, Hardness, Heft

Grade Level: Grade 4

Time Allotted: 45 - 60 minutes

Standards Addressed: ESS1 (3-4) 2.1.1, 2.1.2 2.1.3, 2.1.4, 2.1.5, 2.1.6, ESS1 (K-4) INQ-1, PS1 (3-4) 3.1.1, 3.1.2, PS1 (K-4) INQ-1

Science Topics: Correlates with science topics Earth Materials and Properties of Matter

Materials Needed:

For Part One:

- Assorted rocks collected by the group
- Magnifying lenses
- Water bottle

For Part Two:

- Pennies
- Dull metal butter knives
- Streak plate or ceramic floor tile

Procedure:

Part One-

1. Before going outside, ask the students what the four basic materials are that make up the Earth. Once they have identified these as rocks, soil, water, and air, explain that today's focus will be on rocks.

2. Take the children on a walk along the nature trail to collect 3-5 different rocks each. Encourage them to look for different shapes, sizes and colors of rocks for their own personal mini-collection.

3. Give a few hand magnifiers to each group.

4. The students in each group should first share their rocks with each other, and explain why they liked and chose that rock to be part of their mini-collection.

5. Next, the students should take some time to really examine their rocks and choose one for a fun observation exercise. Once they have decided which one of their rocks they know the best, based on what they noticed when examining it closely, the students will place that one rock in a pile in the middle of the group.

6. The teacher then goes from group to group and mixes up the rocks in the pile in the middle, so they will be in a different position in the pile from where they started. After the teacher has mixed the pile, the students have about 30 seconds to look carefully at the pile to see if they can pick out their rock.

7. Finally the students all count out loud "1..2..3 !" and all point to their rock at once. How did they do? Did they figure out which rock was theirs? Why or why not?

8. Now the students will do some sorting. They will place all the rocks their entire group collected in one pile in the middle of their group and try to figure out how the rocks are the same and how they are different.

9. They can sort in several different ways:
    a. by size. There are a variety of sizes rocks can be. Have students make piles:
        i. The smallest is very small, like pieces of **sand**.
        ii. The next size is called **gravel** – people use this in driveways sometimes.
        iii. Bigger than gravel are **pebbles** – most of the rocks the students collected are probably pebbles. Pebbles fit nicely in a person's hand.
        iv. Bigger than pebbles are **cobbles** – those take at least two hands to hold.
        v. The largest of all are **boulders** – these are often too big to lift and they *definitely* would not fit onto a picnic table or a desk!
        vi. There are good examples of **boulders** along the red trail near the pond.

    b. by shape and texture
        i. ex. round vs. pointy or smooth vs. rough
        ii. Have students practice using adjectives to describe their rocks.

    c. by how heavy the rocks feel
        i. This is called **HEFT** by geologists who study and classify rocks.
        ii. It has to do with something called density, and refers to how close together the tiny molecules that make up the rock are packed together inside the rock. The more closely packed the molecules, the denser and usually heavier the rock or mineral is.
        iii. If possible, when the students get back to the classroom with the rock they chose to keep, they can weigh it on a balance scale. Students can make a chart or a bar graph with all the weights of the different rocks they collected.

d. by the color and shape of the minerals in the rocks
    i. Rocks are made of a bunch of different minerals stuck together, and these minerals help geologists classify rocks.
    ii. Try squirting a little water on the rocks to see if their colors change, then re-sort them if needed.

Part Two

1. Another way to sort rocks and minerals is by how hard they are. Geologists call this **HARDNESS**, and there are some simple tests we can do to sort by hardness.

2. Give each group a penny, a butter knife, and a streak plate/floor tile.

3. Explain to the students that these tools (the penny, knife and streak plate) will help determine how hard the minerals in our rocks are.

4. Geologists use a scale to figure out how hard rocks are. They do not test the rocks and minerals by smashing them together; instead they test the rocks and minerals by scratching them together.

5. Students will take turns in their groups trying to scratch their rocks with
    a. their fingernail
    b. a penny
    c. a metal knife
    d. the edge of the tile/ streak plate

6. Directions:
    a. Test your rock or mineral by trying to scratch it with your fingernail. If a scratch line appears that you cannot wipe away with your finger, place this rock aside (it has hardness of 1 or 2).
    b. If the rock doesn't have a scratch left by your fingernail, next try a copper penny. If you are able to scratch your rock with the penny but not with your fingernail, place this rock in a different pile. (It has a hardness between 2.5 and 3.5.)
    c. If the rock does not have a scratch left by a penny, try a knife. If you are able to scratch your rock with a knife but not a penny, place this rock in a different pile (it has hardness of 4 or 5).
    d. Lastly, if your rock doesn't get scratched by a knife, try the edge of the tile/ streak plate. If you are able to scratch your rock with the tile, but not with the knife, place this in the last pile (it has a hardness of 5.5 to 6.5).

7. Refer to the included Mohs Hardness Scale for further questions about the hardness test.

8. Have students choose one specimen from their piles that they would like to take back to the classroom to research or make a poster about. The rest of the rocks can be placed back along the trails so others can enjoy them as well. Once back in the classroom, the students can draw a picture or write a description of their rocks.

Extensions:

1. Science Extensions:
   Using field guides from the kit, ask the groups to identify the rocks and maybe even some of the minerals in the rocks they found. Label each identified specimen. It is often difficult to tell whether a rock is igneous, sedimentary, or metamorphic just by its appearance, but the students may be able to identify the rocks by the kinds of minerals that are visible in them. Go over the 3 rock types in the classroom with rock samples; this may aid in the students' identifications.

   Students can also try to identify and learn more by researching the rock they chose to bring back to the classroom. They can then present their findings to the rest of the class, or maybe some of the other students in school, focusing on what kind of rock, what kind of minerals might be in the rock, and how people use those rocks & minerals in their everyday lives.

2. Art Extension:
   Students can create rock animals with the rocks they have found. Add construction paper or foam pieces for ears, tails, legs, etc. Glue on googly eyes and paint them.

Mohs Scale of Mineral Hardness

In 1812 the Mohs scale of mineral hardness was devised by the German mineralogist Friedrich Mohs (1773-1839), who selected the ten minerals because they were common or readily available. The scale is not a linear scale, but somewhat arbitrary.

Hardness	Mineral	Associations and Uses
1	Talc (softest)	Found in Talcum powder. (Can be scratched by a fingernail.)
2	Gypsum	Used to make Plaster of Paris and sidewalk chalk. Gypsum is formed when seawater evaporates from the Earth's surface. (May be scratched by a fingernail or by a copper coin.)
3	Calcite	Limestone and the bumpy skin of a sea star, sea urchin and sand dollar contain calcite. (Can be scratched by a steel pocket knife or sometimes a copper coin. Will scratch a fingernail, may scratch a copper coin.)
4	Fluorite	Fluoride from fluorite prevents tooth decay. (Can be scratched by a steel pocket knife. Will scratch a fingernail and a copper coin.)
5	Apatite	The mineral in all vertebrate animal (including human) bones. (Can be scratched by a steel pocket knife. Will scratch a fingernail and a copper coin.)
6	Orthoclase	Orthoclase is a kind of feldspar, and in German, "feld" means "field". (Will not scratch glass but will scratch steel blades, copper coins & fingernails.)
7	Quartz	Many glass items are made from quartz. (Will scratch glass, steel blades, copper coins & fingernails.)
8	Topaz	The November birthstone. Emerald & aquamarine are varieties of **beryl** that also has a hardness of 8. (Will scratch glass, steel blades, copper coins & fingernails.)
9	Corundum	Sapphire and ruby are varieties of corundum. Twice as hard as topaz. (Will scratch glass, steel blades, copper coins & fingernails.)
10	Diamond (hardest)	Used in jewelry and cutting tools. Four times as hard as corundum. (Will scratch all of the above.)

Hardness of some other items:

2.5	Fingernail (will scratch 1-2 hardness)
2.5–3	Gold, Silver
3	Copper penny
4-4.5	Platinum
4.5	Iron
5.5	Knife blade
6-7	Glass
6.5	Iron pyrite
7+	Hardened steel file

On each level of the scale a mineral can be scratched by something of the same or higher level, but nothing lower.

Geology Scavenger Hunt

Objectives:

- Students will be able to explain different geological features and terms learned through observation.

Vocabulary: Lichen, Deposition, Conglomerate, Erosion, Pebble, Boulder, Igneous, Metamorphic, Sedimentary, Mica, Feldspar, Quartzite

Grade Level: Grades 4- 12

Time Allotted: 1- 2 hours

Standards Addressed: ESS1 (3-4) 2.1.1, 2.1.2 2.1.3, 2.1.4, 2.1.5, 2.1.6, ESS1 (K-4) INQ-1, PS1 (3-4) 3.1.1, 3.1.2, PS1 (K-4) INQ-1

Science Topics: Correlates with science topics Geology, observation, identification, and classification

Materials Needed:

- Scavenger Hunt sheets
- Clipboards
- Pencils
- Scavenger Hunt key

Procedures:

1. Begin by telling students they are about to go on a hike. Include hike length and general hiking rules and expectations (stay on the trail, no running, do not pick or take anything with you, etc.).

2. Give each student or pair of students a scavenger hunt card, writing utensil, and clipboard.

3. Tell them that they are going to see many interesting things on the hike, and are going to keep track of what they see. Go over any items the students may not know or be very familiar with.

4. During the hike, have students look for items on the card. If they see one, have them point it out to the rest of the group. After students point something out, you might want them to go to the back of the line so everyone has an opportunity to see and potentially point things out first.

5. *Note: It might help to have a scavenger hunt word, such as "bingo," to differentiate when students are asking you general questions or trying to get your attention versus having found a scavenger hunt item.*

Procedure Variation:

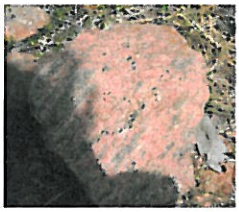
1. Have the students work in small groups, each with a chaperone, and have each group find different examples for each item on the scavenger hunt card.

2. This activity can also be done at any point during the hike, rather than at the beginning. After all the items on the scavenger hunt have been found, or enough time has lapsed, stop and discuss the group's results. What items did they find? What did they look like? Did anyone have different things for the same scavenger hunt item? Why are these things important to the area? What, if anything, did you not see? Why do you think that is?

Extensions:

1. Science Extension:
   Students can try this same activity back in their schoolyard, neighborhood or home. Go on a rocks and minerals hunt. Have a rock and mineral collection in your classroom.

Geology Scavenger Hunt Sheet
Can You Find?

A rock of 2 or more colors 	A rock as big as your bed 	A rock covered in lichen 	A rock with cuts or marks on it 
Signs of Deposition 	A Conglomerate Rock 	Signs of Erosion 	A pebble 
A boulder 	Sand 	Quartzite (White/Grey) 	Mica (Shiny clear, black) 
Feldspar (pink) 	Smooth Rock 	Round Rocks 	Igneous Rock 
Metamorphic Rock 	Sedimentary Rock 	A Pile of Rocks 	A rock with plant/ tree growing out of it. 

Scavenger Hunt Key

Lichen: a type of organism that is part fungus and part algae (plant).

Deposition: the laying down of any rock material by wind and water.

Conglomerate: a sedimentary rock made up of smaller rocks and pebbles cemented together.

Erosion: the wearing away of rock by wind, water, ice or chemical reactions.

Glacial Geology Scavenger Hunt

Objectives:

- Students will be able to understand land formation, glacial activity.
- Students will be able to recognize signs of the most recent glacial activity.

Vocabulary: Glaciers, Glacial Polish, Striations, Chatter marks, Plucking, Glacial Erratic

Grade Level: Grades 5-12

Time Allotted: 20 minutes

Standards Addressed: ESS1 (3-4) – 1a, ESS1 (3-4) – 1b, ESS1 (5-6) -5a, ESS1 (5-6) -1b

Science Topics: Correlates with science topic Geology

Materials Needed:

- Scavenger Hunt
- Clipboards
- Pens/pencils

Procedures:

1. Give each pair of students a clipboard with a scavenger hunt and pencil.

2. Take the students to the Geology Station on the Maxwell Mays Nature Trail.

3. The students will look around and try to find evidence that's listed on their scavenger hunt.

Extensions:

1. Language Arts Extension:
   Students can create a story based on the evidence they found of glacial activity on the nature trail.

2. Science/ Art Extension:
   Students can look at maps of the northeast to look at the bigger picture of glacial activity. Go online to watch videos illustrating the changes in the land from the last ice age. Draw or create pieces of art that show the changes in the land over time.

Glacial Geology Scavenger Hunt Sheet

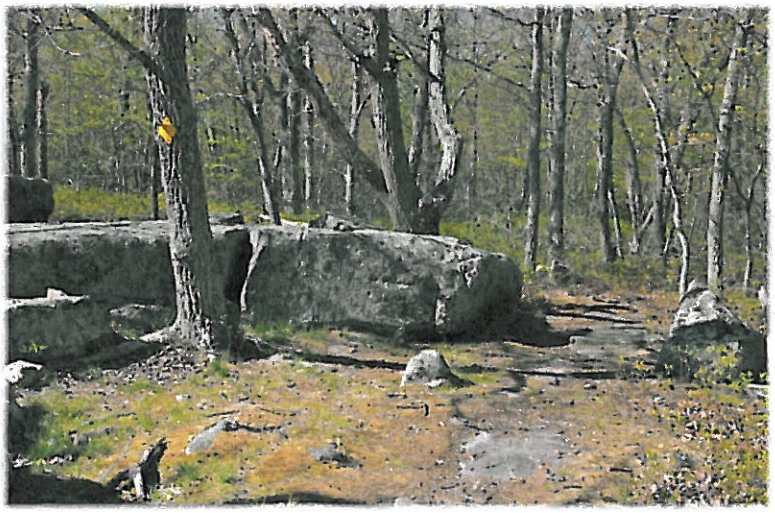
Glacial Geology Scavenger Hunt: Find examples of the five features described below that provide evidence of recent (in geologic terms) glacial activity. As glaciers move along, they carry with them fragments of rock. As these rocks are pulverized and scraped across the surface of exposed bedrock they leave distinctive marks that can tell a story…

1. Glacial Polish: very smooth "polished" rock surface resulting from abrasion by "rock flour" (the powder being created as the ice pulverizes rock it is carrying).

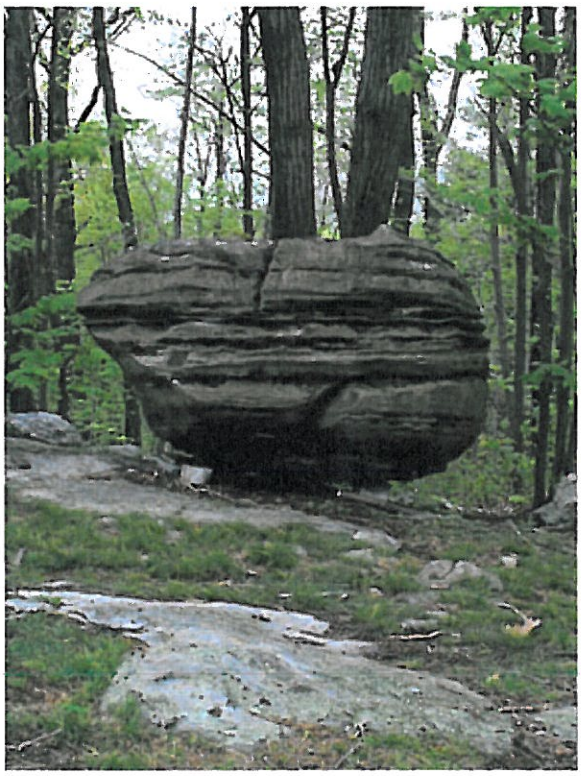
2. Striations: long grooves and scratches cut into the bedrock. They can be a few inches or several feet long and usually between $^{1}/_{16}$ to ½ inch wide. They show smoothing on the edges distinguishing them from more recent, human marks that may be present as well. Striations indicate the direction of movement of the ice sheet.

3. Chatter Marks: As the ice slides along the bedrock, it sometimes gets stuck on the surface. The built up pressure is sometimes released explosively taking little chips of rock out as it goes. The marks left can appear as little crescent-shaped depressions in the rock, usually several in a series. These marks can be large (inches across) or small and can often be seen inside a striation Chatter marks are perpendicular to the flow of ice with the crescent opening in the direction of flows the ice slides along over the bedrock, it can sometimes get "stuck" on the surface.

4. Plucking: As ice moves over large expanses of exposed bedrock, it can "pluck" large pieces of the rock off the trailing edge. You see this as a smooth, often slightly upward sloping, exposed surface of bedrock ending in a sharp, nearly vertical break. Small to very large pieces of rubble can be seen beyond. The transition from smooth bedrock to sharp-break indicates the direction of ice flow. NOTE: smaller versions of this can occur due to weathering and frost cracking of the bedrock; can you find examples of these as well?



5. Glacial Erratic: small to very large, boulders of a rock type unlike that of the local bedrock. They are smoothed and worn on all sides as a result of being carried and worked by the glaciers (not just the smooth on the top as would be water-worn boulders).



Taking a "Lichen" to Gravestones

Objectives:

- Students will be able to explain the effects of weathering on gravestones.

Vocabulary: Lichen, Weathering

Grade Level: Grades 5 - 12

Time Allotted: 45- 60 minutes

Standards Addressed: ESS1 (7-8) - 3a

Science Topics: Correlates with the science topics Geology, Classification, Observation, and Identification

Materials Needed:

- Lichen Identification Sheet and/ or Lichen Field Guides
- Lesson worksheets
- Magnifying lenses
- Clipboard & pencils
- Digital camera (optional)
- Online Lichen Identification: http://www.huh.harvard.edu/collections/lichens/guide/index.html

Teacher Background:

Weathering is a slow process. Some rocks erode faster than others. The conditions causing the deterioration may be chemical, physical (temperature change) and biological activity. The durability of rocks varies with climate, composition, and exposure to weather. Rocks that are rich in quartz, such as granite, are highly resistant to chemical weathering. On the other hand, marble, which consists of soluble calcite, is more easily weathered by acidified precipitation. Medium-grained quartz sandstone containing feldspar and micas are much less soluble than marble. Fine-grained sandstone consisting almost entirely of quartz is very insoluble and hence, more resistant to chemical weathering. Both moisture and heat promote chemical reactions. Weathering generally goes deeper into rock materials in a moist warm climate than in a dry, cold one. Rocks provide an environment for lichens to grow.
Weathering is an intrinsic part of erosion and so participates in the rock cycle.

Examples of stages of weathering for your tombstones:

1. Un-weathered
2. Slightly Weathered - faint rounding of corner of letters
3. Moderately Weathered - rough surfaces, letters still legible

4. Badly Weathered - letters and difficult to read
5. Very Badly Weathered - letters almost indistinguishable
6. Extremely Weathered - no letters left, scaling

Procedures:

1. Take the students to the Historical Cemetery on the Maxwell Mays Nature Trail

2. Review the rock cycle. Distinguish between weathering and erosion.

3. Discuss the assignment requirements. Organize students into groups of 2 to 4 members.

4. Have students sketch the weathering on different tombstones in the cemetery according to attached worksheet.

5. Conduct a whole-class discussion around the results and the following questions:
    a. Which rock type showed the greatest resistance to weathering? Why?
    b. Which rock type showed the least resistance to weathering? Why?
    c. What are the effects of weathering on rocks?
    d. What types of weathering have affected the tombstones (e.g. physical)? Support your answer.
    e. Which rock type would you choose for a gravestone? Why?
    f. Why is the cemetery placed where it is? Consider the geology of the area

Extensions:

1. Social Science Extension:
   Visit a local monument maker. Watch carving in action. Find out the cost of a monument/tombstone for a rock of your choice. Which country is the rock from? Why did you select this type of rock?

2. History Extension:
   Contact the local Genealogical Society and invite a representative to join the field trip. These groups are experienced in the preservation of historical information and monuments, and may have insight or stories about the history of the cemetery and source of the stones.

3. History Extension:
   If some students have ancestors or family buried at the cemetery, encourage an independent study that takes this human factor into account. Why would the family have decided to use a particular type of stone? How much would they have had to pay for it? What is the oldest monument in the cemetery? What could students find out about the first families that settled in your area?

4. History Extension:

Conduct research about why the cemetery is placed where it is. Is there a geological reason? Consider interviewing a gravedigger to obtain this information.

5. Science Extension:
   Find out if the coffin requires a concrete cover to protect the groundwater from pollution (embalming fluid). Design an experiment to show how weathering occurs in the most weathered material seen during the study.

Student Worksheet

Date: _____
Group Members: _____
Cemetery Location: _____

In this activity, you will investigate the effects of weathering on tombstones.

1. Walk through the assigned study area of the cemetery and observe the extent of weathering on the gravestones.
2. Choose 4 tombstones that vary in condition from un-weathered to extremely weathered. For each tombstone, record the following information in the provided chart (**Rahn's Index):**
   a. Identify the extent of weathering on the tombstone(s) you observed:
      1. Unweathered
      2. Slightly Weathered - faint rounding of corner of letters.
      3. Moderately Weathered - rough surfaces, letters still legible.
      4. Badly Weathered - letters are difficult to read.
      5. Very Badly Weathered - letters almost indistinguishable.
      6. Extremely Weathered - no letters left, scaling.

   b. Note which areas are weathered. Sketch a few representative letters to illustrate the extent of weathering (if a digital camera is not available).
   c. Identify the rock type and color.
   d. Note the presence (or absence) of lichens.
   e. If lichens are present, examine them closely. What type are they? Do they grow on the sheltered sides of the tombstone, or on all sides? What is the effect of biological weathering?
   f. Calculate the age of the tombstone.
   g. Mark each of your four tombstone locations on the cemetery map.
3. Does stone orientation to the wind also have an impact on the extent of weathering? Explain.
4. Find the oldest gravestone in the cemetery. Describe the extent of weathering and the type of rock used.

Tombstone # ____:	
Tombstone Age:	
Rahn's Index:	
Rock Type and Color:	
Lichens Present or Absent:	
Lichen Description(If present):	
Description of Weathering:	**Sketch or digital photograph of tombstone:**

STATION 5

THE POND

5. THE POND

Located after crossing the dirt road and descending down towards the pond. The first open/pond access area
GPS Coordinates: North 41°40.177', West 71°41.284'
Elevation: 560 Feet

You are now standing on the banks of Carr Pond of Coventry – not to be confused with the Carr Pond of West Greenwich, another body of water in the Pawtuxet River Basin. Although ponds are usually smaller than lakes, in Rhode Island the terms *pond* and *lake* were used interchangeably when naming such bodies of water. Carr Pond is approximately 11 acres in size and is often termed a lake by RI DEM in various studies. Lakes in Rhode Island formed primarily in one of two ways: either by glaciers or by humans. Carr Pond is man-made, just like about 75% of the lakes and ponds in the state. It offers important ecosystem services like recreation, in addition to providing an aquatic habitat for various organisms. Animals such as the river otter, freshwater fish, and aquatic invertebrates all live in and around the lake.

The lake is composed of the shore zone, the open water, and the bottom sediments. The shore zone, or the *littoral* zone, is very productive and is a nice place for animals to raise their young. Once grown, many of these organisms take to the open water, or the *pelagic* zone, either to live or to feed on the fish and pelagic organisms that call the zone home. Waste and dead organisms from the *epilimnion* (upper layer of the lake) sink and settle into the *hypolimnion* (the cold, still bottom layer of the lake) and the bottom sediments. The phosphorus and nitrogen from the waste products and decomposing plants and animals enrich the sediments with nutrients. These nutrients are cycled back up to the epilimnion during the spring and fall overturns, as wind and thermal convection accompany the season change and mix the layers of the lake.

As you look out across the pond – what different kinds of animals do you see? Are the fish jumping? Are dragonflies or swallows swooping above the water? What do you think lives in the water? How might life in and around the pond differ as the seasons change?

Are You Me?

*Adapted from: Project Wild Aquatic; Council for Environmental Education, 1996

Objectives:

- Students will be able to recognize various young stages of aquatic animals and match them with corresponding adult stages.

Vocabulary: Aquatic animals, Grow, Change, Adult, Young

Grade Level: Grades K-2

Time Allotted: 15 minutes

Standards Addressed: LS1 (k-2) – 3b

Science Topics: Correlates with science topics Analysis, Classification, Communication, Comparing Similarities and Difference, and Matching

Materials Needed:

- "Are You Me?" Cards

Procedures:

1. Many animals look significantly different in their earliest stages of development when compared to adulthood. This is particularly true for Aquatic Insects found in a pond. Many aquatic insects undergo complete or incomplete metamorphosis. Incomplete metamorphosis, the insect egg hatches and produces a nymph and a pupae stage is absent. In complete metamorphosis the egg hatches to a larva, pupa, and then emerges to an adult.

2. This activity can be done prior to Investigating pond life at the pond on the Maxwell Mays Nature Trail. It will introduce students to the various aquatic insects they will be catching.

3. Make pairs of aquatic animal cards using the master sheets provided.

4. Randomly distribute cards to students.

5. Students can act out their animal if they know what it is, or hold it up for others to see and try to guess, and students must find their match. The adult will look for its young stage and young stage will try to find its adult. NOTE: You can attach each animal card to a string loop to worn around students' necks.

6. Are the pairs correct? Ask the students to change any pairs that are not correct. Talk about how difficult or easy it was to correctly match the pairs. Introduce the idea that many animals look very different as adults than they appear in younger forms.

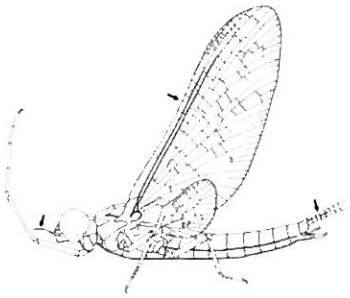
7. This activity can be repeated several times by assign different cards to different students so that each student becomes familiar with a wider array of animals.

Extensions:

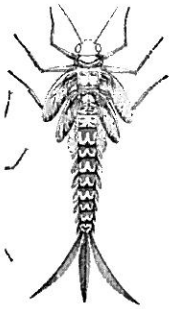
1. Science Extension:
   Have students find out as much as possible about some of the habitats in which these animals live.

   Pick a pair of cards, or from the Aquatic Investigation activity find out more about the life cycles of some of the pond animals.

   Discuss metamorphosis in more detail.

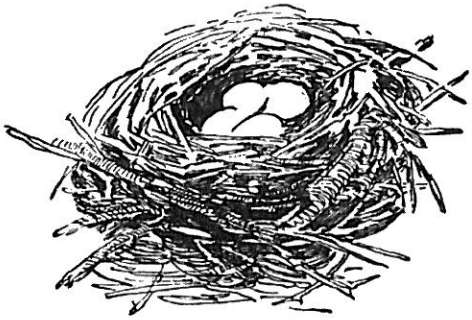


Mayfly (adult)

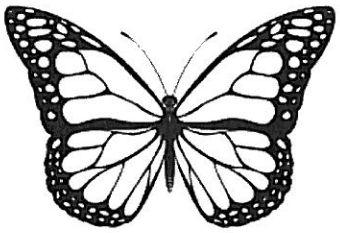


Mayfly (nymph)

Kingfisher

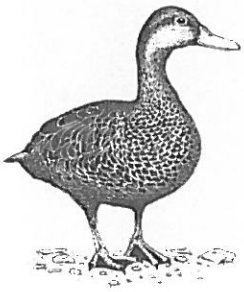


Nest with eggs



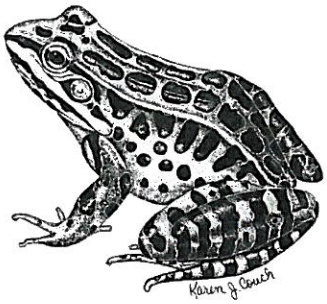
Monarch Butterfly

Caterpillar

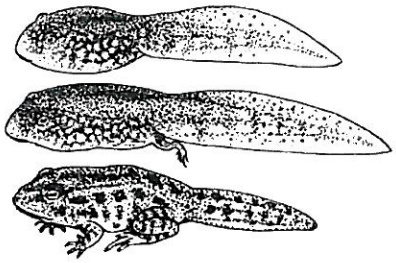


Duck

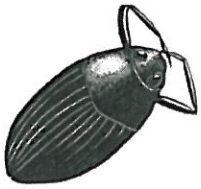
Duckling



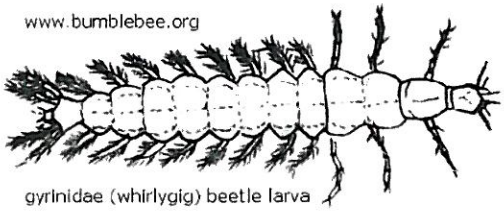
Frog



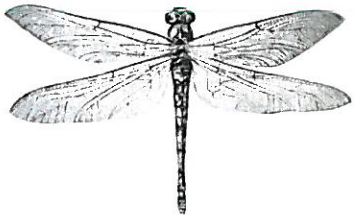
Tadpole



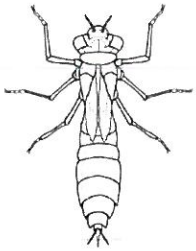
Whirligig Beetle



Whirligig Beetle larva



Dragonfly



Dragonfly Nymph

Caddisfly

Caddisfly larva

Investigating Water Critters

Objectives:

- Students will be able to identify 3 kinds of animals that live in the water.
- Students will be able to state an adaptation animals have to live in the water.

Vocabulary: Adaptation, Aquatic

Grade Level: Grades 4

Time Allotted: 45 – 60 minutes

Standards Addressed: LS1-1(3-4) 1.1.1, 1.1.2, 1.1.3, 1.1.4, 1.1.5, 1.1.6 LS1(3-4)-2 1.2.1 LS1(3-4)-4 1.4.1, 1.4.2 LS2(3-4)-6 1.6.1, 1.6.3 LS3(3-4)-7 1.7.1, 1.7.2

Science Topics: Correlates with science topics Structures of Life and Ecosystems

Materials Needed:

- Sampling Nets
- Clear Containers
- Magnifying Glasses,
- Plastic Spoons
- Field Guides
- Paper and Pencils
- Water Thermometer
- Optional-hip waders and rain boots

Procedures:

1. The organisms that can be found in the water may vary greatly over the course of a year due to the changes in the water properties like temperature, precipitation patterns, and pH that may occur.

2. Before you begin this activity, check the weather for the day, conducting this activity on a rainy day may present safety issues.

3. Bring the students outside and walk around to the far side of the pond (closer to the road). The water access is safest and creates more space on this side.

4. Explain to students that they will be investigating what lives in the pond. Specifically they will be looking for macro-invertebrates.

5. Explain that through studying the macro-invertebrates that live in the pond we will explore how the animals that live in the pond meet their survival needs, we will explore their adaptations, and determine how healthy the water is by looking for indicator species.

6. Review what organisms need to survive in an ecosystem (food, water, shelter, space, air).

7. Review what an adaptation is (a physical feature that assists in an animal ability to survive).

8. Review what an indicator species is (an organism whose presence, absence or abundance reflects a specific environmental condition).

9. Before you begin the investigation, give the students boundaries. For example: They can only go so far along the bank. They can only go so deep (perhaps only up to their ankles if they are wearing boots) into the water.

10. For this activity have the students work with a partner or a group of three. Each group will share a net.

11. Have students make predictions as to what they think they will find in the water.

12. Fill up the containers with water from the pond. Almost everything that the students will find in the water needs to be in water and will not survive long outside of water.

13. Make sure to demonstrate for the students how to use the net before they begin.
    a. Have the students pull the net along the bottom of the pond. It is helpful to get some mud and leaf litter in the net as many creatures like to burrow in the mud and leaf litter.
    b. Good places to use the net to look for animals are along any plants or grasses.
    c. When the students have a net full of material - plants, mud, rocks - have them look at it *while it is still in the net* for anything living. Their hands will get dirty, but they should look closely at the leaves and mud for any evidence of movement. Many pond critters camouflage well into the mud.
    d. Any of the plants, mud or rocks that they remove from their net should be put back into the water. (Do the students know why? There may be small aquatic creatures living in the plants, mud or on the rocks that we can't see.)
    e. Anything alive that the students find should be placed carefully into the clear containers; the plastic spoons can help pick up some of the smaller animals.

14. Students without the nets can look at the animals that have been collected in the buckets and start the identification process.

15. After collecting the animals, the students can investigate what they found.
    a. Have the students use the field guides to try to identify what they have found.
    b. If time and resources allow, the organisms collected can be brought back to the classroom for a more detailed and focused investigation. If this is done, it will become someone's responsibility to *return all critters back to the pond* at some point on the same day.
    c. They can sketch the animals in their science journals, or they can write a description of the animals even if they cannot identify what the animals are.
    d. They can write down a list of adaptations they see or they can hypothesize how the animals might have to survive in the water. For example, they can write down how the animal moves/swims, how they think the animal gets its air, etc.

16. When the activity is completed, make sure to return the animals back to the water. Ask students why we do this. The animals' habitat is in the pond, not in our classroom or at any of our homes. They need their habitats to find all the things they need to survive (food, water, shelter, space).

17. Have students help with the clean-up by assisting in rinsing out the containers and nets when back at the school. This is important to do every time the nets are used because the muck and pond water makes the equipment smell and will eventually rot the fabric of the net if they are not well rinsed.

Extensions:

1. Science/ Language Arts Extensions:
   After collecting in the water and identifying the animals, have the students research them to find out more about how they live. After researching the different animals, have the students present their findings to the others in their group.

   Have the students create a web of life for the water. In addition to the animals that they found, add birds, plants, the sun, etc.

   Repeat this activity at different times of the year. Each time, record the temperature, the weather, and the tide to see if these factors affect how many animals are found.

   Have students simply collect water samples from the water and use microscopes to explore the micro-invertebrates that live in the water; discuss the role of micro-invertebrates in the fresh water ecosystem.

2. Math Extension:
   Have students count and graph the quantity and type of organisms found. If it is a one shot investigation this could come in the form of a bar graph, but if scooping is done many times over an extended period of time the graph could come in the form of a line graph to document species populations over time.

Water Survey

Objectives:

- Students will be able to state some of the factors that affect water velocity.
- Students will be able to sort and quantify pond substrate material.
- Students will be able to map out a pond with a series of measurements.

Vocabulary: Velocity, Substrate, Riffle, Glide, Erosion, Deposition, Water Current

Grade Level: Grades 4 - 5

Time Allotted: 1 hour

Standards Addressed: ESS1 (3-4) 2.1.2, 2.1.7, ESS1 (K-4) INQ -1, ESS1 (3-4) 2.2.1, 2.2.3, ESS1 (K-4) INQ-2, ESS1 (3-4) 2.4.1, 2.4.5, 2.6.1, ESS1 (K-4) INQ+SAE -4, PS3 (3-4) 3.7.1, 3.7.3, 3.7.6, PS3 (K-4) INQ+SAE -7
ESS1 (5-6) 2.4.2, 2.4.6, 2.4.7, ESS1 (5-8) SAE+POC-4 ESS2 (5-6) 2.8.2, 2.8.4, PS1 (5-6) 3.1.3, 3.4.4

Science Topics: Correlates with the science topics Weather and Water, Properties of Matter, Earth Materials, and Sinking and Floating

Materials Needed:

- Metric measuring tape
- Water study data sheets
- Stop watches
- 3 pine cones per group
- Rubber boots or waders
- Rulers
- Meter sticks
- Thermometers
- Magnifying lenses
- Paper and Pencils

Procedures:

1. Go over some background information with the students before heading outside to take measurements.

2. When a body of water is forming, its shape and size depends on a few things:
    a. The amount and speed of water flowing through the system.
    b. The gradient or slope of the land on which the water sits/flows.
    c. The amount and size of sediment carried by the water.

3. Velocity is a measure of speed. The water velocity refers to the speed the water in a body of water is moving. Do all bodies of water have water movement? (Although it may seem like a pond or a lake is not moving, there is usually a place where water is draining out and a place where water is running into the pond or lake. Sometimes an underground stream or spring "feeds" water into a pond or lake, so it is not so visible.)

4. Which bodies of water have the most movement? Rivers and streams have water flowing through them much faster than a pond or a lake does. Also, the water in a bay or the ocean moves in and out constantly. (What is that called? The tides.)

5. The velocity of the water gives the water the force to scour the bottom and the banks (or edges) of the body of water. The water velocity also determines how much sediment and other material gets picked up and moved by the water.

6. The faster the water is moving, the larger the materials it can pick up and carry.

7. Water velocity changes with the width and the depth of the land the water is traveling through. In wide/ deep water, velocity decreases. In narrow/ shallow water, it increases.

8. This creates sections of a body of water moving at different speeds. Some of these sections are called pools and riffles and glides. (These are found most commonly in rivers and streams rather than ponds and lakes.)
    a. In a riffle, the water is swift and shallow. Fish spawn in these areas.
    b. Pools are deep and quiet areas where fish can rest.
    c. A glide is the smooth, fast-moving water that often separates pools from riffles.

9. Lastly, velocity also affects the erosion and deposition of material along the edge of the body of water. This difference in erosion and deposition of materials is seen in cut banks (steep, eroded banks) and sandbars (sandy areas along banks).

10. When we survey the pond and the culvert along the nature trail, we will also be surveying the substrate. Substrate is the material found on the bottom of the body of water. Substrate can be many different sizes and kinds of material.

11. Substrate can be classified into general categories: sand, gravel, cobbles and boulders. Other descriptions for even finer substrate might include mud, silt, and clay. What forces work against the motion of the water? Friction and gravity. How do these affect the substrate?

12. Take students to the pond edge area along the nature trail.

13. Have students measure and mark off with stakes and/or flagging at least one 20-30 meter section along the edge of the pond. If you want to do the measurements for the culvert as well, mark the area off and follow the same instructions listed below.

14. Divide the students into groups to conduct the tests and record their data into the data sheets provided.

15. For the students conducting the Velocity Test:
    a. They take velocity readings in a riffle or pool if they can find one. This will give students an understanding of where water travels the fastest or slowest. *(Since this is a pond, it may not seem to be moving at all. They should try to take the measurement for the sake of the experiment.)*
    b. They measure out a 5 meter section along the bank that is free of obstacles.
    c. One student drops the pinecone into the water, another student uses a stop watch, and a third student yells "STOP" once the cone has traveled the 5 meter distance.
    d. Repeat this process two more times and record the results.
    e. Back in the classroom, students can divide their results to get the meters per second calculation.

16. For the students conducting the Substrate Test:
    a. Within this group, students will work in pairs (or in a group of 3). Each pair of students should work in a different part of the pond section.
    b. One student in each pair will work in the pond while the other records data.
    c. One student collects substrate samples by taking two giant steps into the pond and looking for a stone or pebble in front of his/her big toe. This stone/pebble will be the one measured.
    d. This assures at least some degree of "random" sampling.
    e. The student collecting substrate will measure the length and width OR the circumference (around the stone) of the stone/pebble in metric units and call out the measurement to the recorder.
    f. The collector should then take two more giant steps to find the next sample, repeating the process.
    g. After 3 measurements, the students will switch jobs and the other student will collect three more samples.

17. For students doing the Mapping activity:
    a. Measure the length of the pond along the bank.
    b. When measuring the shallowest point, encourage students to decide where this is located within the 20-30 meter pond section marked off. It is more important for them to reach a consensus about this point than to find the "correct" or "absolute" location.
    c. When measuring the deepest point, realize that this may not be the deepest point in the pond, because that is not accessible. Students should decide how far

out they can go before the water reaches the top of the rubber boots, then measure the depth there. If they are wearing waders, they may be able to go out farther. They can make an estimate of how deep they think the pond is in the middle since they may not be able to get there.

d. When measuring the narrowest point, students may have to move out of the 20-30 meter section that is marked off. They need to make sure they stay within sight of the teacher and the rest of the class at all times.
e. In addition, this group of students should complete a fairly quick "from the top" sketch of this pond area, taking into account the curve of the bank and water features, vegetation and wildlife.

18. If there are enough thermometers, have each small group take the temperature of the air and water and record on their data sheets. They should set the thermometer in a shady location for 2 minutes before taking the air temperature.

19. For the water temperature, the students hold a thermometer in the pond for 2 minutes. As they are taking these reading, have students observe if the water is moving. Try taking water temperature readings in all the different corners of the pond, right next to the bank and a few steps out into the pond. Use this information to determine if there is a current of water moving from warmer areas to colder areas.

20. Gather all students back together to share their results.

21. Try coming back outside to take these water measurements in different weather situations and in different seasons. How does the weather or the time of year affect the data? Is the water frozen in the winter?

Extensions:

1. Math Extension:
   Have students graph the different groups of students' data.
   Here is a suggested list of graphs:
   highest pond velocities by group,
   graph of substrate particle sizes from smallest to largest,
   water temperatures

2. Science Extension:
   Ask students to draw conclusions about the habitat types that the animals in the pond prefer.

3. History Extension:
   Ask students to research how the motion of water has been used by people to power their factories and their inventions through history.

Names of Researcher Team _____

Date _____ Time _____ Weather _____

Temperature: Air _____ ° F/C Water_____ ° F/C

Mapping

Decide where you think the water in your section is the narrowest, deepest and most shallow. Record your data **HERE.**

Measure the LENGTH of your pond along one side of the bank._____ centimeters/meters

Measure the NARROWEST part of your pond section_____ centimeters/meters.

Measure the DEEPEST part of your pond section within reach _____centimeters/meters

Measure the MOST SHALLOW part of your pond section _____centimeters/meters

Water Movement Study Dictionary

Definitions:

Velocity— a measure of the water's speed; how fast the water is going. (measured in meters or feet per second)
Pool— deep, quiet areas in the water where fish can rest. These provide good cover from predators.
Riffle— a more turbulent area where the water is swift and shallow. Fish often spawn in riffles.
Glide—is the smooth, fast-moving water that often separates pools from riffles.
Substrate—is the material found on the bottom of the body of water. For example, silt, gravel and boulders are substrates.
Silt—very fine substrate material, usually found in slow moving water.
Cut bank—a steep, eroded side of a body of water where fast-moving water cuts (or erodes) the bank.
Sand bar—a sandy area along the bank where substrate material is deposited by slow moving water.
Pollution— anything altering the environment in some way that it is unsuitable or harmful for life.
Macro invertebrate—an animal without a backbone found living on the bottom of water habitats. These are often a food source for fish and other animals.
Macro = can be seen with the human eye without the aid of a microscope.
Metamorphosis = a life cycle process by which insects change from an immature form to an adult form.

WATER MOVEMENT

How many of each do you see in your pond section?

pools _____ ***riffles*** _____

cut banks ____ ***sand bars***____

In which one does the water move the fastest?

_____

_____

Which one would provide the best habitat for animals? Why?

_____

_____

_____

_____

To Measure Velocity:

1. Choose a section that looks free of obstacles and measure out a 5 meter section.
2. We will measure the velocity of the pond in meters per second.
3. We take our measurement by timing how long it takes for a pinecone to travel from the beginning to the end of the 5 meter section.
4. **In the classroom, your teacher can help you calculate the velocity with a calculator.**
5. Repeat this experiment 3 times.

How many seconds did it take your pinecone to travel 5 meters?
RECORD seconds from beginning to end **HERE**.

Reading #1: Velocity = 5 meters in _____ seconds

Reading #2: Velocity = 5 meters in _____ seconds

Reading #3: Velocity = 5 meters in _____ seconds

Substrate Observations

Make some observations about the bottom of the pond.
What does it look like?
___Muddy ___Sandy ___Silty ___Rocky

Does the bottom of the pond change throughout your section?

Measure Substrate:

1. Each pair of students works in a different part of the pond section.
2. Decide who the recorder is and who will collect rocks first.
The rock collector will be wearing rubber boots.
3. The rock collector will take two giant steps into the pond, and look for a rock in front of their big toe to pick up and measure in centimeters.
4. The rock collector will call out the measurement to the recorder, who records it. Put the rock back.
5. From this spot, take 2 giant steps in any direction and repeat this 2 more times.
6. After measuring 3 rocks, switch jobs.

STUDENT 1

Substrate #1 = length _____ cm / width _____ cm
OR circumference _____ cm

Substrate #2 = length _____ cm / width _____ cm
OR circumference _____ cm

Substrate #3 = length _____ cm / width _____ cm
OR circumference _____ cm

STUDENT 2

Substrate #4 = length _____ cm /width _____ cm
OR circumference _____ cm

Substrate #5 = length _____ cm /width _____ cm
OR circumference _____ cm

Substrate #6 = length _____ cm /width _____ cm
OR circumference _____ cm

STATION 6

CLUES TO THE PAST

6. CLUES TO THE PAST

Located at the Chimney Foundation/ Trail junction
GPS Coordinates: North 41°40.116', West 71°41.337'
Elevation: 582 Feet

The Mystery of the Stone Chimney!
The chimney that you see here could be what is left from a hunting or fishing cabin that was built here in the past. The lack of any stone foundation around the chimney may suggest that this was a temporary structure, rather than a long term residence. There are masonry cut lines on the stone which suggest it was attached to a wood structure, and not a free standing chimney. Also, notice the bricks put into the chimney; these suggest someone in more recent times may have been trying to patch up the chimney. There are many other clues to the people that once lived on this land along the property and trail you have been walking. You probably noticed stonewalls along the trail. These were built to keep livestock contained, such as a pound or as a fence, and sometimes to mark property boundaries. In general, the stonewalls that we see throughout New England were built between 1775 and 1825, before the use of concrete mortar, which came into prevalent use after the civil war.

As you follow the trail to the right of the chimney, you will notice the path getting wider. This part of the trail is called "the carriage road", because it was an actual road that the people who lived here in the past would have used in their horse drawn carriages. As you continue on the carriage road, you will come to the Carr Family Cemetery.* As early as 1738 the Carr Family lived and farmed this land. The Carr Farm raised sheep and cattle and provided yarn and homespun cloth to the area.

There are many clues to the past that scientists can use. What clues can you find?

To learn more about how to tell about the past from both man made remains and natural identifiers check out these books:
Reading the Forested Landscape by Tom Wessels
Exploring Stonewalls: A Field Guide to New England's Stone Walls by Robert M Thorson

*This is a Historical Cemetery; please get permission from the Historical Society before entering or using it for teaching purposes

Forest Forensics!

Objectives:

- Students will be able to describe features in a forest that show that it once was farmland.
- Students will be able to measure tree stumps, rotten logs and branches to hypothesize their ages and how long ago the damage occurred.
- Students will be able to predict how the landscape features will continue to change through time.

Vocabulary: Topography, Pit, Mound, Sprout, Top Bud, Blow-down, Diameter, Circumference, Wetland, Floodplain

Grade Level: Grades 4 - 12

Time Allotted: 1 hour

Standards Addressed: HP2 (3-4) 1a, HP 2 (3-4) 2a, HP 2 (3-4) 3a, HP3 (3-4) – 3a, HP3 (3-4)- 2a, HP1 (5-8) – 1c, HP1 (5-8) – 1d, HP2 (5-8)- 1a, HP2 (5-6)- 2a, HP2 (5-8) 3a, HP1 (Ext) – 1, HP1 (Ext) – 2, HP3 (Ext) -2

Science Topics: Correlates with the science topics Investigation, Observation, Measurement, Calculation, Hypothesis, and Deduction

Materials Needed:

- Paper and Pencils
- Tape Measures
- Magnifying Glasses
- Rulers
- Compass

Procedures:

1. This activity can be done anywhere along the Maxwell Mays Nature Trail. Students can write their investigations down on paper, or in a science journal.

2. While walking along the trail, discuss "Pit and Mound Topography" (aka pillows and cradles)

3. Point out places where trees have fallen.

4. Look for the tell-tale signs even if the rotting log is no longer there.
    a. Ask questions like

i. What happened here?
ii. What caused the hole (the pit or cradle) and what caused the mound (or pillow)?
iii. Can we still see any roots? Can we see any of the trunk?
iv. What happened to those parts of the dead tree?
v. Can we predict how long the roots or trunk will still be visible?
vi. How long ago do you think this happened?

5. **Double and Triple trunks, and stump sprouters**
   Look for trees that have more than one trunk.

6. Count how many trunks there are.
   a. Ask questions like
      i. Can we see what this multiple trunked trunk is growing from? (if it is a stump sprout, you might be able to see the old stump)
      ii. If it is only 2-3 trunks: why do you think the tree grew this way?

7. Students may need a little background on how tree grows, so find a seedling or a sapling to demonstrate where the top bud is. The part of the stem that grows from the top bud will eventually become the main trunk of the tree. Trees usually grow straight up from this top bud. Ask students why they grow straight up (the tree is trying to grow up as fast and straight as possible to be able to get closer to the sun). If something happens to this top bud, one or sometimes two or three of the side buds will become the top bud and begin to grow straight up instead of to the side.

8. Ask students:
   a. What could happen to the bud of a young tree as it is beginning to grow?
   b. Are there any animals that might eat the buds of trees? (deer browse on young trees is a common cause of double and triple trunks)
   c. Can we find evidence of this on any of the young trees?
   d. Predict what will happen with these young trees who have been nibbled upon.

9. If your multiple trunked tree is a chestnut, explain the history of the chestnut and the effect of the blight. See how many other chestnut stump sprouters you can find during your hike.

10. Using the tape measure, measure how tall these are, or how thick around the young trees are before they seem to show signs of the blight.
    a. How many other examples of this can we find on our hike today?
    b. Will the temperature be different in the pit or the mound? Why? Test it!

11. **Blow-downs**
    Look for any places where large branches or even whole trees have fallen.

12. Ask students to guess what caused the damage. They may remember recent storms that had a lot of wind.

13. Examine the broken ends of the trunks or branches.
    a. How would this look different if people had decided to cut this tree down?
    b. Another possible discussion would be about if and why Audubon might sometimes cut a tree down.

14. Measure the length of the trunks or branches that fell down.
    a. How does its length compare to the height of other trees in the area?
    b. How does the length compare to the height of the tree?
    c. Is there any pattern in where the trunks or branches fell?

15. **Stump Science**
    Look for any stumps large enough to gather a group around or a place where there are a few stumps to examine.

16. Make sure students have magnifiers to examine the stump closely, and rulers or measuring tape to measure the stump.

    a. Ask questions like:
        i. How did this tree fall? How long ago do you think it fell? How can we tell?
        ii. What is happening with the stump now? Are there are living things on the stump?
        iii. How are those living things affecting the stump? Each other?
        iv. Feel the stump. How soft is it? What does that tell us? Is it wet/ damp?
        v. Can the students easily break a small piece from the stump? What does it smell like?
        vi. How large was the tree? Measure the diameter and circumference if possible.
        vii. Are there any trees around that are the same width?
        viii. Is there any bark left on the stump? Does it look like bark of any living trees around it?
        ix. What will happen with this stump? How long will it look like this?
        x. Is it valuable to have a stump like this in the forest?
        xi. Is the temperature different in the middle of the stump or in the ground surrounding the stump? Why?

17. **Trees growing in rows**
    Look for patterns in how the trees are growing. Sometimes pine trees may be found in rows, or short trees like apples are found in rows or groups.

    a. Ask questions:
        i. Is there any particular pattern to the way the trees grow in this area?

ii. What is the pattern?
iii. Do trees in the forest normally grow in rows?
iv. Why would these trees be in rows?
v. How did these trees get here? If trees don't grow this way naturally, how else could they have gotten this way?

18. **Wolf trees**
Look for a large tree growing in the forest that has spread out wide as it grew. Point out this tree and ask the students to notice its growth pattern.

a. Ask questions like:
i. Do you notice anything about how this tree is growing?
ii. Is it growing like the other trees around it in the forest?
iii. How large is it compared to the other trees around it?
iv. Which tree in this area do you think is the oldest?
v. If a tree in the forest has to be concerned about getting outcompeted for sunlight (getting shaded out by taller trees), how does that affect how a forest tree grows?
vi. Is this tree straight and tall or as wide as it is tall?
vii. Do you think that the rest of the landscape could have looked different when this tree was first growing? Why? What kind of landscape do you think was here earlier?
viii. This is called a wolf tree – why do you think it is called that?

19. **Lightning scars**
Look for lightning scars on trees.
a. Ask students what they think caused that damage.

20. Use the compass to try to figure out the direction from which the damage came.
a. See if they can find any other signs of damage in the immediate area.

21. **Flowering trees/shrubs on forest edges**
Look for flowering shrubs like lilacs or forsythia, or vines like wisteria, or even a shrub like burning bush in the forest or on the edges.

22. Ask students if these plants look like the other plants growing in the area.
a. Ask them to notice the growth pattern of these plants.
b. If there are flowers (or the autumn leaves of burning bush) ask students if they recognize the plant. Where are plants like these usually found?
c. Many of these plants are non-native, so they wouldn't normally be in the forest: how did these plants get here?
d. What does these plants growing here mean about what used to here on this spot?

e. Is there any other evidence of what used to be here on this spot? (look for cellar holes or cement foundations)

23. **Water and wetland wonders**
    Look for shallow streams or dry creek/stream beds.

24. Get down into the dry bed or right next to the small stream.
    a. Challenge students to discover the floodplain: where will the water go in/after a rainstorm?
    b. If time permits and the trail passable, challenge them to find the place where the water from a storm will drain.

25. Follow the bed to the larger stream it will dump its water into (or to the marsh, swamp or other wetland that absorbs the water). They have to predict which direction to walk: how will they determine the direction?

26. Measure the width of the stream bed and width where it meets the larger stream.
    a. How does the width affect the way the water moves? What else affects the speed of the water?
    b. Is there any evidence of erosion on the banks? Can it be measured?
    c. What is the shape of the stream bed? Does this shape slow the water or allow it run faster?

27. **Hydrophyllic plants (water-lovers!)**
    Find a wetland area to explore where there is no visible water.

28. Ask students if they think there is water nearby. How can they tell?
    a. Can the plants give clues as to where the closest freshwater is?

29. Point out some water loving plants:
    a. spicebush (scrape the bark of a twig or crush 1 leaf for them to smell)
    b. red maples (use red flowers, buds, fall leaves, or samaras to identify it)
    c. skunk cabbage (crush a leaf for them to smell)
    d. trout lilies or march marigolds (yellow flowers help identify)
    e. sphagnum moss (pick a small piece and ask them to squeeze it)
    f. cattails (if seed pods are available, let them touch one)

30. **Dams, Bridges and Boardwalks**

31. Discuss this on one of the many boardwalks or bridges at the refuge.

32. Ask questions:
    a. Why is this here? How long has it been here?
    b. In the case of the boardwalks, see if they can figure out what it is protecting.

c. Look for evidence of other uses of water besides recreation (any mill stones?)

Extensions:

1. Science Extension:
   Discuss the field of Forensics and its important role in solving mysteries and crimes. Invite a forensic professional to talk about this.

2. Conservation Extension:
   Talk about the role of "Forest Forensics" in forestry practices, land use, and conservation. Invite an expert to speak with your class.

3. Social Science Extension:
   Look for clues in urban and suburban areas in your local community for the changes in land use. Students can interview senior citizens in the community that remember how the land has changed over the years. Visit your local library for maps of the area from the past. Students can't create a time log of changes in their community as a research project.

Land Use Sequencing Activity

Objectives:

- Students will be able to sequence and learn about the pattern of land use in the past 200 – 300 years.

Vocabulary: Emergence, Abandoned

Grade Level: Grades 4 - 12

Time Allotted: 15 minutes

Standards Addressed: HP1 (3-4) -1c, HP1 (3-4) – 2a, HP1 (3-4) -2b, HP2 (5-6) -2a, HP2 (5-8) – 3a, HP2 (9-12) – 3a

Science Topics: Correlates with the science topics Order/ Sequencing, and Succession

Materials Needed:

- Land Use Cards

Procedures:

1. Print several sets of the Land Use cards.
2. Divide students into small groups, and let each student have a land use card.
3. Students must arrange themselves in the correct order of sequence of land use.
4. Have each group present the sequence.
5. The correct sequence is as follows: Forest Growth> Forest Clearing> Farming the Land> Emergence of stones> Building Stonewalls > Abandonment of Farms> Suburbia.

Extensions:

1. Language Arts Extension:
   Students can write a story about life during each of these stages throughout history.
2. Art Extension:
   Students can draw or create dioramas of different stages of land use over time.

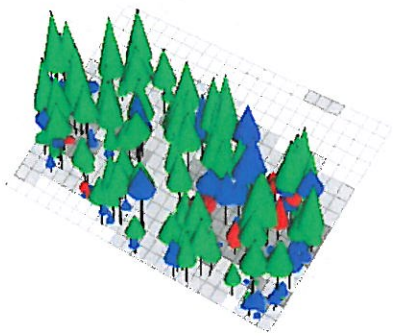
Land Use Cards

Abandonment of Farms

Suburbia

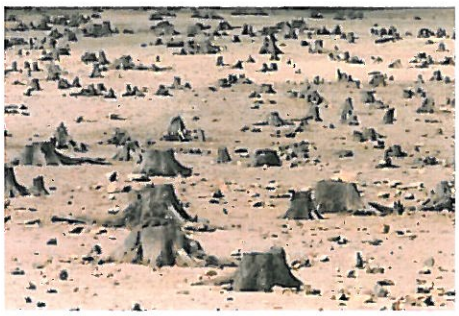
Farming the Land/ Emergence of Stones

BUILDING of the WALL



FOREST GROWTH

FOREST CLEARING



Audu

Stonewall Observations

Objectives:

- Students will be able to examine stonewalls and the area around them to make inferences about the land use over the past 200 years.

Vocabulary: Landscape, Stonewalls

Grade Level: Grades 4 - 12

Time Allotted: 30 minutes

Standards Addressed: HP2 (3-4) 1a, HP 2 (3-4) 2a, HP 2 (3-4) 3a, HP3 (3-4) – 3a, HP3 (3-4)- 2a, HP1 (5-8) – 1c, HP1 (5-8) – 1d, HP2 (5-8)- 1a, HP2 (5-6)- 2a, HP2 (5-8) 3a, HP1 (Ext) – 1, HP1 (Ext) – 2, HP3 (Ext) -2

Science Topics: Correlates with the science topics Inference, and Observation

Materials Needed:

- Observation Sheets
- Clipboards
- Pencils
- Tape measure
- Rulers

Background Information:
Below is a short history of stone walls in ten easy steps.
From: The Stonewall Initiative- www.stonewall.uconn.edu.org

1. MAKING MATTER
   It is self evident that a stone wall is made of matter, rather than of energy. However, there once was a time -- approximately 13.7 billion years ago -- when matter and energy, as well as time and place, were indistinguishable. This moment, called the Big Bang, marks the beginning of everything we know. Only after the first few moments of creation and in ways we do not yet understand, did matter come into being.

2. MAKING ELEMENTS
   Initially, matter consisted of nothing more than the lightest element hydrogen, with minor helium. Heavier elements were produced later, either in stars undergoing nuclear fusion, or during times when stars exploded, events called supernovae. Elements are the basic building blocks of everything we can touch or hold, whether solid, liquid, or gas. Oxygen, for example, isn't just something we breathe. It's an element, the most a

common one in familiar minerals. Quartz, for example, consists of two large atoms of oxygen and one smaller atom of silicon. Lime, for example, consists of one part calcium, one part carbon, and three parts oxygen. All of the elements found in New England walls -- dominated by oxygen, silicon, aluminum, iron, calcium, sodium, potassium, etc. -- were part of the stellar dust and debris from which our present solar system was gathered, about five billion years ago, and from which earth formed about 4.6 billion years ago.

3. MAKING ROCK

   A rock is an aggregate of one or more minerals, which are naturally occurring, inorganic, crystalline substances whose composition varies within specified limits. Most of the minerals making up the bedrock in New England were created when older materials such as mud, sand, and lava were transformed by heat and pressure -- often to the melting stage -- during a prolonged episode of mountain building that created the Appalachians between 500 million and 250 million years ago. At the time, the northern Appalachians were a seam of compressed and partially molten crust within the center of supercontinent called Pangaea. Mountain building spanned the evolution of primitive fish into archaic reptiles, and primitive mosses and horsetail rushes to primitive, tree-like forms called lycopods and seed ferns. Neither dinosaurs nor flowering plants had yet been invented.

4. MAKING STONES

   Deep in the crust, Earth's bedrock is an unbroken amalgam of discrete masses welded together within the roots of ancient mountains. To this day, there are no fractures or voids, and therefore no stones at the depths the rock formed. During the last few tens of millions of years, however, as the weight of eroded rocks was removed by erosion, the top mile or so of the of New England's crust expanded slightly, rupturing progressively into billions of tightly nested fragments. This took place gradually, coinciding with the time when the great apes in east Africa were evolving into humans. Beginning less than a million years ago, giant ice sheets began to ooze southward from Canada every 100,000 years or so. When they encountered the bumpy bedrock surface of the New England interior, they quarried countless boulders, crushing most of them into mud and sand before those that escaped crushing were smeared on to the land as a substance called lodgment till. When the glacier stopped moving forward, uncrushed stones within the ice were let down gently, from the melting ice. These are the stones -- produced between 150,000 and 15,000 years ago -- that would later end up in stone walls.

5. BURYING STONES

   When the last ice sheet melted northward, it uncovered a landscape that was dusty, rocky and barren. Running water, frost heaving, and relentless wind concentrated the stones at the surface. Gradually, however, plants invaded the surface. Rock, sand, and silt yielded to tundra which yielded to boreal parkland, then to a continuous coniferous forest, then to a largely deciduous forest, the one in which Native Americans lived for

millennia, the one encountered by the first Europeans. In the fifteen thousand-year interlude between deglaciation and English settlement, rich forest soils developed on sand and silt that was fractionated upward from the till, hiding many of the stones by burial. European settlers arrived at a time when the stones were most deeply buried, typically at least 18 inches beneath the surface.

6. HARVESTING STONES
   The subsequent conversion of forest to farm precipitated great changes in the soil. Most important was the gradual loss of the soft organic mulch and black topsoil, which had previously helped insulate the mineral subsoil from winter's cold. Loss of this insulating organic layer coincided with a climatic interval known as the Little Ice Age, during which winters were colder than today. The combination of exposure to the winter wind, bare mineral soil and cold climate enhanced the rate at which stones were heaved upward by frost to reach the surface of the soil. Deep freezing also accelerated the loss of organic topsoil by erosion, because spring rains had more difficulty infiltrating, and therefore no alternative except to run off over the surface. For at least a generation of farmers, stones appeared at the surface like magic.

7. STACKING STONES
   The accumulation of stones in cleared fields, mow lands, and pastures required that they be removed. In an age before petroleum-powered heavy equipment, this was done either directly by hand or indirectly with the assistance of oxen and draft horses. Stones were scuttled aside and seldom hauled further than necessary, which usually meant to the nearest fence line, where there were pitched. A pumpkin or a pile of pumpkins thrown in the same place would disappear by the following fall. A stone, or a pile of stones, however would not. Hence, over the years, elongate piles of stone and primitive tossed walls accumulated along fence lines -- almost automatically -- year after year.

8. BUILDING WALLS
   Broadly speaking, the cultural prestige of farming in New England and its profitability began to decline after the 1830s, following: completion of the Erie Canal; construction of large mill-powered factories; and the spread of early railroads. Before the tide turned, however, rural upland farmers experienced several decades of great prosperity, one that coincided with a movement towards scientific farming, a surplus of labor, and rural population growth. During this interval, even as pioneering farmsteads were being created in more remote regions, many of the ragged tossed walls that had accumulated in earlier settlements were rebuilt into more aesthetically pleasing forms, especially by wealthy farmers and early industrialists. This was particularly true along property boundaries, many of which were being subdivided along earlier generations of walls.

9. ABANDONMENT
   By the 1880s, thousands of rural farms had been abandoned, especially in upland terrain removed from growing industrial cities. Those stone walls not already enveloped by forest were often quarried for the stone they contained for use in bridges, canals, and

piers, or crushed for road sub-grade. Walls on remaining working farms were often destroyed to create larger fields or to drain the land. The invention of concrete and structural steel, the allure of all things urban, and the steadily growing secondary forest rendered walls into an almost forgotten phenomenon, invisible at first because they were buried in brush, then remote because they were deep in the closed canopy forest. The walls tumbled apart and crusted over with lichens, the trees grew larger, and dryland stone habitats were colonized by a wide array of creatures that would otherwise have no place to live. Throughout it all, walls separated discrete patches of forest, ensuring that the woods would more diverse than without them.

10. RECLAMATION
    Beginning in the first decades of the 20th century, and accelerating toward the present, rural farmstead walls have become cultural icons to the origin of America as a nation, as well as a reminder of the slower, simpler life before the modern era. The allure of stone walls, especially old and time-tarnished ones, led to the re-building of walls on many properties reclaimed during the last half century. Other walls were torn apart for their stone for use elsewhere. The allure of walls is now so great, however, that they are increasingly being destroyed to make newer walls in wealthier places. In the process, the archaeology is lost to architecture, the habitat compromised by becoming more simple, and the authenticity of place is being compromised by change. Efforts are now being made to preserve old stone walls

Procedures:

1. Bring students to a stonewall on the Maxwell Mays Nature Trail, and divide them into pairs.

2. Give each pair a clipboard, pencil and observation sheet.

3. Give students time to answer questions.

4. After about 20 minutes, gather them together to go over their findings.

Extensions:

1. Science Extension:
   Students can build their own "stonewalls" using different materials.

Stonewall Observation Sheet

(Part 1)

1. Look around the area. What is the oldest item you can find in this forest? What is the youngest? How do you know?

2. Find several different items around you, and write down a guess as to how each item is.

3. How would this forest look in the middle of December? When do trees have leaves?

4. How does the landscape change from season to season?

5. What do you think this land looked like 200 years ago?

6. How old do you think these trees are?

Stonewall Observation Sheet

(Part 2)

1. How do you think the walls are able to stay up so quietly and easily?

2. Why are the stones in the wall shaped differently on the outside?

3. What lives inside the stone walls?

4. Where did the stonewalls come from?

Where Stones Talk

(Exploring the Carr Family Cemetery)

Objectives:

- Students will be able to explain the local history that they learned through the exploration of a historic family cemetery.
- Students will be able to describe and learn about people and culture in the past from clues found on headstones in a historic cemetery.

Vocabulary: Cemetery, Engraving, Epitaph, Footstone, Granite, Headstone, Marble, Obituary, Sandstone

Grade Level: Grades 4 - 12

Time Allotted: 1 hour

Standards Addressed: HP2 (3-4) 1a, HP 2 (3-4) 2a, HP 2 (3-4) 3a, HP3 (3-4) – 3a, HP3 (3-4)- 2a, HP1 (5-8) – 1c, HP1 (5-8) – 1d, HP2 (5-8)- 1a, HP2 (5-6)- 2a, HP2 (5-8) 3a, HP1 (Ext) – 1, HP1 (Ext) – 2, HP3 (Ext) -2

Science Topics: Correlates with the science topics Identification, Classification, Inference, and Geology

Materials Needed:

- Paper and Pencils
- Worksheets
- Camera (optional)
- MeasuringTapes

Procedures:

1. Conduct one or several visits to the Carr Family plot on the Maxwell Mays Nature Trail.

2. Explain the importance of Cemetery Safety and Etiquette to students:
    a. Make sure you have permission from the Audubon Society of RI
    b. Arrange for adequate adult supervision
    c. Make sure you are aware of poison Ivy
    d. Never move a gravestone
    e. Use only water to clean a gravestone, never use a wire brush or cleaning products
    f. Do not sit on or lean against headstones

d. Who has the tallest or biggest monument?
e. Who has carvings of angels, gates, trees, animals, or other designs on their headstone? Discuss what you think these symbols mean.
f. Who has the most recent grave?

Extensions:

1. History Extension:
   Research any of the historic events that took place in the time periods of the people of the Carr Family Plot.

2. Art Extension:
   Create dioramas of the farm life back in the 18th and 19th century.

3. History Extension:
   Research the meanings of the symbols and epitaphs on the headstones, what does this tell us about 18, 19th and early 20th century beliefs?

4. Language Arts Extension:
   Write an article about why cemeteries are important.

Cemetery Survey Worksheet

Student Names:

_____

Name and Location of the Cemetery:

_____

FOR EACH GRAVESTONE, COMPLETE THE FOLLOWING INFORMATION:

1. Sketch the stones shape and any motifs or decorative carving you see.

2. Full name of the deceased:

_____

3. Birth Date: _____ 4. Death Date:_____

5. Age of death: _____

6. Husband/ Wife of:

_____

7. Son/ Daughter of:

_____

8. Does this stone have any other interesting or unusual features?

_____

_____

9. Is this person related to others buried nearby? If yes, who are they and what is their relationship?

_____

_____

_____

_____

Cemetery Survey Worksheet

Student Names:

_____

1. Name on tombstone:

_____

2. Male _____ Female:

_____

3. Date of birth:

_____

4. Date of death:

_____

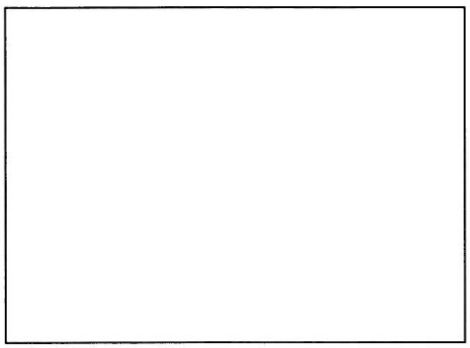
5. Age at death:_____

6. Type of Stone Material:

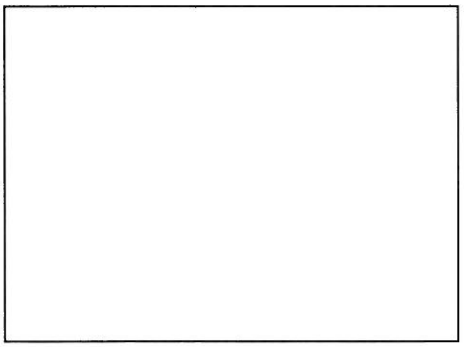
Marble: _____ Sandstone_____

Granite:_____ Metal: _____

7. Draw Shape of Stone:



8. Symbol or Design:



9. Epitaph:

_____

_____

Common Symbols in Historic Cemeteries

Late nineteenth and early twentieth century headstones contain a wide variety of carved figures and designs that reflect people's beliefs about death. The symbols used on American gravestones are gathered from many sources including the Bible, Greek, and Egyptian civilization, European cultural history since pre- Christian Rome, and from the Masons, who influenced many fraternal organizations that sprang up during the 19th century. The meanings of various symbols are wide varied and shifting through time. A few of the more common designs found in area cemeteries' and their possible interpretations follow:

Angel Flying	Rebirth; Trumpeting; Call to the Resurrection
Bible	Faith in God
Bird	Eternal life, Birds in Flight; Flight of the Soul
Flower	Frailty of Life; Severed Blossom; mortality
Candle, Flame	Life
Crown	Glory of life after death
Dove	Purity, devotion
Garland	Victory
Gates/ Doors	Heavenly entrance
Hand Pointing	Heavenly Reward
Heart	Love; Mortality, and triumph of the soul over death
Hourglass	Times inevitable passing
Lamb	Innocence
Shell	Resurrection, life everlasting
Tree	Life; Severed Branch; Mortality
Wheat Sheaf	The divine harvest
Wreath	Victory

STATION 7

VERNAL POOL

7. THE VERNAL POOL

Located along the carriage trail on the left
GPS Coordinates: North 41°40.134', West 71°41.369'
Elevation: 570 Feet

You are now at the site of a seasonally-flooded depression, known as a vernal pool, autumnal pool, ephemeral pool, or temporary woodland pond. Northeastern ephemeral ponds like this one tend to fill with water in the fall or winter, hence the name *autumnal pool*; whereas, similar pools in California fill up in the spring and are commonly termed *vernal pools* (*vernal* meaning *spring*). This autumnal pool floods as the water table rises in the fall, and continues to fill with meltwater from snow and spring showers. By mid to late summer, ephemeral pools usually dry up.

Due to this drying, the temporary wetland is not a good habitat for fish. Organisms such as insects and amphibians benefit from this fish-free environment and use the pool for breeding and the development of their young. Some species have adapted to the transitory nature of the vernal pool and depend upon it for different stages of their life cycle; these species are termed obligate species. Common obligate vernal or autumnal pool species in this area include the fairy shrimp, wood frogs, and spotted salamanders.

Vernal pools come under the protection of the RI Freshwater Wetlands Act, because they play a vital role in the breeding cycle of certain species of frogs, toads, and salamanders. In Rhode Island, the Department of Environmental Management (DEM) regulates construction and other activities that will affect the pools.

Is the vernal pool wet or dry on your visit? Do you hear any frogs calling? Are there egg masses present? What other kinds of animals do you think visit vernal pools?

Observing Vernal Pools

Objective:

- Students will be able to identify 3 of the species that live in vernal pools.
- Students will be able to explain the significance of vernal pools.

Vocabulary: Macro-Invertebrates, Larvae, Nymph

Grade Level: Grades 2 - 12

Time Allotted: 35 minutes

Standards Addressed: LS1-1(3-4) 1.1.1, 1.1.2, 1.1.3, 1.1.4, 1.1.5, 1.1.6 LS1(3-4)-2 1.2.1 LS1(3-4)-4 1.4.1, 1.4.2 LS2(3-4)-6 1.6.1, 1.6.3 LS3(3-4)-7 1.7.1, 1.7.2

Science Topics: Correlates with the science topics Life Science, Identification, and Observation

Materials Needed:

- Nets and Buckets
- Trays (preferably white)
- Watercolor brushes
- Magnifying Lenses
- Viewing Microscopes
- Field Guides
- Paper and Pencils
- Camera (Optional)

Procedures:

1. From the edge of the pool have the class look for and count salamander and wood frog egg masses attached to submerged branches or vegetation.

2. Collect invertebrates from the pool - diving beetles, caddisfly larvae, and fairy shrimp-to observe up close with hand lenses and viewing microscopes.

3. Students should look at what they find and try to classify the organisms and understand their relationships with other organisms. Questions to be answered by observation: How does the organism eat? How does it get oxygen? How does it move through the water?

4. Questions for further research: Is the animal an herbivore? Carnivore? How does the organism deal *with seasonal drying up of the pool? How does it reproduce?*

Extensions:

1. Science / Arts Extension:
   Students can design a project that will address some aspect of vernal pools.
   Sample Topics:
   - How federal, state and local laws affect vernal pools
   - Amphibian life cycles/ mutation research
   - Mapping of vernal pools for planning, land protection
   - Raising public awareness
   - Design a t-shirt to raise money or awareness

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Oh, Wood Frog!

Objective:

- Students will be able to state that food, water, space and shelter are essential components for wood frogs to survive.
- Students will be able to describe the importance of a good habitat for animals.
- Students will be able to define limiting factors and give examples.
- Students will be able to explain why fluctuations in wildlife populations are natural.

Vocabulary: Habitat, Limiting Factors

Grade level: Grades 3 - 5

Time Allotted: 30 minutes

Standards Addressed: LS1 (K-4) –INQ+POC -1d, LS1 SAE-2a, LS2(K-4) SAE -5a, 6b, 6c, LS3 (K-4) SAE -7a, 7b, LS1 (5-8) –POC -3a, 3b, LS1 (5-8) –INQ+SAE – 1a, LS2 (5-8) –INQ+SAE -5a

Science Topics: correlates with the science topics Structure and Survival, Interdependence in Ecosystems and Ecosystems

Materials Needed:

- Paper and Pencils
- Science Journals
- Cones or other marker for boundaries

Procedure:

1. Describe with students the fundamental necessities of animals: food, water, shelter and space in a suitable arrangement. Can any of us survive without these essential components? NO!

2. We are going to do an activity in which the students will become wood frogs, having to get their fundamental needs from the habitat in which they live. Wood frogs are obligate vernal pool species which means they require vernal pools for their life cycle.

3. Before beginning the activity, do a quick review:
    a. What kind if an animal is a frog? (amphibian)
    b. How do we know it is an amphibian? What are its characteristics?

    (Slimy, wet skin, born from eggs, breathes with lungs absorbs air through skin, usually born in water, but can leave on land, cold blooded)

4. Bring students to an open field on the nature trail, for the activity. Students should bring their paper and pencils.

5. Have students count off in fours, with all those sharing the same number gathering together. This will help make the proportions work for the activity.

6. Mark off two parallel lines on the trails that are about ten to twenty yards apart.

7. Have all the "ones" behind one line and all the rest behind the other line. The "ones" will begin as frogs.

8. The other students (all the twos, threes and fours) will become the components of the aquatic habitat: food, water, shelter and space.

9. The deer will be looking for the one of the essential components of its habitat each round.
    a. When a frog is looking for food, it should clamp its hands over its stomach.
    b. When a frog is looking for water, it puts its hands over its mouth.
    c. When a frog is looking for shelter, it holds its hands together over its head.
    d. When a frog is looking for space, it should hold its arms straight out at its sides.
    e. A frog can choose to look for ANY ONE of these needs during each round, but it *cannot change* what it is looking for in the middle of that round. It can change in the next round if it survives.

10. The students who are the components of habitat may choose which component they will be at the beginning of each round. They will display that component using the same actions as the frogs.

11. The game starts with all players lined up shoulder to shoulder on their respective lines and with their backs to the students at the other side.

12. The teacher asks all students to pick which habitat component they are going to display and they make their sign.

13. When all students are ready, count, "One...two...three." At the end of the count, the students turn and face each other showing the sign of the habitat component they choose.

14. The frogs hop towards the other line where the students displaying the habitat components are standing. Frogs are looking for a habitat component that matches the one they are displaying.

15. If a frog successfully finds a match for what it is looking for, it gently takes the student representing that habitat component back to the frog side of the line.

This represents the frog successfully meeting its needs and reproducing as a result.

16. Any frog that fails to find a match of the component it was seeking dies (students are welcome to swiftly but dramatically act this out). That frog becomes part of the habitat, joining the students on the habitat side.

17. Have everyone line up again and begin the next round.

18. The teacher keeps track of the number of frogs at the beginning and end of each round. Continue play for several rounds, so that you begin to see some fluctuations in the frog population.

19. At the end of all the rounds, discuss the activity. Encourage the students to talk about what they experienced and saw.
    a. Did they notice the population growing, and then some frogs ending up dying as the habitat was depleted?
    b. Does this happen in nature? Yes, this fluctuation is a natural process unless there are other limiting factors that affect the habitat.
    c. Some of the limiting factors could be things like drought, fires, deforestation, uncontrolled hunting. Can the students think of any others?
    d. Do frogs only search for ONE of their habitat components every year? No, so this activity is just an approximation of what might happen in nature.
    e. Is it difficult for frogs to find all the habitat components it needs to be able to survive?
    f. Why did the frog get to take a habitat person back to the frog side with them if they found a match? If a frog has all the food, water, shelter and space in which to find all those things, then it is healthy, and healthy individuals in nature are usually the ones that reproduce. In nature, a species of wild animals cannot survive if it cannot reproduce.

20. Next, make a line graph of the number of frogs alive at the end of each round to show that it is naturally cyclical. Have the students copy the numbers and/or the graph onto their papers.

21. Have the students summarize what they have learned from the activity.

22. Give the students an opportunity to do this activity again (either on the same day, or on another day). The next time, be sure to include the limiting factors. For example, if there is a drought during one round, no student on the habitat side can choose water as their symbol in that round.

23. A new graph can then be made to show the difference made in the natural cycles, and compared to the first graph.

24. Have students evaluate the vernal pool at the Maxwell Mays Nature trail to see if it is suitable for wood frogs.

Extensions:

1. Science / Language Arts Extension:
   Students can research online to try to find data on frog populations in the state or even in the New England area over the last few decades. Many State Departments of Environmental Management (DEM in RI, DEP in CT, DCR in MA) collect data on the animal population so that they know how many hunting licenses they can issue each year.

   If students find data on wood frog populations, they can graph that and compare the results to what they found when doing the activity. Does the population fluctuate? What other factors might contribute to the increase or decline in population numbers?

   They can prepare a report on their findings, and/or present their findings to the rest of the class. Some students can choose other common wild animals, too, and see if their populations have similar ups and downs.

Mapping Vernal Pools

Objectives:

- Students will be able to explain the procedures for mapping a vernal pool

Vocabulary: Topography, Topographic Map

Grade Level: Grades 5 - 12

Time Allotted: 60 minutes

Standards Addressed:

Science topics: Correlates with the science topics Life Science, Measurement, Identification, Observation and Mapping/Compass Skills

Materials Needed:

- Topographical map (Free- customized USGS topo-maps can be found at: http://topo-market.weogeo.com/)
- Compass
- Tape measure or Trundle Wheel
- Paper and Pencils

Procedures:

1. This activity should be done after students have become familiar with topographical maps and feel comfortable using a compass. Divide students into pairs or groups.

2. Write clear and concise directions to your pool using compasses and two permanent landmarks as reference points.

3. Draw a sketch map of your pool, noting its location in relation to the permanent landmarks.

4. Measure the pool and record its dimensions on the map.

5. Locate vegetation, egg masses and any other relevant details of the pool.

6. Visit the RI vernal pools website for photos of vernal pools, species that inhabit vernal pools, and photos of different egg masses:
   http://www.uri.edu/cels/nrs/paton/index.html

Extensions:

1. Science Extension:
   Ask the students to collect the detritus and muck from the vernal pool, place this in an aquarium and observe the growth of aquatic creatures over time.

2. Science Extension:
   Collect the leaves at the bottom of the pool and classify the percentage of each type of leaf represented.

How Could You Live in a Vernal Pool?

Objectives:

- Students will be able to explain the adaptations, lifecycles, and interrelationships of vernal pool species.

Vocabulary: Vernal Pool, Adaptations, Metamorphosis, Predators, Prey, Adaptations

Grade Level: Grades 3 - 8

Time Allotted: 1 hour

Standards Addressed: LS1 (K-4) –INQ+POC -1d, LS1 SAE-2a, LS2(K-4) SAE -5a, 6b, 6c, LS3 (K-4) SAE -7a, 7b, LS1 (5-8) –POC -3a, 3b, LS1 (5-8) –INQ+SAE – 1a, LS2 (5-8) –INQ+SAE -5a

Science topics: Correlates with the science topics Life Science, Scientific Inquiry, Collecting and Presenting Data

Materials Needed:

- How Could You live in a Vernal Pool Sheet, Pencils
- Various Arts and Crafts Materials

Teacher Background:

What are vernal pools? Vernal pools are contained basin depressions generally holding water for at least two months in the spring and early summer and supporting the activities of amphibian and invertebrate species. "Vernal" means "spring" in Latin so these pools are filled with spring snow melt and spring rains, usually drying up by late summer. However, in southern New England some pools fill up in the fall and can be called autumnal pools. Vernal pool is the generally accepted term however. The RI Fresh Water Wetland Act protects vernal pools as special aquatic habitat. The identification and assessment of vernal pools, and mapping of its location, is essential to protecting these valuable habitats.

Procedures:

1. Discuss *adaptations* various animals (or even humans) have to ensure survival in their environment.

2. Many *vernal pool* species undergo *metamorphosis* during their life cycle. You may find it helpful to explain the term *metamorphosis.*

3. Each student will either choose or create an organism that would live in or around the *vernal pools*.

4. Have students research the life cycle, food sources, *predators,* and *adaptations* associated with the organism.

5. Have students fill out the "How could you live in a vernal pool?" activity sheet for guidance in addition to the "Animals of the Vernal Pools" sheet.

6. Explain to students they will present the species they researched/created to the "scientific community" (their classmates). They will pretend to be scientists who have just discovered a new *vernal pool* species.

7. In order to do this, they must create a drawing, puppet, or model/sculpture of their *vernal pool* organism. Students should focus on *adaptations.*

8. After Students have created their species they can fill out the "How could you live in a vernal pool? Assessment sheet provided.

9. Discuss with students the possible effects of human activities on the *vernal pools* and the animals that depend on them.

10. Talk with the students about the fragility of *vernal pool* habitat and how conditions in the pools (temperature, water chemistry and quality, available water) are easily altered by the construction of roads, ditches, trails, mining operations, and overgrazing. For example, oil and gasoline runoff from roads pollutes *vernal pool* habitat.

Extensions:

1. Art Extension:
   Have students create a mobile to illustrate the life cycle of their *vernal pool* animal.

2. Science Extension:
   Create puddles on the trails/ near the parking area by pouring water into depressions. While there may not be much in the way of life *in* the artificial pool, you can watch for life *around* it by sprinkling flour or cornstarch in the surrounding area and looking for animal tracks on a return visit the next morning.

3. Art Extension:
   Divide students into groups of five or six. Have each group create a play depicting a *vernal pool* food chain with each student acting the part of their chosen animal.

Name: _____

How could you live in a vernal pool?

Research an animal that lives in the vernal pool habitat and/ or create your own imaginary vernal pool species using the following questions as a guide. Then get creative and make a model of the animal. Be sure to include the necessary adaptations needed for survival in a vernal pool habitat. Be prepared to share your creation with the class and explain how it would survive in a vernal pool habitat.

1. Who am I?

2. What is my prey (what do I eat)?

3. What is my predator (what eats me)?

4. Adaptations:

   How do I survive the dry season, when there are no pools?

   How do I move in or around the vernal pools? (What are my limbs like)?

   What other adaptations help me or my offspring to survive?

5. Am I a crustacean?

6. Am I a macro-invertebrate?

7. Do I metamorphose?

8. What other animals am I related to?