Winter Ecology Observations

Activity Overview
Students collect data about ecosystems in winter to compare similarities and differences between communities and identify plant and animal adaptation strategies for survival in a particular environment.

Objectives
Students will:

- Increase their understanding of winter ecology
- Utilize their observation and data gathering skills
- Discover and understand plant/animal adaptations to winter environmental conditions
- Explore the visual assessment of a winter landscape
- Analyze and infer how plants and animals have adapted to their particular habitats
- Determine the amount of meltwater in the ecosystem's snow cover

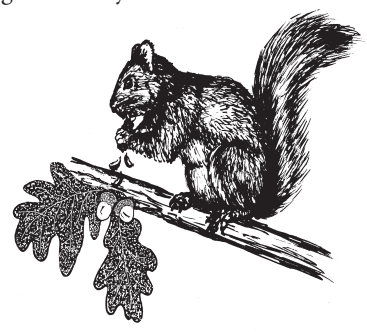
Subjects Covered
Science, Language Arts, Math, and Art

Grades: 6 through 12

Activity Time
30-45 minutes in the field

Season: Winter

Materials
Winter Ecosystem Data sheets, clipboards, pencils, measuring sticks, soil and air thermometer, animal track identification books (see resources section), plant identification guides, graduated cylinder



Background

"In January one may follow a skunk track, or search for bands on the chickadees, or see what young pines the deer have browsed, or what muskrat houses the mink have dug, with only an occasional and mild digression into other doings January observation can be almost as simple and peaceful as snow, and almost as continuous as cold. There is time not only to see who has done what, but to speculate why."

Aldo Leopold, "January Thaw," in *Sand County Almanac*

As students begin a restoration project, they need to understand the seasonal ecology and habitat requirements of the community they are restoring. Students develop a clear understanding of how plants adapt to their environment and what condition plants need to survive as they study and compare ecosystems. The knowledge gained will help them to select suitable plants for their site. Such an understanding of the seasonal needs and adaptations of plants and animals will also help to hone their observational skills and to gain an appreciation of the wildlife found on or near their school grounds.

Wintertime is an ideal opportunity to get outside and look for signs of wildlife and other changes in your school restoration or ecosystem. Animals leave evidence in the snow like burrows, fur or feathers, droppings, food litter, and tracks. These tracks can also tell a story about where the animals may have traveled from and where they may be going. We might also find clues about where an animal makes its home in the winter season and how active it might be. Identifying tracks and recording other winter observations can also provide clues to the types and numbers of various plant and animal species found in your school yard area. Prairies and woodlands are natural communities that have a different set of plants, insects, animals, soils, and micro-environments. Yet, there are also similarities—each community has a basic set of requirements to survive as healthy, balanced ecosystems. Species in each community need sun, water, and space and share a myriad of interrelationships among the component parts for success.

Plants and animals found in a variety of ecosystems make adjustments to the seasonal changes of winter. Just as humans put on extra layers to stay warm in winter, plants and animals have unique ways to survive the rigors of winter. In many cases, plants and animals have developed physical and/or behavioral. For example, some mammals have fur for protection and insulation against the cold. Fur provides insulation of the animal's body heat by trapping small pockets of air between the hairs. Air doesn't conduct heat very well. So the more layers of air between the animal and the cold, the warmer it will be. When mammals get cold, they fluff up the fur on their bodies to increase the amount of air space in the fur.

State Standards
Science:

Decide questions to ask (A.4.1), data pertinent to new problems (A.4.2), data to collect(A.4.3), themes (A.4.4), changes that have occurred (A.4.5)

Develop themes for questions (A.8.1) Describe limits of science systems (A.8.2) Collect and organize data to explain or critiques models (A.8.3), Collect scientific evidence (A.8.4), Show how models change based on evidence (A.8.5), Use models to predict actions/events (A.8.6), Design investigations to test models (A.8.7), Use themes to predict future (A.8.8)

Apply themes to develop future visions (A.12.1), Show effects of different opinions and decisions about themes (A.12.2) Give examples of models for solutions (A.12.3) Construct arguments for conflicting models (A.12.4) Reexamine evidence & reasoning (A.12.7)

Use scientific sources & resources (B.4.1) Explain general rules of science (B.8.3) Show contribution of research (B.12.4)

Ask questions, plan investigations, make observations, predictions (C.4.2), Select multiple information sources (C.4.3), Use scientific equipment (C.4.4), Use data to answer questions (C.4.5), Communicate results (C.4.6), Support conclusions with logic (C.4.7), Ask new questions (C.4.8).

Identify questions using available resources (C.8.1), Identify data and sources to answer questions (C.8.2), Use inferences and observations (C.8.4), Use knowledge, models, and theories to explain results (C.8.5), State learning from investigations (C.8.6), Explain data & conclusions (C.8.7), Use computer software to organize data (C.8.8), Discuss results (C.8.10), Identify further questions (C.8.11)

Evaluate questions, hypotheses, conclusions (C.12.3)

Unlike most other mammals, human "fur," or hair, is sparsely scattered over our bodies. When we get goose bumps when we are cold, our bodies are instinctively trying to "fluff up" our fur. However, people have evolved so that we don't have enough hair to insulate us completely; we wear clothing to create air spaces between the external environment and us.

An animal's fur may help it survive winter in other ways as well. For instance, the outer hairs may camouflage the animal, allowing it to blend in with the colors of its surroundings. A deer's winter coat is grayish-brown like the bare branches of trees and shrubs in its winter habitat.

Animals and plants adapt to winter in different ways. Animals may hibernate, migrate, go into deep or light sleep periods, or remain active. Small birds like finches must shiver constantly in the cold to generate heat. Some plants like wintergreen survive under the snow and contain oil that is both distasteful to animals and may prevent freezing. Other plants adapt by overwintering in their seed stage (e.g., foxtail, ragweed) or dying back so only the root system survives (e.g., yellow coneflower). Others, like pines, retain their green leaves through the winter season. Whatever the process, all animals must meet the basic life requirements of food, water, shelter, and warmth even during the harsh winter months of the year.

Activity Description

Introduction:
Read "January Thaw" in *Sand County Almanac,* by Aldo Leopold. Leopold writes about the early signs of seasonal changes and animals' adaptations to the winter season.

Description:
Students involved in this activity will look at air, soil, and snow temperature. They will estimate wind speed, investigate and describe surface litter, estimate average snow depth and the related volume of water that can be supplied to a given area, observe and record signs of animal activity, identify potential food and shelter sources; consider aesthetics, describe how they feel in the ecosystem, and determine the meltwater in snow cover.

Procedure:
1. Depending on class size, divide into teams. If necessary, one student can record the information while other students collect the data.
2. Hang or place the air thermometer in the ecosystem to be studied (e.g., prairie, woodland, lawn area) then insert a soil thermometers to a 1" depth (if possible; frozen ground may preclude collection of this information).

Winter Ecology Observations (cont.)

Standards continued

Ask questions, build hypotheses, design investigations (C.12.1)

Identify issues, questions, research; design & conduct investigations (C.12.2)

Evaluate data (C.12.3)

Choose & evaluate data collection methods (C.12.4)

Use explanations & models to describe results (C.12.5)

Present results (C.12.6)

Observe, describe, and measure physical events (D.4.7)

Use scientific themes to explain physical & chemical interactions (C.8.4)

Use definitions of energy & energy conservation (D.8.7)

Use models of energy transmission (D.8.9), Identify types of chemical interactions (D.12.6)

Use science themes to explain physical word (D.12.11)

Use science themes to explain interactions (D.12.11)

Find patterns and cycles in earth's changes (E.4.6)

Explain & predict changes in earth's systems (E.8.1)

Describe changes on the earth's surface (E.8.3)

Analyze influence of living organisms on earth's systems (E.8.4)

Discover how organisms meet their needs (F.4.1)

Investigate how organisms respond to internal/external cues (F.4.2)

Find connections among living and non-living things (F.4.4)

Investigate cooperation & competition (F.12.7)

Infer changes in ecosystems (F.12.8)

Understand energy storage, digestion, metabolism (F.12.9)

Understand energy impact on organisms (F12.10)

3. Using your data sheet, collect data in the designated ecosystem for 30 minutes. The following instructions will explain how to collect your data:

- Air movement: Estimate air movement on a scale of zero (no wind) to ten (strong wind) using the jar of bubbles provided. Bubbles will drop immediately in little or no wind; bubbles will stay up in the air and move quickly in a strong wind.
- Surface litter: Examine the dead material (leaves, stems, etc.) on the surface of the soil (look under the snow if necessary). Estimate the depth of litter and list what you see.
- Soil temperature: Record temperature with soil thermometers at one inch.
- Snow temperature: Record the snow temperature.
- Take three measurements of snow depth and calculate the average. Use the attached form, "Meltwater in Ecosystem Snow Cover," for further calculations of related water volume.
- Adaptations of plants: Describe representative plant forms, leaf size and shape, flowers or fruits that indicate a survival mechanism for plants in winter. If necessary, use plant identification guidebooks to determine the scientific names of plants observed.
- Evidence of animals: Search for evidence of animals such as animal tracks, chewed leaves, and animal droppings.
- List likely places for mammal or bird shelter from winter winds and other harsh conditions.
- Identify three food sources for mammals or birds that are active in winter. Indicate the abundance of food and if evidence of animal browsing is present (e.g. tracks, chewed bark, etc.)
- Aesthetics: Describe patterns/textures/colors & contrasts in the ecosystem.
- Describe how this ecosystem makes you feel.

In the classroom

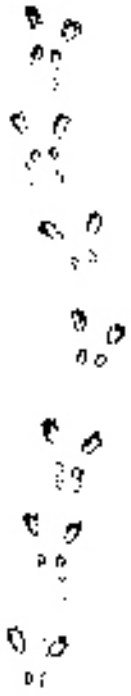
4. Determine the meltwater in snow cover. Before coming inside, fill a ten ml graduated cylinder with snow. Do not pack the snow in the cylinder.
6. Follow data sheet to find the amount of water in the snow.
4. If time permits, repeat activity in other ecosystems.

Questions for discussion:

- What connections did you observe between living and non-living things?
- Howdo plants adjust to environmental conditions?
- Will the information collected help you design an ecological restoration?
- How can different plants and/or animals affect each other?
- Consider at least three ways are plants and animals interdependent?
- What were the results of the "meltwater in snow cover" calculations? How might these findings differ in a prairie, woodland, and lawn?

Winter Ecology Observations (cont.)

- What types of food and shelter could your restoration provide mammals and birds?
- Why would urban or suburban meltwater be less valuable than prairie or forest meltwater?
- Think about the total volume of meltwater in your ecosystem, what could this mean for your restoration plants and other local wildlife?



Extensions

- Compare communities in different stages of succession and during different seasons of the year.
- Organize and display your findings using graphs, tables, charts, and diagrams.
- Collect this information over time and through different seasons of the year to create a phenological history of the site
- Create artwork and poetry based on the aesthetic information collected about patterns, textures, colors, and contrasts observed in the winter landscape
- Draw inferences from the data gathered and test your hypotheses.
- Use this activity in conjunction with the Earth Partnership for Schools activity, "Ecosystem Comparisons."

Additional Resources

- Curtis, John T., (1959). Vegetation of Wisconsin. University of Wisconsin Press. Madison, WI.
- Levine, Carol. (1995). A guide to wildflowers in winter. Yale University Press, New Haven, CT.
- Murie, Olaus J. (1982). Animal tracks (Peterson field guide). Houghton Mifflin Co., Boston, MA.
- Pearce, Tony. (1990). Exploring woodlands: A cross-curricular approach to investigations of the woodland environment. Hampshire Books, Exeter.
- Stokes, Donald W. (1976). A guide to nature in winter. Little, Brown & Co., Boston, MA.
- Weber, Larry. (1996). Backyard almanac. Pfeifer-Hamilton Publishers, Duluth, MN.

Assessments

- Describe at least three winter survival strategies you observed during the activity.
- If you were a wild creature, what physical and/or behavioral adaptations would you personally choose to survive winter?
- Write an article for a scientific journal based on the data you collected.
- Given what you know about animal's needs to meet basic life requirements of food, water, shelter, and warmth during the winter; what changes would you make on your school grounds to help animals survive?

Winter Ecology Observations Data Sheet

Location and Ecosystem: _____

Name(s): _____

Date: _____ Time of Day: _____

Weather Conditions:_____

Air temperature; _____

Wind speed:

_____

0	5	10
No wind (bubbles float straight down)		Strong Wind (bubbles blow far)

Soil temperature at 1″:_____

Litter depth and contents: _____

Snow temperature: _____

Average Snow Depth: (Use this information back in the classroom to determine the amount of meltwater in snow cover.)

1st depth	2nd depth	3rd depth	Average depth
_____ cm	_____ cm	_____ cm	_____ cm

Two visible winter plant adaptations:
Common name:_____ Scientific name: _____

Adaptation: _____

Common name:_____ Scientific name: _____

Adaptation: _____

Signs of animals: (tracks, nests, cavities, chewed vegetation, droppings, etc.)

Likely places for mammal or bird shelter.

Winter Ecology Observations Data Sheet (cont.)

Three food sources for mammals and birds.

What type? Is it abundant or sparse? Do you see evidence of animal browsing?

1.
2.
3.

Aesthetics::

Patterns
Textures
Colors
Contrast

How does this ecosystem make you feel? Of what does it remind you?

In the Classroom: Meltwater in Snow Cover

1. Before coming inside, fill a 10 ml graduated cylinder with snow. Do not pack the snow in the cylinder. Melt the snow in the cylinder by using your hands and breath. Note the volume of water left in the cylinder. Divide this amount by the total ml in the cylinder (which should be 10). Example: If 10 ml of snow melts to 2 ml of water, then the water-to-snow ratio is 2/10 or 1/5 or .2. This gives you the water-to-snow ratio. Water-to-snow ratio = _____

2. Find out the volume of snow in cubic centimeters:
(Assume 1 sq. ft. of snow measures 30cm X 30cm.)

30cm X 30cm (~ 1 sq. ft. of snow) X _____cm (average depth measured in the field) = A _____cc's (vol. of 1 sq. ft. of snow)

3. Calculate volume of water after snow melt:

_____cc's (vol. of 1 sq. ft. of snow) X _____ (water-to-snow-ratio) = B _____cc's (vol. of water in 1 sq. ft. of snow)

4. Determine total volume of meltwater in the area.:
Convert volume of snow to a liquid measurement in milliliters. (1 cc of water = 1 milliliter water or B = C)

B _____ cc's volume of snow = C _____ ml of water in snow

Convert the volume of water from milliliters to liters.

C _____ ml ÷ 1000 = D _____ liters of water in 1 sq. ft. snow

D _____ liters in 1 sq. ft. of snow (volume of water) X _____ sq. ft. (site's area or 1 acre = 43, 560 sq. ft.) = E _____ total liters

5. Determine number of humans who could be supplied with their daily water consumption needs from the meltwater

E ____ liters of water from snow ÷ 380 liters (liters per person) = F_____ (the number of humans)