Science

SCIENCE CONCEPT TWO:
trees & forests: the basics

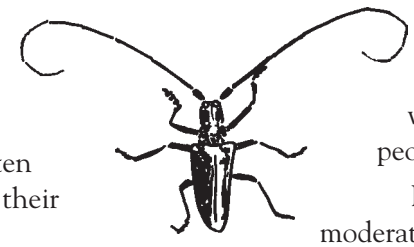
1. **Our Plantwatch tree and shrub species are valuable!**

   - **As habitats for a variety of living things**

     Two thirds of Canada's estimated 300,000 wildlife species live in the forest.

     Saskatoons provide food and shelter for species such as birds, hares, mice and mushrooms.

     Aspen poplar bark and leaves are the preferred food of beavers, and these animals often use the branches to construct their dams and lodges.

     Sawyers beetle

     Aspen poplar winter buds are eaten by grouse.

     Young aspen twigs and leaves are browsed by hoofed animals such as deer, moose and elk. These animals can also use aspen poplar groves as shelter to hide from wind and predators.

   - **For recreation**

     Saskatoon berries are fun to pick and turn into pies, jams and syrup.

     Saskatoon bushes provide a good habitat for numerous nesting birds, and mixed poplar/conifer forests are home to more kinds of nesting birds than any other forest type in Canada. Birdwatchers know this and appreciate it!

   - **As part of a life-supporting environment**

     Maintaining biodiversity (total variety of living things) keeps our planet's ecological systems strong and healthy and more able to withstand the stresses imposed by people and our changing climate.

     Forests play a key role in moderating our climate, regulating our water systems, preventing erosion, and alleviating air pollution.

2. **A variety of plants and animals live under, on and among trees. Trees affect and are affected by these other living species.**

   Some examples from Plantwatch species are as follows:

   Beavers cut aspen poplar trees down to get branches to build their dams and lodges. Aspen bark also is an important winter food for hoofed animals such as elk, moose and deer.

ALL WORDS HIGHLIGHTED IN BLUE CAN BE FOUND IN THE GLOSSARY (APPENDIX 1).

Saskatoon provides food (berries) for birds as well as mammals such as mice and squirrels. The winter buds are a preferred food for sharp-tailed grouse, and deer, elk and moose eat the branches in winter. Saskatoon also provides a sheltering habitat for these animals and others, such as the snowshoe hare.

Because saskatoon is a native shrub found throughout much of temperate North America, and has been evolving here over thousands of years, many insects and fungi have adapted to use it as a food source. Insects (and fungi) feed on its roots, stems, leaves, flowers and/or fruit. There are nineteen species of moths/butterflies whose caterpillars (larvae) eat saskatoon. The insects in turn are valuable food for birds!

Helping Songbirds


GARY ROSS

Recent studies show that there have been significant and rapid declines in some forest songbird populations in the past decade. The main causes of this decline appear to be forest fragmentation (large areas of forest becoming small patches of forest) and the loss of habitat along bird migration routes due to agriculture and urban development. If we can retain hedgerows and other areas of native bushes and trees, birds will have needed shelter and food-rich habitat in their migration and nesting seasons.

A healthy forest depends on complex relationships between tree species and other organisms. All wild or native plants have important partnerships with some soil **fungi**.

For example, fungal partners are known to give saskatoon shrubs great drought hardiness. The saskatoon's roots are connected to fine fungal strands through which plant and fungus trade nutrients. The plants provide sugars to the fungi (or mushrooms) and receive water and minerals in exchange. By greatly increasing the saskatoon roots' ability to absorb water, fungi help the shrub survive drought.

The growth and survival of forest plants is dependent on these fungi, which protect them from infection and enable them to absorb water and nutrients from the soil. Without this partnership, neither green plant nor fungus would do well, which is why native plants need undisturbed prairie or forest soils where their **fungal partners** live and why some native plants can be hard to grow in domestic gardens.

3. Trees play an important role in nutrient cycles

In the fall, aspen poplar leaves turn yellow and saskatoon leaves turn bright orange, red or purple. The leaves then fall off and pile up on the ground. Then an army of decomposers (insects, worms, bacteria and fungi), all assisted by rain and warmth, begins to turn the leaves into nourishing soil.

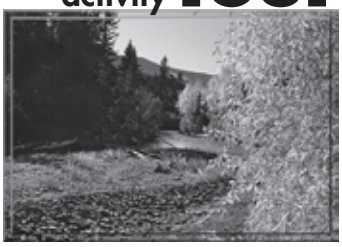
Some leaves don't go through the decomposition process, but are directly consumed. For example, freshly fallen aspen poplar leaves (which look like gold coins) are a very popular food for deer and elk.

The fallen leaves also provide insulated hiding places for many overwintering adult insects such as beetles, as well as butterfly, moth and spider eggs.

Trees are defined as perennial plants with a single woody stem over 5 cm (2 in.) in diameter.

A shrub (or bush) has two or more main woody stems, each less than 5 cm (2 in.) in diameter coming up from the ground. However, what grows as a shrub in some parts of Canada, grows as a tree in other areas. For example, in rich soil in British Columbia, a saskatoon can develop a single trunk and grow up to 10 m (30 ft.) tall.

SCIENCE activity four



Forests: Discussion and Investigation

1. **Forests are used for**
   - logging trees for lumber and pulp
   - preserving the environment (plants and animals, biodiversity, ecosystems)
   - preserving cultural heritage (the land and culture of Canada's First Nations people)
   - recreation (camping, hiking, hunting, fishing)

2. **Different animal and plant species live in young forests and in older forests**
   - In younger forest we see birds such as yellow warblers and American redstarts, as well as many shrubs and young trees, including aspen poplar and saskatoon.
   - In older forests we see larger trees; thick carpets of lichen, mosses and horsetails; cavity-dwelling birds such as woodpeckers and some ducks; warblers such as the Blackburnian, Cape May and black-throated green; and predators such as goshawks and barred owls.
   - If all the older forests disappeared, we would lose the many plants and animals that need this habitat to survive. As old forests are often fairly open to walk through, with trees spaced far apart, a significant recreational resource would be lost. If all the forest was gone and converted to agricultural land, then precipitation falling on the land would no longer be stored by mosses, tree roots, etc. but would run off causing erosion of the soil. Heavy rains could easily cause floods.

3. **Fire can be helpful to many forests**

   Fires have burned our forests for thousands of years, and they have helped build the healthy, diverse forests we have today. Would putting out all fires be good or bad for our forests? How can we find out? Which impact leads to a healthier regrown forest, a hot forest fire or clear-cutting?

   - Plants, fungi, lichens and insects have adapted over thousands of years to fire conditions — seeds can persist and germinate after a fire and often plant roots survive (e.g. aspen poplar and saskatoon sprout vigourously after a fire). The cones of the jack pine and lodgepole pine trees require heat from a fire to open the cone

scales and release the seeds. Other benefits are as follows:

- wood lilies (*Lilium philadelphicum*) produce more bulbs, flowers and seeds after a fire, and the blooms can then turn the forest floor bright orange
- mountain bluebirds prefer to nest in holes in burned trees or snags
- nighthawks nest on the ground in burned areas
- woodpeckers become very numerous after a fire, as they use burnt trees for food and shelter
- some birds that need to perch high above the ground (flycatchers, hawks, owls) use the dead trunks left by a fire
- Another benefit is that weedy, invasive, introduced plants are often eliminated.
- Fires often kill trees but the dead trunks stay standing for many years, whereas clearcut logging removes all the tree trunks to a pulp mill or saw mill. Can you think of any plants or animals that could live in a recently burned forest but could not live in a clearcut forest?

activity SCIENCE five

DYNAMIC GRAPHICS

Developing a Phenology Calendar

Students can build on the observation skills developed through Plantwatch by expanding the focus of observation to other seasonal events that occur throughout the school year.

In the following article, reproduced (with permission) from *The Green Teacher*, grade 7 teacher Larry Weber describes his innovative approach to studying the environment, exploring the natural world and fostering respect for native habitats. By following the seasons in his area (Minnesota, USA), Larry Weber has developed a science curriculum based on local phenology. Each month, Larry and his students examine a new topic that explores what is happening outside the door to their classroom.
You may wish to develop a similar list of events for your area. Consult with a local naturalist to help develop a list of monthly events. Make a class 'phenology calendar' by filling in the dates when these events occur!

LARRY WEBER

Teaching with the Seasons

Nature's daily and seasonal drama provides the textbook for this grade seven natural science course based on phenology.

by **Larry Weber**

Those of us involved in environmental education in the late 20th century face a formidable challenge. Environmental degradation continues even as we try to tell the next generation how unwise this is. Preaching the wrongs of environmental sins does not work. Nor do environmental scare tactics or blaming the students for the lifestyle enjoyed by their families. And merely describing environmental problems and possible solutions is a boring way to teach and to learn.

Underlying the difficulty of finding ways to foster concern for the environment is the fact that the majority of the youth we are trying to reach have less interaction with and awareness of the natural world than any previous generation. Over my thirty-year teaching career I have seen a dramatic decline in the amount of time students spend outdoors exploring on their own. Pick up an interesting insect, leaf or seed pod from your schoolyard and chances are that most of your students — and many of your colleagues — will be completely unfamiliar with it. "I never saw that before!" they will exclaim. Ask your students to name ten animals and most will name animals from other parts of the world. Given how little

many of our students see or know of the natural world right outside the window, how can we expect them to care about environmental problems? Is it reasonable to hope that they will work to protect what they do not see?

I believe that part of our task as environmental educators is to fill in this gap in students' education and awareness, to give students a positive, healthy view of the planet, starting with the abundance and variety of nature nearby. For the past 15 years I have been teaching a Natural Science course to seventh graders that seeks to do just that. The curriculum I developed is based on phenology, or as Webster explains, "the study of natural phenomena that recur periodically, such as migration or blossoming, and their relation to climate and changes in season." The students learn about local flora and fauna, track the weather, and closely monitor the progression of the seasons. Through the year, they develop skills of observation and prediction, experience the excitement of recognizing trees, wildflowers and animal tracks, and become attuned to the environment generally. They come to see that nature is not "somewhere else" but a dynamic presence in their daily lives.

Design of the Course

The phenology natural science course operates around three conditions that together make it unique: We do not use a textbook; we regularly use the outdoors as a classroom; and we follow the seasons' phenology as the curriculum.

Instead of using my alloted money to buy textbooks, I buy classroom sets of reference books (mostly the Golden Zim guides) which students use to research the weekly topics of study, to verify observations and to identify finds. Students bring two notebooks to class. One stays indoors, while the other becomes a field journal in which students take copious notes and make sketches on our outdoor forays.

We go outdoors on a weekly basis and, with the exception of two short bus trips, we make use of the school campus and nearby property for the entire year. The purpose of the outdoor walks is to find examples or evidence of the phenology topic we are exploring that week. However, students are encouraged to look for other interesting things along the way and these add an element of spontaneity and excitement. Students observe and make notes on some of these unanticipated finds, as well as on weather and ground conditions, and the phenology topic of the walk.

While always rewarding, going outdoors weekly is not without its difficulties. Students do not always come properly prepared for weather conditions, and their energy levels outdoors can be very taxing on the teacher. For these reasons it is important to maintain a semblance of classroom structure. I have found that taking students outdoors regularly from the beginning of the school year helps to establish a routine. And, as in the indoor classroom, we have a strict code of conduct involving how we act towards each other and how we treat organisms that we find. Knowing what to expect from me and what is expected of them allows us to build a pleasant working rapport. Most students find that they enjoy the walks even when the weather may be undesirable.

Class Procedure

Regular class procedure revolves around the following five main components of the course:

Weather: Temperatures and precipitation are recorded regularly, and each day we plot the high and low temperatures. Being near Lake Superior, we often find huge variations in temperature within very short distances. As a result, we obtain the official weather

from a local weather station, but we also check our instruments. We compare monthly weather statistics to the norm, and measure and mark snowfall totals on a "snowboard" on the wall. For students who are unaccustomed to noticing or remembering the weather from one day to the next, this constant weather-watching fosters an awareness of the newness of each day, of recurring patterns, and of links between weather and wildlife. Recalling the weather during the past week often enables us to predict what we are likely to find on our outdoor walks.

LARRY WEBER

Months: At the beginning of each month, we list and discuss what will happen in nature during the coming month, including the timing of the full moon and other astronomical events. We also talk about the names of the months and try to come up with more meaningful ones that reflect events in the natural world, such as The Dark Month (December) or The Crusty Snow Month (March).

Fall and spring phenology charts: Each year, the class plots the dates of the last sighting in fall and the first appearance in the spring of common flora and fauna. Similar data is kept for weather happenings such as freezing, thawing, snows, etc. The phenology charts are extremely valuable in documenting the change of seasons and the consistency of events from one year to the next. Kept over a long period time, such charts can even aid in detecting long-term trends such as global warming.

Students' discoveries: Students are regularly given time to share their own findings, either sights (critter news) or specimens caught and brought to class and examined. All collected organisms are returned to the wild within a day of being caught.

Phenology topics: I have developed a sequence of 30 phenology topics, each of which is explored for a week or two, not more. This means that the current topic is always pertinent to what is happening in nature at that time of year.

A typical week

Monday: Discussion of present phenology; critter news, sharing of students' discoveries; weather news; introduction to the week's phenology topic

Tuesday: Discussion of the week's topic, using classroom references and other sources as well as 35 mm slides

Wednesday: Outdoor walk to look for examples or evidence of the present phenological topic. Students take notes and make sketches as we go along.

Thursday: Go over the findings from the walk and continue discussion of the topic.

Friday: Students hand in a written report summarizing the walk and our findings; students take a quiz on the topic, often done in cooperative groups.

Phenology Topics by Month

The following 30 phenology topics are covered during the course of the school year. Their timing may vary some years, but this is the desired sequence. Teachers attempting to use phenology-based methods will need to become aware of their own local weather and phenology. This may be challenging, but it is a terrific learning experience and offers the joy of learning along with the students.

September: The Cooling Month

Mushrooms and other fungi: Mushrooms and other fungi abound nearly every fall near the school, often on the school lawn.

They are easy to find and lead into good discussions and activities.

Fall migration - raptors: Hawks and other raptors are the focus of the bird migration in the fall. We visit Hawk Ridge, about 15 minutes away by bus.

Fall wildflowers: At this time of year, the meadows are filled with asters, goldenrods, sunflowers, clovers, and many other wildflowers. We go among and learn about these often overlooked plants.

Deciduous trees: We learn trees by their leaves, fruits and berries. In our region, deciduous trees spend more of the year without leaves than with leaves.

October: The Leaf-Drop Month

Insects: During the warm mild days of October, insects are very common in the meadows. Here we catch, observe, and release many. We also find galls and leaf miners.

Spiders: Mild autumn days are excellent for observing spiders in meadows, lawns, and ballooning in the bare trees. We catch and release.

The pond in fall: Now before the freezing, a visit to a nearby pond reveals the diversity of aquatic life. Many organisms are observed and released.

Small mammals: With the leaves dropping from trees, small mammals are getting ready for winter. We look for signs of nearby residents and live-trap a few.

November: The Cloudy Freeze-Up Month

Non-flowering plants: Now with the leaves off trees and before snow, small plants such as mosses, clubmosses and ferns are easy to see. We learn about them before they are covered.

Animal signs: November is a good time to see nests, gnawings, caches, droppings, and other indications of animal presence. This topic can also be done in the snow.

Animal tracks: In the early light wet snows, many mammals are active and their stories are left in the lawns, meadows and woods.

December: The Dark Month

Large mammals: Introduced to animal signs and tracks last month, students now take a closer look at large mammals. We usually do not see many large mammals but we recognize their signs and tracks.

Winter birds: With the advent of cold weather and the snows of December, bird feeders become active. We observe the birds at the feeders as well as other birds that winter with us.

Natural lights: During the darkest week of the year, in anticipation of the coming solstice, we look more closely at natural lights around us and discuss the color of sky, ice, snow, etc.

January: The Cold Month

Wildlife in winter weather: In the cold and snow of January, we take time to look at how wildlife is able to cope with these conditions and survive.

The pond in winter: Using ice augers, we drill through the ice covering the pond and sample the water beneath, examining it for pond critters. This is a good time to introduce the use of microscopes.

Conifers: Staying green all winter, the evergreens are now easy to see. We learn different kinds of conifers and how they use their leaves and shape to deal with winter.

February: The Dry Month

Humans in winter weather: With a little planning and understanding of winter conditions, we learn how to be outside safely. Wind chill, hypothermia, frostbite, etc. are discussed.

Winter wildflowers: Often looking dead and stick-like, the perennial "weeds" persist throughout the winter. We learn different ones and how they differ in their methods of seed dispersal.

Deciduous trees in winter: The trees are bare, but can be identified by their shapes, colors and various twig conditions. We make and use a simple dichotomous key.

March: The Crusty-Snow Month

The sap flow: Quietly, the trees respond to the warmer and longer days of early March. We tap sugar maple trees for sap and make syrup enough for everyone to taste.

Fish and streams in early spring: Streams break up before ponds and lakes. Several fish are quick to spawn. We go to a nearby small stream to look for fish and other stream fauna.

Early spring things: March is the time of micro-environments. We wander around the school, searching for the first dandelions, earthworms, flies, jumping spiders, etc.

Tree flowers: Responding to the longer days, trees flower early. We see pussy willow and aspen start the catkin season and several others quick to follow.

April: The Thawing Month

Spring migration - waterbirds: Rivers now hold many early migrants, the waterbirds. We learn common waterfowl and visit the St. Louis River to see them, a twenty-minute trip off campus.

Frogs and other amphibians: With the thaw, ponds are the location of calling and mating frogs. We listen and look for common species. No egg collecting is done.

The pond in spring: The water is still cold, but the spring pond is filled with life. The eggs and larvae of many organisms are different from the adults we saw on earlier visits.

May: The Greening Month

Spring wildflowers: Since the leaves are still not on the trees, sunlight penetrates to the forest floor. We seek out and learn many of the ephemeral wildflowers.

Spring and summer songbirds: Spring migration is at its peak in May. Warmer weather brings myriad insects, and the songbirds, many of which nest here, return. We listen and look for them.

Lesser-loved critters: As the school year comes to an end, we go outside more often and are more likely to come in contact with wood ticks, mosquitoes, black flies, etc. We learn about these.

The phenology-based Natural Science course has been very successful and has been adapted by colleagues for use with elementary, middle and secondary classes. Both students and parents have shared with me how observant they have become as a result of this class. They report that family outings are now enriched with comments about local plants and animals, and most remark that they never knew so much was so close by.

As we leave the 20th century, we and our students are living in a world of shrinking natural habitat and diminishing opportunities for interacting with nature. The phenology-based approach to Natural Science helps to counter this trend. By putting students in touch with nature on a daily basis, by familiarizing them with local flora and fauna, and by teaching and reinforcing the skills of observation, we can help them build the foundation of a lifelong appreciation of the richness of the natural world around them. Only then can we expect young people to care enough about the environment to make the effort that will be needed to save it from the demise that may now appear inevitable.

Selected Bibliography

Borland, Hal. *Sundial of the Seasons*. New York, NY: J.B. Lippincott Co., 1964.

—. *Book of Days*. New York, NY: Alfred A. Knopf, 1976.

—. *Twelve Moons of the Year*. New York, NY: Alfred A. Knopf, 1979.

Gilbert, Jim. *Jim Gilbert's Nature Notebook*. Chanhassen, MN: Minnesota Landscape Arboretum, 1979.

—. *Through Minnesota's Seasons with Jim Gilbert*. Chanhassen, MN: Minnesota Landscape Arboretum, 1987.

Serrao, John. *Nature's Events*. Harrisburg, PA: Stackpole Books, 1992.

Teale, Edwin Way. *Circle of the Seasons*. New York, NY: Dodd, Mead, and Co., 1987.

—. *A Walk Through the Year*. New York, NY: Dodd, Mead, and Co., 1987.

Weber, Larry A. *Backyard Almanac*. Duluth, MN: Pfeiffer-Hamilton, 1996.

Wilber, Jerry. *Wit and Wisdom of the Great Outdoors*. Duluth, MN: Pfeiffer-Hamilton, 1993.

Larry Weber teaches science at The Marshall School in Duluth, Minnesota, and is the author of *Backyard Almanac: A 365-day guide to the plants and critters that live in your backyard*.

Reprinted with permission from "*Green Teacher*": 54: 26-29, published Winter 1997-1998