Those of us involved in environmental education in the early 21st century face a formidable challenge. Environmental degradation continues even as we try to tell the next generations 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 35 years in teaching, 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 seedpod 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 might exclaim. Ask your students to name ten animals and most will name domestic animals or animals from other parts of the world. Given how little many of our students see or know of the natural world right outside their 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 or know about? I believe that part of our task as environmental educators is to fill this gap in students’ education and awareness, and to give students a positive healthy view of their planet, starting with the abundance and variety of nature nearby. For the past 20 years, I have been teaching a natural science course to seventh graders that seeks to do just that.

The curriculum I have developed is based on phenology, which is, 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.” Students learn about local flora and fauna, track the weather, and closely monitor the progression of the seasons. Through the year, they develop the skill of observation, gain an awareness of seasonal changes in local flora and fauna, and become more attuned to the environment generally. They come to see that nature is not “somewhere else” but a dynamic presence in their daily lives.

This phenology-based natural science course has been very successful and has been adapted in its entirety or modified 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.

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 can help us counter this trend. By putting students in touch with nature on a daily basis, by encouraging them to become familiar with local flora and fauna, and by teaching and reinforcing their 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.

Design of the course

This phenology natural science course operates around three unique conditions:

- We do not use a textbook.
- We regularly use the outdoors as a classroom.
- 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 (see A Typical Week sidebar, below). 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. To add spontaneity and excitement, students are encouraged to look for other interesting things along the way. Students observe and make notes on the phenology topic of the walk and some of these unanticipated finds, as well as on weather and ground conditions.

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 taxing to a 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 establishes a routine. As in the indoor classroom, we have a strict code of conduct for how we act toward one another and how we treat organisms that we find. (See Tips and Rules sidebar.) Knowing what to expect from me and what is expected of them helps us to build a pleasant working rapport. Most students find that they enjoy the walks even when the weather is not ideal.

Class procedure

Regular class procedure revolves around five main components.

Weather: Temperatures and precipitation are recorded regularly; 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 watch 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, students learn to predict what they are likely to find on our outdoor walks.

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 are kept for such weather events as freezing, thawing, or snowfall (see example, page 5). 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 such long-term trends 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 for observation. All collected organisms are returned to where they were found within a day of being caught.

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

---

A Typical Week

These suggestions can be modified for longer or shorter periods.

**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 slides

**Wednesday:** outdoor walk to look for examples or evidence of the phenological topic, take notes, and make sketches

**Thursday:** go over findings from the walk and continue discussion of the topic

**Friday:** students hand in a written report summarizing the walk and findings, and then take a quiz on the topic, often done in cooperative groups
Phenology topics by month

The timing of the 30 phenology topics described below may vary in some years, but this is a desirable sequence, as it reflects natural patterns through the school year. 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, often on the school lawn. They are easy to find and lead to good discussions and activities.

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

  * Fall wildflowers: We go into meadows filled with asters, goldenrods, sunflowers, clovers, and many other wildflowers to 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 them.

October: The Leaf Drop Month

* Insects: On warm mild days, insects are very common in meadows. We catch, observe, and release many. We also find galls and leaf miners.

  * Spiders: Mild autumn days are excellent for catching, observing, and releasing spiders in meadows, lawns, and ballooning in the bare trees.

  * Ponds in fall: A visit to a nearby pond before freeze-up reveals the diversity of aquatic life. Many organisms are caught, observed, and released.

  * Small mammals: With leaves dropping, we look for signs of small mammals getting ready for winter. We livetrap, observe, and release a few.

November: The Cloudy Freeze-up Month

* Non-flowering plants: With leaves off trees, we learn about small plants such as mosses, club mosses, and ferns, which are easy to see before they are covered by snow.
Animal signs: November is a good time to see (even in the snow) nests, gawings, caches, droppings, and other indications of animal presence.

Animal tracks: In early light wet snows, many mammals are active and leave their stories for students to observe in lawns, meadows, and woods.

December: The Dark Month

Large mammals: Having been introduced to animal signs and tracks last month, students are on the lookout for large mammals. We rarely see many large mammals but we recognize their signs and tracks.

Winter birds: With the advent of cold weather and snow, we observe birds at feeders as well as other birds that winter with us. We make and maintain a bird feeder at our school.

Natural lights: In the darkest week, in anticipation of the solstice, we look more closely at natural light and discuss colors of sky, ice, and snow.

January: The Cold Month

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

“You taught me new and wonderful things!”
“It’s cool to know what you’re looking at when you’re outside.” — Students

Fall and Spring Phenology Charts

<table>
<thead>
<tr>
<th>Fall Weather</th>
<th>Spring Weather</th>
<th>Spring Animals</th>
</tr>
</thead>
<tbody>
<tr>
<td>First frost</td>
<td>First 50°F, 60°F, and 70°F</td>
<td>First spring robin</td>
</tr>
<tr>
<td>First 20°F, 10°F, and 0°F</td>
<td>Last below 0°F, 10°F, and 20°F</td>
<td>First red-winged blackbird</td>
</tr>
<tr>
<td>First Below 0°F</td>
<td>Last freezing</td>
<td>First tree swallow</td>
</tr>
<tr>
<td>Last 70°F, 60°F, and 50°F</td>
<td>Last snowfall</td>
<td>First killdeer</td>
</tr>
<tr>
<td>Ground frozen</td>
<td>Last snow to melt</td>
<td>First great blue heron</td>
</tr>
<tr>
<td>Ice on puddles</td>
<td>First spring rain</td>
<td>First migrating geese</td>
</tr>
<tr>
<td>Ice covering nearby pond</td>
<td>First spring thunder shower</td>
<td>First grouse drumming</td>
</tr>
<tr>
<td>Ice covering nearby lake</td>
<td>Ice off nearby pond</td>
<td>First bird’s nest</td>
</tr>
<tr>
<td>First snow flurry</td>
<td>Ice off nearby creek</td>
<td>First spring chipmunk</td>
</tr>
<tr>
<td>First snow of 2”</td>
<td>Ice off nearby lake</td>
<td>First woodchuck</td>
</tr>
<tr>
<td>First snow of 4” or more</td>
<td>Last rain</td>
<td>First bear</td>
</tr>
<tr>
<td>Last rain</td>
<td>Last thundershower</td>
<td>First bat</td>
</tr>
<tr>
<td>Fall Plants</td>
<td></td>
<td>First baby rabbit</td>
</tr>
<tr>
<td>Peak of mushroom growth</td>
<td>Spring Plants</td>
<td>First snake</td>
</tr>
<tr>
<td>Peak of deciduous tree color</td>
<td>Green grass</td>
<td>First turtle</td>
</tr>
<tr>
<td>Peak of tamarack tree color</td>
<td>First lawn-mowing</td>
<td>First frog</td>
</tr>
<tr>
<td>Leaves off trees</td>
<td>Leaves on deciduous trees</td>
<td>First frog calling</td>
</tr>
<tr>
<td>Last flower still in bloom</td>
<td>Sap flowing</td>
<td>First frog eggs</td>
</tr>
<tr>
<td>Fall Animals</td>
<td></td>
<td>First spring mosquito</td>
</tr>
<tr>
<td>First migrating geese</td>
<td></td>
<td>First butterfly</td>
</tr>
<tr>
<td>Peak of hawk migration</td>
<td>First spring rain</td>
<td>First monarch</td>
</tr>
<tr>
<td>Peak of bald eagle migration</td>
<td>First tree swallow</td>
<td>First dragonfly</td>
</tr>
<tr>
<td>First snowy owl</td>
<td>First spring thunder shower</td>
<td>First bumble bee</td>
</tr>
<tr>
<td>First redpoll</td>
<td>Ice off nearby pond</td>
<td>First jumping spider on wall</td>
</tr>
<tr>
<td>Last snow</td>
<td>Ice off nearby creek</td>
<td>First orb web</td>
</tr>
<tr>
<td>Last snake</td>
<td>Ice off nearby lake</td>
<td>First wood tick</td>
</tr>
<tr>
<td>Last frog</td>
<td></td>
<td>First earthworm</td>
</tr>
<tr>
<td>Last butterfly</td>
<td>Spring Animals</td>
<td>Smelt running</td>
</tr>
<tr>
<td>Last grasshopper</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Last mosquito</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Last chipmunk</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Ponds in winter: With augurs, we drill through the ice covering the pond and sample the water to examine it for pond creatures. This is a good time to introduce the use of microscopes.

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

February: The Dry Month

Humans in winter weather: With a little planning and understanding of winter conditions (i.e., wind chill, hypothermia, frostbite), students learn how to be outside safely.

Winter wildflowers: We learn about different perennial plants (“weeds”) that persist throughout winter, often looking dead and stick-like, and how they differ in their methods of seed dispersal.

Deciduous trees in winter: Trees are bare but can be identified by their shape, color, bark, and various twig conditions. We make and use a simple dichotomous key.

March: The Crusty Snow Month

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

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

Early spring events: As this is the time of micro-environments, we wander around the school searching for the first dandelions, earthworms, flies, and jumping spiders.

Tree flowers: We observe trees that flower early, responding to the longer days; pussy willow and aspen start the catkin season and several others follow.

April: The Thawing Month

Spring migration — waterbirds: Rivers now hold many waterbirds as early migrants. We learn common waterfowl and visit the St. Louis River to see them, a 20-minute bus trip away.

Frogs and other amphibians: With the thaw, ponds are the location of calling and mating frogs. We listen and look for common species, but do not collect eggs.

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

May: The Greening Month

Spring wildflowers: Since the trees are still leafless, 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 and warmer weather brings myriad insects. We listen and look for songbirds, many of which nest here, as they return.

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

Larry Weber has taught middle school natural science for more than three decades at The Marshall School in Duluth, Minnesota. He is the author of Backyard Almanac: A 365-day guide to the plants and critters that live in your backyard, and two regional guide books, Butterflies of the North Woods and Spiders of the North Woods.

RESOURCES


