



Phenology:

Emergence, green up and migration, a lesson of observations around you.

Grade Level: Middle School but could be tailored for many different age groups.

Essential Question:

What phenological events are happening around you? What can these observations tell you about your local ecosystems?

Performance Expectations: Next Generation Science Standards:

MS-LS2-1

Analyze and interpret data to provide evidence for the effects of resource availability on organisms and populations of organisms in an ecosystem.

MS-LS2-2

Construct an explanation that predicts patterns of interactions among organisms across multiple ecosystems.

<http://www.nextgenscience.org/msl-s2-ecosystems-interactions-energy-dynamics>

Objectives:

At the end of this lesson, your students will be able to:

- *Understand* what it means to be a naturalist and how to keep a field journal.
- *Recognize* significant phenological events in the field.
- *Collect* detailed field notes, and import findings into WyoBio.

Assessment opportunities:

At the end of this lesson, you will be able to assess students through:

- The student's data collection
- Student's field notes and journal entries.

Background information

Phenology, the study of seasonal changes such as fall colors, migrations, green-up in the spring or flowering timing, has a long history with being a naturalist. Naturalists, or just avid observers of our natural world, have for centuries taken detailed field notes about species they are observing and what stage they are in their life-cycle. These field notes and historical observations are being used as baseline data to compare to ecosystems and species today and see if there are any dramatic changes in phenological timing of significant events.

Why is this important? Why do we care? Migration of birds or overland animals time their movements on the availability of certain foods along their path. Think about the difference of your grass becoming green compared to the time in which you would expect the mountains to be snow free. A mismatch in migration and food availability could be detrimental to the life expectancy or survival rates of these animals. Observations of local migrations in comparison to local food availability could provide important data to scientists, as well as to your own understanding of the complex interactions of plants, animals and climate.

The use of field journals have been used for centuries by naturalists, such as lewis and clark, Darwin and more. They can be very organized and follow specific guidelines, Grinnell, or can be a way for students to engage with the natural world through their senses and skills. Overall, field journal is very different than a student's lab book they may have for science class; here are some great examples of this is:

Basic info with extra links: <http://www.kabt.org/2012/11/23/laboratoryfield-notebooks-in-biology-classrooms/>

Keeping a Nature Journal: http://www.amazon.com/Keeping-Nature-Journal-Discover-Seeing/dp/1580174930/ref=sr_1_12?ie=UTF8&qid=1426877707&sr=8-12&keywords=field+journal

How to keep a naturalists notebook: http://www.amazon.com/Naturalists-Notebook-Susan-Leigh-Tomlinson/dp/0811735680/ref=pd_sim_b_2?ie=UTF8&refRID=1GSK0TKDFJ7GCI14AEMQ

Also looking for images to inspire students is very helpful; enter "field journals" in any web search engine under the image section and a plethora of great examples come up!



Part 1: Being a Naturalist

Materials:

- Field journals (notebooks)
- Pencils (color and regular)
- Natural items
- Sensory stations materials

Time Commitment:

1 hour +

Preparation:

- Have copies of field journals available, either copies of certain pages or whole journals (some examples are attached, but can easily search for some on the web).
- Collect found natural items (branches, flowers, pinecones etc).
- Have field guides with paintings and drawings (not pictures) available for students to look at. Good resource are Audubon books and Olaus Murie's work.
- Watch: <https://www.youtube.com/watch?v=Ao98kilu5xU> (a great example of the power and interdisciplinary work involved in field journaling, in case you needed to be sold on the idea).

Directions:

In this portion of the lesson is meant for students to engage with field journaling, understand the history of it and why it's still important.

1. After passing out examples of journaling projects ask students what they notice.

Answers may include: lots of drawing, some writing, can be about anything (living or non-living).

2. From here explain that being a "naturalist" comes in many different forms, from drawing and writing about

the natural world to creating podcasts or television shows in the more recently.

3. Depending on the age of your students set up varying levels of sensory stations. This is meant to prompt observation skills and focusing on details. Having a theme such as plants or a life cycle of a certain species could be helpful. Example of a few stations and prompted questions include:

Theme: It's not a Pine all the time

- a. Sight (have three different branches, a pine, spruce and fir): by just looking at the needles, draw a Venn diagram explaining the similarities and differences that you see.
- b. Touch (have small piles of the three types of needles: spruce, pine and fir): using only words, have students describe the differences of the three in as much detail as possible. Hint: have them roll the needles between their fingers, looking for slight coloration differences or if they are soft or hard to the touch.
- c. Blind touch (in large paper bags put one cone per type: spruce, pine or fir and staple the bag so the students can't look inside but only stick their hand in): NO WORDS, only draw what you are feeling. Make sure to draw all three... are there any differences or similarities?

4. Class Brainstorm: As a class, identify any key learnings. Were they able to distinguish the different species, and, if so, any guess which is which. Why is this important for being a naturalist? Emphasize that being able to identify species correctly is the first step in being a naturalist. If time permits, hand out field guides for students to look through and try key out a certain species. This will become important for the field trip.



Part 2: the POWER of Phenology

Materials:

- Field guides
- Journals
- Pencils

Time Commitment:

1 hour+

Preparation:

- Have access to internet
- Have computer lab or computers available to students

Directions:

Now that students can begin to identify different species, or recognize subtle differences the same species, it is time to introduce phenology.

As talked about in the inquiry project, phenology has many implications to research going on today. Specifically understanding the significance of animal migrations and food supplies here in Wyoming.

Therefore, having students being to recognize the complex relationship of climate, plants and animals is not only relevant but also valuable to current research.

1. Intro to phenology: Use the TED-ed interactive website to watch a quick video on phenology and take a virtual online quiz as a whole class:
<http://ed.ted.com/lessons/phenology-and-nature-s-shifting-rhythms-regina-brinker>

2. Have students work through the phenology inquiry project on WyoBio's website, or create their own phenology question that could be answered using this mapping software.

The inquiry project online uses Sandhill cranes as an example for "collecting" data and making a hypotheses on when we can expect to

see certain things in nature happening, such as migrations.

3. Writing prompt: Why do you think long-term data collection is important? What was it able to tell you?

Once students have had time to answer these and any other questions you wish, frame their field trip in terms of contributing to, or starting a long term dataset.

Depending on if you want to make this an annual unit, creating a standardized methods collection process (species, location and dates) could provide important data to WyoBio and regional information on species phenology.

4. Field trip brainstorm: now that the students have researched one phenological event, prep them for going into the field.

Depending on the season, and where you are ask them about what phenological event they might be able to see near-by? As a class come up with a species they want to observe, and any predictions on what they may see. Make a class hypothesis and design how you are going to collect data.

Some examples may include: flower presence, animal signs, leaves changing colors, green-up of grasses or bud bursting (aspen cottonwood ect.).



Part 3: Phenology naturalist in action

Materials:

- Field guides
- Journals
- Pencils
- Binoculars
- Data sheets
- Cameras/phones

Time Commitment:

1 Day (or length of field trip)
1hours+ depending on length of
computer entry time and wrap up.

Preparation:

- Have data sheets available for students, depending on collection process.
- Use of computers and internet available for students
- Depending on where the hike is have necessary equipment for students (clothing, sunscreen, parent chaperones etc.)
- Make necessary arrangements for field trip

Directions:

1. Review the goal of field trip observations before leaving and make students have everything they need.
2. When in field, have students collect data on their given phenological event. This could be done individually, or in small groups. Think about having them observe different areas depending on what it is you are looking for or where you are at, such as open meadow areas versus riparian areas.
3. Once students have collected the data on their phenology project have each student do one detailed species account from anything they found in the field. This way students can provide data on more than just the group's species but also spending time working on their own naturalist skills from observing, using field guides and taking notes (writing and drawing).
4. Data! Before leaving the field site review the findings that students came across. Were they able to support their hypothesis? If not, why not? If so, what does this tell us about the phenology occurring in the area at the time?

Prompt students with any other questions, and final journal entry you wish before leaving.
5. Once you are back in the classroom decide which observations you want the students to import to WyoBio. Give students ample time to finish this, uploading photos, species name, date and relevant information that they recorded.

