Mapping and Graphing your Phenology Observations


Photo Credit: Brian Powell

Grade Levels
Undergraduate

Overview
Students will develop their own research field site, learn to make observations and collect data outdoors, build their own dataset and then will learn to plot graphs of that data. They will also learn to use GPS and mapping tools and resources. They will be asked to make predictions and claims and explain their reasoning, and then try to find evidence to support (or refute) their claims. They will analyze the data according to site variability and will create graphs showing two-group comparisons.

Real-world Connection
Students are encouraged to infer meaning from the graphs, engage in speculation, and learn to articulate and support claims and conclusions. Students' graphs can be used as a basis for classroom discussion focused on telling stories with data, and exploring new lines of inquiry.

Citizen Science Connection
This activity can be completed with or without a *Nature's Notebook* account. Completing it with an account can provide an opportunity to teach students about the importance of citizen science, and how their contributions help us to better understand the word around us.

Estimated Time
One 30-minute class period to discuss site selection, a field observation plan and schedule

One 30-minute class period to make predictions and claims, and record ideas and notes in scientific notebooks.

One or two 30 or 40-minute class periods for setting up the site, labeling plants, recording the first dataset and mapping locations with GPS and topographic maps

One 40-minute class period for scaffolding students on making graphs that compare two groups.

One 40-minute class period to graph data and talk about what the graphs show

One 30-minute class period to plan how to present their results to the rest of the class or another group of students.

Learning Objectives

Participants will be able to:

- Learn how to use GPS and maps, and/or Google Earth
- Learn to prepare a field site for research
- Learn to make observations and collect data in the field
- Learn how to create graphs showing comparisons between two or more groups
- Practice making predictions, engaging in inference and speculation, and interpreting information contained in graphs
- Learn about climate and ecological principles affecting species, i.e., that the timing of phenological events may vary according to geography, microclimate, or climate change.

Conducting the Activity

Materials

Resources needed

- GPS unit(s) (optional)
- Topographic maps and/or Google Earth
- USA-National Phenology Network *Nature's Notebook* data sheets
- Field kit materials as needed (flagging tape, plant markers, marker pen, hand lens, etc)
- Science notebooks
- Computer and internet connection
- Graphing supplies (by hand or computer)

Engage

Connect to prior knowledge

- Engage in a discussion with your students to answer the following questions:
  - How can we use GPS and mapping tools to plot the locations of research plants?
  - How do we conduct proper field research, including site selection and data collection?
  - How can we graph data to compare two groups?
  - Can we find evidence to support our predictions about plant growth?

Explore

Hands-on learning

1. Decide on a flowering plant species that is common in your area to observe.
2. Decide on when and how to collect the data. Use **this guide** to find at least one field site that has multiple individuals of the flowering plant species that you chose to observe. It's good to choose at least 5 sites with different characteristics as a class, and at least 3 plants at each site, so you have a greater likelihood of seeing trends or differences between sites.
3. If you will be observing a number of different sites, you may wish to assign small teams to keep track of different sites.
4. Mark any individual plants you are observing; establish a schedule and system for making regular observations.
5. Your students will need a science notebook or journal to be used in the course of this project. Talk about basic information that should be included in a science-minded journal. This depends on the activities and research but might include things like dates, weather information, careful observations of species, phenophases, behavior, predictions and hypotheses, drawings, samples (pressed leaves or flowers) or notes about the process and any limitations.

RESOURCES
Adapted from:

Signs of the Seasons: a New England Phenology Program: Mapping and Graphing your Phenology Observations

By: Beth Bisson, Medea Steinman, and Esperanza Sancioff

NOTES ON ACTIVITY

Conducting the Activity

Explore

Hands-on learning continued...

6. Use USA-National Phenology Network (NPN) Data Sheets or mobile app to record your observations. Establish a plan for logging your data into the NPN online database, *Nature's Notebook*, and make sure the data are added to the database. Instructions for how to do this can be found on the ***Nature's Notebook*** **website.**
7. Use a GPS unit and a topographical map with a Latitude/Longitude grid, or Google Earth, to mark the locations of your class phenology observation sites (schoolyards, parks, students' homes, etc.).
8. Gather and record other data about each of your sites, such as the elevation, whether they are sunny or shady, fertilized or unfertilized, watered or not watered, etc.
9. Based on your map and your site data, ask the students to make claims/predictions about when/where the flowers and fruits will appear first or last during their observation period. Then ask them to record why they made the claims they did, and to list what types of evidence they'll need to collect to support their claims.
10. Have each student use record their selected plant phenology at least weekly at their marked site for several weeks in early spring.
11. Use the data on the datasheet (in addition to entering it online at www.usanpn.org) and your site characteristic data to graph the timing of your flowers and fruits against the other site characteristics to test their claims.
    For example, if they thought sites at higher elevations would bloom later, then group all of the higher elevation observations together, take an average first bloom date, and compare with the average first bloom dates of all the lower elevation sites. Note: Creating graphs that show average differences (if there are any) between two groups will be most useful for this activity.
12. For most students, it is good to keep this very simple – only graph the phenology timing with one other site characteristic at a time.
13. Ask the students to look at their graphs and check their claims and write why they do (or do not) show the evidence they needed to support their claims. If the graphs don't support their original claims — do they show any other surprising differences between sites, or other trends they didn't expect?
14. Ask the students to present their results to the rest of the class/group, and explain what their data show about the plants they observed. What would they do differently next time? What other claims might they test?

Explain

Listening and communicating understanding

Ask students to interpret the graphs and explain what they show. Engage them in speculation about meaning in the graph. Talk about any other questions the graphs raise. Were there other trends or surprising results? How might they conduct the research differently next time? Point out to them the value of engaging in these kinds of speculations and inquiry and how this process is central to the experience of "doing" science. For any questions that you can't answer now, how might you find the answers? Do they need additional data to answer their questions? If so, what additional information would be most useful? Often, it is essential to come up with recommendations for further research or inquiry.

Extend

Group projects, real world connections

Consider expanding the project to include more diversity in study sites, perhaps by partnering with other teachers and students at other schools. Also visit the USA-National Phenology website and try out the **Phenology Visualization Tool**. Here you can download and visualize data, view the map gallery and view historic data sets. You may find other sets of dandelion data in other parts of the country to compare with yours.