DATA Nugget

Springing forward:
Do flowers flower later or earlier depending on temperature?

Featured scientists: Shaun Davis, Mark Hammond, Elizabeth Schultheis, and Jen Lau
from Michigan State University

This is a modified version of the original Data Nugget that has been designed to be used on the DataClassroom web-app. The original pencil and paper activity can be found here on the Data Nuggets website.

Research Background:

Image right: Sean Mooney, a high school researcher, collecting phenology data in the climate change experiment. He is recording the date that the first flowers emerge for dame's rocket.

Every day we add more greenhouse gases to our air when we burn fossil fuels like oil, coal, and natural gas. Greenhouse gasses trap the sun's heat, so as we add more the Earth is heating up! What does climate change mean for the species on our planet? The timing of life cycle events for plants and animals, like flowering and migration, is largely determined by cues organisms take from the environment. The timing of these events is called **phenology**. Scientists studying phenology are interested in how climate change will influence different species. For example, with warming temperatures and more unpredictable transitions between seasons, what can we expect to happen to the migration timings of birds, mating seasons for animals, or flowering times of plants?

Plants are the foundation for almost all life on Earth. Through photosynthesis, plants produce the oxygen (O_2) that we breathe, food for their own growth and development, food for animals and microbes, and crops that provide food and materials for human society. Because plants are so important to life, we need to find out how climate change could affect them. One good place to start is by looking at flowering plants, guided by the question, how will increased temperatures affect the phenology of flowering? One possible answer to this question is that the date that flowers first emerge for a species is

driven by temperature. If this relationship is real, we would expect flowers to emerge earlier each year as temperatures increase due to climate change. But if flowers come out earlier and earlier each year, this could greatly impact plant reproduction and could cause problems for pollinators who count on plants flowering at the same time the pollinators need the pollen for food.

Left: An aerial view showing one of the heated plots. The silver boxes are electric ceramic heaters, raising the temperature inside the ring.

Right: Dame's rocket growing in the field. This species of mustard was introduced to the US from Eurasia.

Shaun, Mark, Elizabeth, and Jen are scientists in Michigan who wanted to know if higher temperatures would lead to earlier flowering dates for plants. They chose to look at flowers of dame's rocket, a leafy plant that is related to the plants we use to make mustard! Mark planted dame's rocket in eight plots of land. Plots were randomly assigned to one of two treatments. Half of the plots were left to experience normal temperatures (**normal**), while the other four received a heating treatment to simulate climate change (**heated**). Air temperatures in heated plots increased by 3°C, which mimics climate change projections for what Michigan will experience by the end of the century. Mark, Elizabeth, and Jen measured the date that each plant produced its first flower, and the survival of each plant. The scientists predicted that dame's rocket growing in the heated plots would flower earlier than those in the normal plots.

Activity

Scientific Question: How does temperature influence the phenology of dame's rocket?

<u>*What is the hypothesis?*</u>

1) Find the hypothesis in the Research Background and paste it here. A hypothesis is a proposed explanation for an observation, which can then be tested with experimentation or other types of studies.

   Hypothesis:

<u>*Scientific Data:*</u>

Use the data (see data table in *Table* tab) to answer the scientific question.

2) Look at the data table and your scientific question, and decide which variables might be most important to answer the scientific question. Which did you choose?

   Independent variable:

   Dependent variable:

3) <u>*Create your graph*</u> <u>*and paste below*</u>:

4) Add a line of best fit with the *Regression line* check box. Refer to your graph as evidence in your answer. Paste your graph which includes your regression line, below:

5) Identify any changes, trends, or differences you see in your graph. Include your graph and specifically refer to it when describing those changes, trends, or differences.

6) Make a claim that answers the scientific question.

7) What evidence was used to write your claim? Reference specific parts of the table or graph.

8) Explain your reasoning and why the evidence supports your claim. Connect the data back to what you learned about climate change and how this could affect flowering time.

9) Did the data support the scientists' hypothesis? Use evidence to explain why or why not. If you feel the data were inconclusive, explain why.

Your next steps as a scientist:

10) Science is an ongoing process. What new question(s) should be investigated to build on Shaun, Mark, Elizabeth, and Jen's research? What future data should be collected to answer your question(s)?

These questions are a digital extension of the original Data Nuggets activity. The data manipulation and graphing tasks within are best completed here on DataClassroom.

11) What conclusion can you draw about temperature's influence the phenology of dame's rocket? Make a graph with Net Ecosystem Exchange on the Y-axis and year on the X-axis. Add a line of best fit with the *Regression line* check box. Refer to your graph as evidence in your answer. You can skip this question if you already made this graph in the Data Nugget activity above.

12) Time to verify the visual trends with numbers! Find the mean and standard deviation for the data by clicking on Descriptive Stats. Select mean-based, or median-based. Include a screenshot of your new graph here:

13) What evidence does the mean, and standard deviation provide towards the trend you stated in #5?

14) Use the Graph Driven Test button (located just left of the blue "Appearance" button) to carry out a statistical test to determine the significance of those trends or changes.

Which test did you run? _____

Include a screenshot/copy of your test results here:

15) What do the results of that test suggest about your selected variables, and the trends you saw on your graph that you listed in #5?