

DATA *Nugget*

Bringing the heat

Featured scientists: Amy Iler (she/her) and Dylan Simpson (he/him) from the Chicago Botanic Garden

Research Background:

Climate change is causing Earth's average temperature to rise, but warming is not the only change happening. Climate change can affect many parts of an ecosystem at the same time. For example, in the Rocky Mountains, temperatures are getting warmer, and the climate is also getting drier. This means that summers have more hot and dry periods, while winters are bringing less snow. Warmer temperatures and less snowfall cause the snow to melt earlier in the spring.

Amy and Dylan are two scientists working in the Rocky Mountains. They are studying plant **phenology**, or seasonal timing of events related to growth and reproduction. Visiting year after year, Amy and Dylan noticed dramatic springtime changes. They were able to observe these differences with their own eyes, before they took a scientific approach.

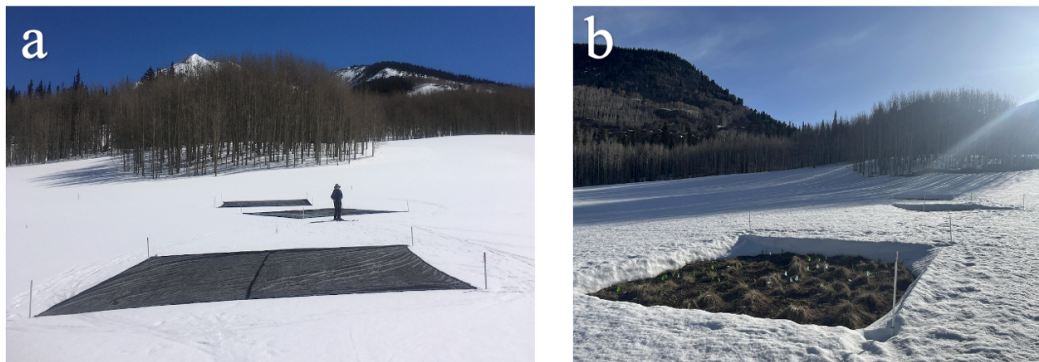


Dylan taking a break during field work.

To support their observations, they turned to historic long-term datasets. They confirmed three important patterns. First, since the 1970s, plants are flowering earlier. Second, over the same time frame, snow is melting earlier and exposing bare ground. Finally, the date that plants are flowering is strongly related to snowmelt date. This suggests that snowmelt date might be a cause of earlier flowering. However, these datasets were also a collection of observations over time. Observations alone cannot prove snow melt is causing earlier flowering. There are too many factors that are changing at the same time.

To tease apart what is going on, Amy and Dylan needed to design an experiment. A carefully designed experiment can isolate factors that may be affecting a variable while controlling other conditions. Amy and Dylan thought that plants rely on the timing of snowmelt as a cue for their phenology.

To test their hypothesis, Amy and Dylan set up an experiment that manipulated the timing of snowmelt. They chose a field site in a Rocky Mountain meadow. This site contained a mix of many plant species, and they focused on three: two-lobed larkspur (*Delphinium nuttallianum*), tall larkspur (*D. barbeyi*), and Lewis flax (*Linum lewisii*).



Photos of the experimental treatment: a) with black tarps on top of the snow and b) with tarp removed and bare ground underneath.

Like the surrounding landscape, the meadow was covered in snow over the winter. Amy and Dylan established 16 plots within the meadow. In the spring of 2025, they placed black tarps on half the plots. The tarp warmed in the sun and melted the snow under it. The tarps are removed as soon as bare ground is visible below the tarp. The snow in these 'experimental' plots melted two weeks earlier than the 'control' plots without tarps:

Treatment	Average snowmelt day	Standard deviation
Control	123	2.9
Experimental	108	1.0

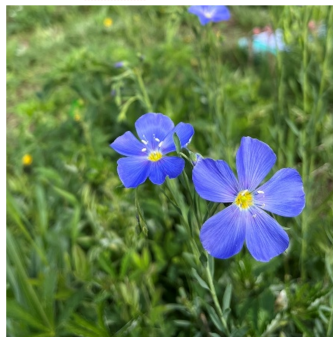
Amy and Dylan then tracked the development and flowering of plants in both plots. They recorded the first flowering date of each individual plant. For their data they converted calendar dates to **day of year**. They started with January 1 as Day 1 and continued to count up by one for each day. They predicted that plants in the experimental plots will flower earlier than plants in the control plots.

Name _____

Delphinium barbeyi



Linum lewisii



D. nuttallianum



Scientific Questions: Does early snowmelt cause plants in a Rocky Mountain meadow to bloom earlier? Is the effect the same across species?

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

Scientific Data:

Use the data below to answer the scientific questions:

Species	Treatment	Average first flowering date	Standard deviation	Standard error
<i>D. nuttallianum</i>	control	158.4	3.1	0.4
<i>D. nuttallianum</i>	experimental	150.5	3.9	0.5
<i>L. lewisii</i>	control	184.0	6.0	0.8
<i>L. lewisii</i>	experimental	180.3	5.7	0.8
<i>D. barbeyi</i>	control	191.4	6.5	0.7
<i>D. barbeyi</i>	experimental	189.4	5.3	0.5

What data will you graph to answer the question?

Independent variable(s): _____

Dependent variable: _____

Name _____

Draw your graph below: Identify any changes, trends, or differences you see in your graph. Draw arrows pointing out what you see and write one sentence describing what you see next to each arrow.

A large rectangular area with horizontal lines, intended for drawing a graph. It consists of approximately 25 horizontal lines spaced evenly apart.

Interpret the data:

Make a claim that answers the scientific questions - Does early snowmelt cause plants in a Rocky Mountain meadow to bloom earlier? Is the effect the same across species?

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

Name_____

Explain your reasoning and why the evidence supports your claim. Connect the data back to what you learned about climate change and plant phenology.

Did the data support Amy and Dylan's hypothesis? Use evidence to explain why or why not. If you feel the data are inconclusive, explain why.

Your next steps as a scientist: Science is an ongoing process. What new question(s) should be investigated to build on Amy and Dylan's research? How do your questions build on the research that has already been done?