

DATA *Nugget*

Flowers chasing spring

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

Research Background:

How does a plant know when to make a flower? Their **phenology**, or seasonal timing of growth and reproduction, can be driven by many things. When the weather warms in the spring, many plants start to make flowers when temperatures are just right. Other plants follow the number of hours with sunlight. In one very particular system, plants might actually be following the timing of snow.

High up in the Rocky Mountains, scientists are studying plants at elevations where snow covers the ground for six months of the year. In the spring, when the ground is still covered in snow. Plants under the snow are unable to sense the temperature of the air or sunlight hours. This means that plants may have to use a different cue, such as the timing of snowmelt, to know when to flower.

Amy and Dylan are two scientists who love and have spent a lot of time in the Rocky Mountains. While there, they noticed the springs were changing and wanted to document what they were observing. They wondered whether the date of snowmelt was changing over time. If so, were the plants responding by shifting their flower timing?

To answer their question, they looked to the work of two additional scientists. The first is David Inouye, a retired plant ecologist from the University of Maryland. David has been observing flowers at the Rocky Mountain Biological Laboratory for the last 50 years. David and his team measured phenology of 163 plant species across 36 plots in the Rocky Mountains. From early spring through summer, they surveyed their plots every two days, recording every plant species flowering in each plot.



Dylan and a field technician, Mairin Boshoven, observing plants in the Rocky Mountains.

They measured **first flowering date** as the day they observed the first flower for each species. His records show, over time plants have been flowering earlier and earlier each year.

Another scientist, billy barr (who doesn't capitalize his name), has been living and working at the Rocky Mountain Biological Laboratory since the 1970s. Initially for his own curiosity, billy started recording the weather at the Lab. He then built a weather station outside his cabin. His records have become important to many areas of research at the station. These records include billy's observations for the first date that snow was completely melted in the area, called the **date of bare ground**. Just like David noticed plants are flowering earlier than they used to, billy noticed that snow has been melting earlier as well.

Hearing about these changes in flowering date and snowmelt timing, Amy and Dylan wanted to know if changes in snowmelt timing itself could explain changes in flower timing. They thought that snowmelt triggers plant growth by exposing the ground to light, warmth, and soil moisture from melting snow. If plants start to grow earlier, they thought they will also flower earlier. This led them to predict that years with earlier snowmelt would have earlier flowering. Fortunately, David's and billy barr's datasets already include all the information needed to test this hypothesis! All they had to do was bring the two datasets together in a new way. They started with one species of plant with a purple flower, *Linum lewisii*.

Scientific Question: How does the timing of snowmelt affect flowering date for *Linum lewisii* in the Rocky Mountains?

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: For both datasets, Amy and Dylan converted the days of the year to **Julian dates**. Julian dates start with January 1 as Day 1 and continue to count up by one for each day.

Use the data below to answer the scientific question:

Species	Year	Date of bare ground	Date of first flower
<i>Linum lewisii</i>	1975	157	193
<i>Linum lewisii</i>	1976	136	186
<i>Linum lewisii</i>	1977	116	174
<i>Linum lewisii</i>	1979	152	192
<i>Linum lewisii</i>	1980	159	194
<i>Linum lewisii</i>	1981	119	171
<i>Linum lewisii</i>	1982	152	192
<i>Linum lewisii</i>	1983	160	198
<i>Linum lewisii</i>	1984	156	194
<i>Linum lewisii</i>	1985	145	188
<i>Linum lewisii</i>	1986	149	181
<i>Linum lewisii</i>	1987	132	180
<i>Linum lewisii</i>	1988	136	179
<i>Linum lewisii</i>	1989	132	178
<i>Linum lewisii</i>	1991	142	189
<i>Linum lewisii</i>	1992	124	178
<i>Linum lewisii</i>	1993	156	197
<i>Linum lewisii</i>	1994	140	178
<i>Linum lewisii</i>	1995	170	211
<i>Linum lewisii</i>	1996	141	188
<i>Linum lewisii</i>	1997	152	190
<i>Linum lewisii</i>	1998	140	183
<i>Linum lewisii</i>	1999	145	188
<i>Linum lewisii</i>	2000	131	175
<i>Linum lewisii</i>	2001	134	177
<i>Linum lewisii</i>	2002	115	164
<i>Linum lewisii</i>	2003	142	182
<i>Linum lewisii</i>	2004	129	176
<i>Linum lewisii</i>	2005	146	189
<i>Linum lewisii</i>	2006	132	170
<i>Linum lewisii</i>	2007	121	174
<i>Linum lewisii</i>	2008	153	194
<i>Linum lewisii</i>	2009	131	180
<i>Linum lewisii</i>	2010	132	176
<i>Linum lewisii</i>	2011	158	190
<i>Linum lewisii</i>	2012	114	168
<i>Linum lewisii</i>	2013	135	172
<i>Linum lewisii</i>	2014	146	182
<i>Linum lewisii</i>	2015	127	176
<i>Linum lewisii</i>	2016	139	178
<i>Linum lewisii</i>	2017	144	179
<i>Linum lewisii</i>	2018	125	166
<i>Linum lewisii</i>	2019	157	193
<i>Linum lewisii</i>	2020	129	169
<i>Linum lewisii</i>	2021	127	172
<i>Linum lewisii</i>	2022	132	173



Linum lewisii

Name _____

What data will you graph to answer the question?

Independent variable: _____

Dependent variable: _____

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.



Name_____

Interpret the data:

Make a claim that answers the scientific question, how does the timing of snowmelt affect flowering date for *Linum lewisii* in the Rocky Mountains?

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

Explain your reasoning and why the evidence supports your claim. Connect the data back to what you learned about plant phenology and the impact of warmer springs.

Name_____

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