

DATA *Nugget*

What wakes the squirrels?

Featured scientist: Cory Williams (he/him) from Colorado State University and Toolik Field Station. Written by Claire Gunder (she/they) and Rachel Rigenhagen (she/her), Avalon School, St. Paul, Minnesota.

Research Background:

The Arctic is home to a unique biome, known as **tundra**. Found at Earth's northernmost region, the tundra ecosystem is defined by frozen land. **Permafrost** is a thick underground layer of organic matter, soil, rock, and ice that has been frozen for at least two full years. Each summer as the temperature warms, a thin upper layer of frozen soil thaws, refreezing again the following winter.

Although the tundra might be far away from where most people live, it is connected to the entire globe through the atmosphere. This means it is affected by climate change, just like other places on Earth. In the tundra, increasing temperatures are causing snow to melt and the top layer of permafrost to thaw earlier each year.



Austin, a PhD student in Cory's lab, releases an arctic ground squirrel that has been tagged. Photo by Rachel Rigenhagen.

Arctic ground squirrels, also called *siksik* (pronounced shrick-shrick) in the Inuktitut language, are an important mammal species that call the tundra home. They hibernate for roughly eight months - the longest of any mammal in the world. As they hibernate, the snow and frozen permafrost insulate their burrows and protect them from severe cold. As the summer months approach, the squirrels emerge and move above ground. Their mating season begins immediately after hibernation ends. With only four months out of their burrows, they have to maximize their time!

Cory is a scientist who lives in Colorado but travels to the Arctic to do research at Toolik Field Station. For over 25 years, Cory and his research team have been studying the

ground squirrel populations. While at Toolik recently, Cory was surprised to discover that male and female ground squirrels were emerging from hibernation on different schedules. He is worried these mismatches could be due to climate change.

This made Cory wonder how ground squirrels know when to come out of their burrow. He suspected that ground squirrels use cues from their environment, such as increasing temperatures, permafrost thaw levels, or the length of time they have been in hibernation. Some of these environmental cues, such as the timing of permafrost thawing, are affected by increased temperatures. Other cues are not affected by temperature, such as the length of time squirrels have been hibernating. If males and females are using different cues, this could be why they are coming out at different times.

To investigate his idea, Cory and his research team turned to data they have been collecting over time. Each year, the research team temporarily captures squirrels. They record each squirrel's sex, give them a unique ID, and put collars on them before releasing them. The collars can detect light, which is used to know when the squirrels are above ground. For each squirrel, the team records the first date that light was detected after hibernation, called the **emergence date**. Cory used **Julian dates**, which start with January 1 as Day 1 and continue to count up by one for each day.

Cory also looked at the data on snowmelt as a potential environmental cue that the squirrels were using. Each year Cory's team installs cameras on tall towers so that they can use images to measure daily snow cover. When no snow was detected, they measured this as the **snowmelt date**. Using these two sources of data, they can look for any patterns in emergence dates and spring snow melt.

Scientific Question: Is there a relationship between snowmelt date and emergence dates for either squirrel sex?

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.



An arctic ground squirrel checking out the scientists from inside a trap. Photo by Rachel Rigenhagen.

Scientific Data:

Use the data below to answer the scientific question:

Year	Snowmelt date	Average emergence date	
		Female	Male
2000	139	121	84
2001	151	121	84
2002	137		83
2003	119	112	
2004	124	105	
2005	127		
2006	130	112	81
2007	108	112	87
2008	115	113	77
2009	119	112	87
2010	120	108	88
2011	134	112	79
2012	132	110	85
2013	131	116	88
2014	116	109	84
2015	111	105	87
2016	122	107	74
2017	136	108	85
2018	132	107	
2019	120	110	84
2020	126	112	
2021	113	105	
2022	128		
2023	135		
2024	136	115	85
2025	137	111	87

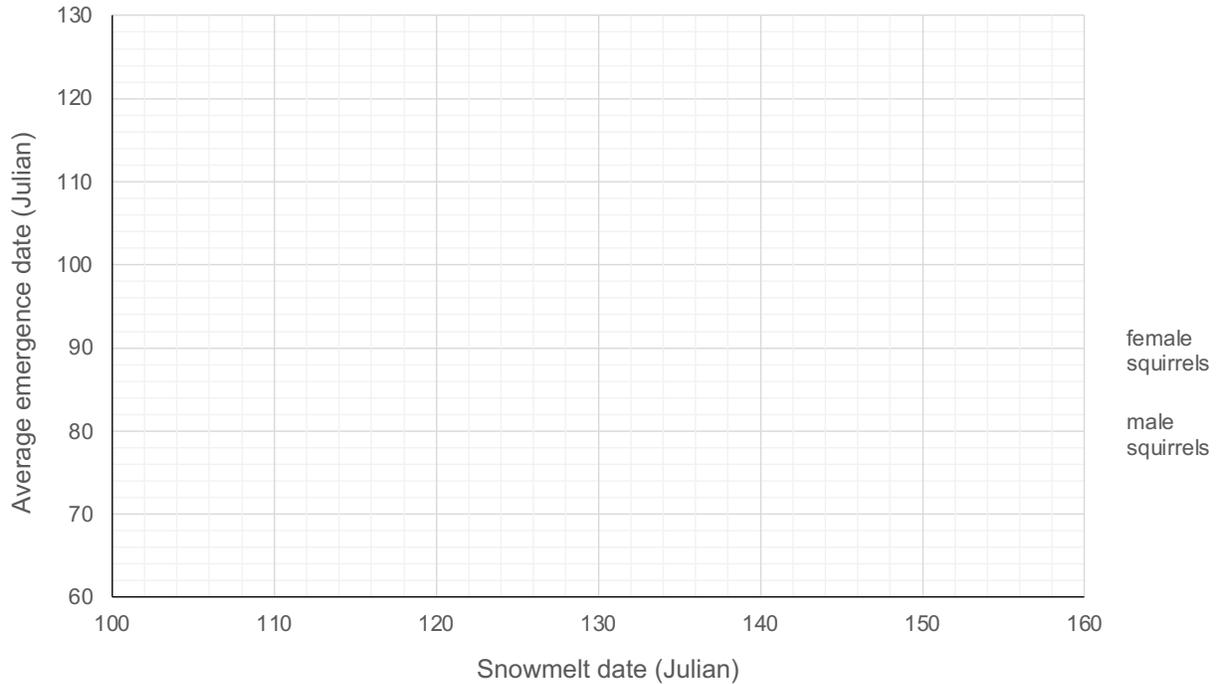
What data will you graph to answer the question?

Independent variables: _____

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.



Interpret the data:

Make a claim that answers the scientific question, is there a relationship between snowmelt date and emergence dates for either squirrel sex?

Name _____

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 what cues squirrels may use to know when to emerge.

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

Name _____

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