Name_____

DATA Nugget

Buried seeds, buried treasure

Featured scientist: Marjorie Weber from Michigan State University.
Other scientists: Frank Telewski, David Lowry, Lars Brudvig, and Margaret Fleming.
Written by: Elizabeth Schultheis and Melissa Kjelvik.

Research Background:

One of the world's longest-running science experiments lies hidden in the soil beneath Michigan State University's campus. Over 100 years ago, a scientist named William J. Beal had a question: how long do seeds survive underground? To find out, he started an experiment. In 1879 he filled 20 bottles with sand and seeds from local plants. William buried these bottles and created a map to document their location, hoping that future scientists would continue to dig them up to test whether the seeds would still grow long after his death.

These bottles and the map have been passed down from generation to generation, with each new scientist responsible for training their successor. To protect the seeds, only a select few scientists are let in on the secret. Today a team of four plant biologists hold the map, and they were the ones to dig up the most recent bottle in 2021.

Early one Thursday morning, before the sun had risen, the team set out on their mission. Marjorie Weber, the first woman to be in charge of the study and currently the youngest team member, was the scientist who found the bottle and pulled it from the ground. This is a big deal, as back when William began the experiment women were generally not even allowed to be scientists!

Originally, the Beal Seed Experiment was designed to test **seed viability**, or how long seeds of different species stay alive in the soil and still germinate. Seeds don't always germinate as soon as they fall off their mother plant. They sometimes become part of a **seed bank** below the soil, waiting for the right conditions to tell them to sprout. William was working with local farmers in Michigan, and he was interested in helping them better understand how long weeds will continue to pop up in their fields after they start to plant crops. This is reflected in the fact that many of the species included in the experiment are weeds in agricultural fields.

Marjorie (right) and David (left) digging up the seed bottle in 2021. This bottle was scheduled to be dug up in 2020, but the experiment was delayed one year due to COVID-19.

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Despite all the changes that have taken place in the world since the seeds were buried 142 years ago, the main question remains the same: how long *can* seeds stay alive in the soil? In addition to helping farmers, Marjorie and the other scientists now have additional reasons for wanting to understand seed viability. Restoration of natural plant communities, conservation of endangered species, and removal of invasive plants from fragile ecosystems can all benefit from a knowledge of the seedbank.

Marjorie holding the excavated seed bottle.

With this long-term study design, scientists can compare how many seeds sprout and which species are able to germinate through time. Originally, William dug up a new bottle every five years. Once scientists realized how long the seeds last, they made the interval between excavations longer; now they wait 20 years before digging up the next bottle. The experiment is set to go at least another 80 years. Imagine, future bottles will be dug up by scientists who are not even born yet!

Once a bottle is found and unearthed, it is taken back to the lab to see which species will germinate. Filled with sand and over a thousand seeds, each bottle contains the same mix of 50 seeds of 21 different species of plants. The contents are spread out on a tray filled with soil and are put into growth chambers. Scientists keep an eye on the trays to watch and see what germinates.

Scientific Question: How does seed viability change over time?

Seeds of *Verbascum blattaria* germinating in 2021. This is the only species that germinated from the most recent collection.

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Scientific Data:

Use the data below to answer the scientific question:

Year	Age of seeds (in years)	Number of species germinating
1884	5	13
1889	10	10
1894	15	13
1899	20	11
1904	25	11
1909	30	9
1914	35	6
1920	40	9
1930	50	5
1940	60	3
1950	70	3
1960	80	3
1970	90	1
1980	100	3
2000	120	2
2021	141	1

What data will you graph to answer the question?

Independent variable: _____

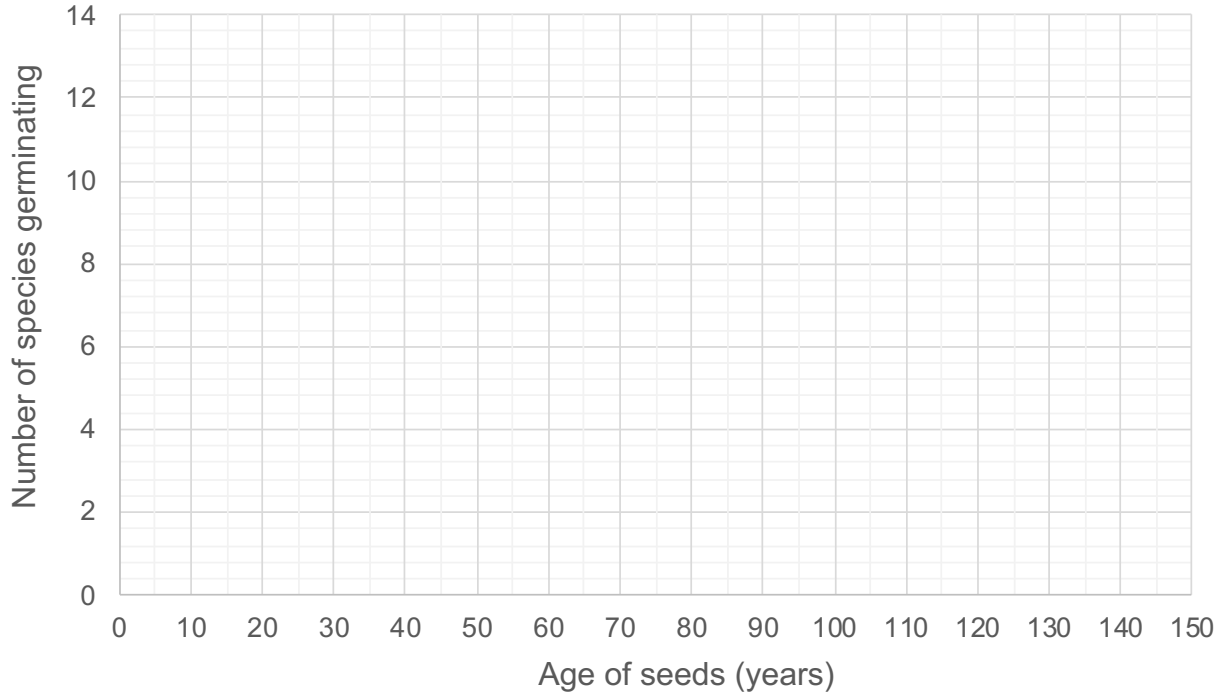
_____

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, how does seed viability change over time?

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

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Explain your reasoning and why the evidence supports your claim. Connect the data back to what you learned about seed viability.

Your next steps as a scientist:

Science is an ongoing process. What new question(s) should be investigated to build on Beal's long-term seed experiment? How do your questions build on the research that has already been done?

What future data should be collected to answer your question?

Independent variable(s): _____

_____

Dependent variable(s): _____

_____

Name_____

For each variable, explain why you included it and how it could be measured.

What hypothesis are you testing in your experiment? A hypothesis is a proposed explanation for an observation, which can then be tested with experimentation or other types of studies.