Name___________________

DATA Nugget

A window into a tree's world

Featured scientists: Jessie K Pearl, University of Arizona and Neil Pederson, Harvard University. Written by Elicia Andrews.

Research Background:

According to National Aeronautics and Space Administration (NASA) and the National Oceanic Atmospheric Administration (NOAA), the years 2015-2018 were the warmest recorded on Earth in modern times! And it is only expected to get warmer. Temperatures in the Northeastern U.S. are projected to increase 3.6°F by 2035. Every year the weather is a bit different, and some years there are more extremes with very hot or cold temperatures. **Climate** gives us a long-term perspective and is the average weather, including temperature and precipitation, over at least 30 years.

Over thousands of years, tree species living in each part of the world have adapted to their local climate. Trees play an important role in climate change by helping cool the planet - through photosynthesis, they absorb carbon dioxide from the atmosphere and evaporate water into the air.

Scientists are very interested in learning how trees respond to rapidly warming temperatures. Luckily, trees offer us a window into their lives through their growth rings. Growth rings are found within the trunk, beneath the bark. Each year of growth has two parts that can be seen: a light ring of large cells with thin walls, which grows in the spring; and a dark layer of smaller cells with thick walls that forms later in the summer and fall. Ring thickness is used to study how much the tree has grown over the years. **Dendrochronology** is the use of these rings to study trees and their environments.

Jessie taking a tree core in the winter.

Different tree species have different ranges of temperatures and rainfall in which they grow best. When there are big changes in the environment, tree growth slows down or speeds up in response. Scientists can use these clues in tree's rings to decipher what climate was like in the past. There is slight variation in how each individual tree responds to temperature and rainfall. Because

Name___________________

of this, scientists need to measure growth rings of multiple individuals to observe year-to-year changes in past climate.

Neil taking a tree core from a pine.

Jessie and Neil are two scientists who use tree rings for climate research. Jessie entered the field of science because she was passionate about climate change. As a research assistant, Neil saw that warming temperatures in Mongolia accelerated growth in very old Siberian pine trees. When he later studied to become a scientist, he wanted to know if trees in the eastern U.S. responded to changes in climate in the same way as the old pine trees in Mongolia. As a result, there were two purposes for Jessie's and Neil's work. They wanted to determine if there was a species that could be used to figure out what the climate looked like in the past, and understand how it has changed over time.

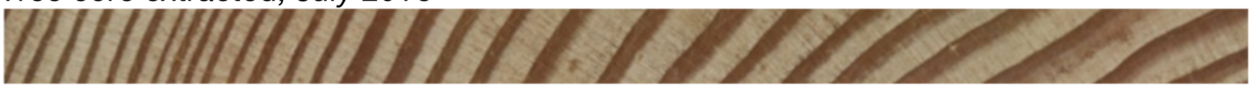
Jessie and Neil decided to focus on one particular species of tree – the Atlantic white cedar. Atlantic white cedar grow in swamps and wetlands along the Atlantic and Gulf coasts from southern Maine to northern Florida. Atlantic white cedar trees are useful in dendrochronology studies because they can live for up to 500 years and are naturally resistant to decay, so their well-preserved rings provide a long historical record. Past studies of this species led them to predict that in years when the temperature is warmer, Atlantic white cedar rings will be wider. If this pattern holds, the thickness of Atlantic white cedar rings can be used to look backwards into the past climate of the area.

To test this prediction, Jessie and Neil needed to look at tree rings from many Atlantic white cedar trees. Jessie used an increment borer, a specialized tool that drills into the center of the tree. This drill removes a wood core with a diameter about equal to that of a straw. She sampled 112 different trees from 8 sites, and counted the rings to find the age of each tree. She then crossdated the wood core samples. Crossdating is the process of comparing the ring patterns from many trees in the same area to see if they tell the same story. Jessie used a microscope linked to a computer to measure the thickness of both the early and late growth to the nearest micrometer (1 micrometer = 0.001 millimeter) for all rings in all 112 trees. From those data she then calculated the average growth of Atlantic white cedar for each year to create an Atlantic white cedar growth index for the Northeastern U.S. She combined her tree ring data with temperature data from the past 100 years.

Name___________________

Let's look at a section of a tree core to see how Jessie collected her data.

Tree core extracted, July 2018



↑Year tree core taken (2018) Center of the tree ↑

Observe the tree core. Notice there are two ring colors. The dark rings are made during slower growth and the light ring is made during faster growth. Each pair of light and dark rings represent one year. Count the dark rings to **estimate the age** of the tree.

Which years are the thinnest? Which are the thickest?

What do you think could have caused the differences in tree ring sizes?

Name___________________

Scientific Question: How does the Atlantic white cedar respond to changing temperature?

Scientific Data:

Use the data below to answer the scientific question:

Year	Atlantic White Cedar Growth Index	Jan-April Temperature (F)
1910	-0.24	44.29
1915	0.02	44.02
1920	-0.62	43.35
1925	-0.81	43.85
1930	-0.95	43.79
1935	0.30	44.80
1940	-0.64	44.71
1945	-0.62	45.07
1950	-0.69	44.98
1955	0.82	46.16
1960	-0.19	44.66
1965	-1.02	43.73
1970	-1.43	44.21
1975	-0.42	44.60
1980	0.54	45.01
1985	1.10	45.12
1990	1.18	45.32
1995	0.10	45.03
2000	0.86	45.89
2005	1.09	45.22
2010	1.41	46.42
Average		

**The Growth Index uses crossdated wood core sample data from a large number of individual trees to get one best estimate of growth. A positive number means growth for a group of trees was higher than average in a given year, and a negative number means growth was lower than average. There are no units.*
**Jessie and Neil used temperature data from January to April because previous research has shown that the temperature in these months has the strongest effect on Atlantic White Cedars.*

Name___________________

What data will you graph to answer the question?

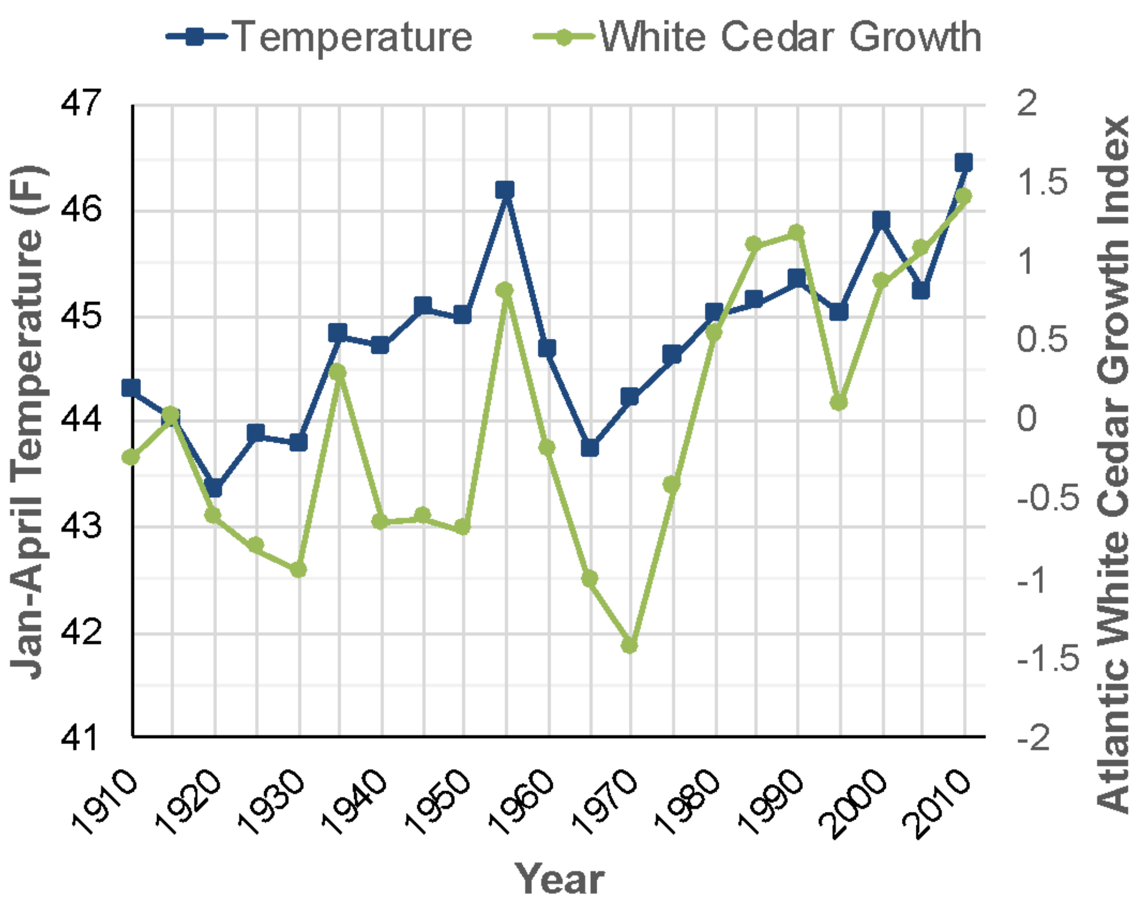
Independent variable(s): ______________________________________

____

Dependent variable(s): ______________________________________

____

Below is a graph of the data: 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.

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 how tree rings width is related to growth.

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