**Fossil Atmosphere Citizen Science Project**

**(Stomata Count of Ginko Trees)**

**https://www.zooniverse.org/projects/laurasoul/fossil-atmospheres**

1. What is the purpose of the Fossil Atmosphere Citizen Science Project?

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1. What is proxy data in the field of paleoclimatology? (You may need to research this.)

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1. What proxy is being used in this project for carbon dioxide concentration? \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_
2. The equation for photosynthesis is shown below. What part of the plant allows carbon dioxide to enter and oxygen and water to exit? \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

**Photosynthesis**

**sunlight + CO2 + H2O 🡪 C6H12O6 + O2 + water**

**sunlight + carbon dioxide + water —> glucose + oxygen + water**

1. Experiments have shown that there is an optimal number of stomata on each leaf (called the stomata index). What environmental factors affect the optimal number of stomata?

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1. Which of the environmental factors in #5 is the most important? \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_
2. What does PETM stand for? \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_
3. How long did PETM last? \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_
4. How long ago was it? \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_
5. Why is this period of time important to this project? \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

11. Why are the scientists in this project using GINKGO tree leaves?

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1. What are scientists asking you to do? \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

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1. Describe the experiment that Rich Barclay is doing in outdoor chambers at the Smithsonian Environmental Research Lab in Edgewater, MD? \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

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1. Why should you care? \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

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1. We want to create a record of how the atmosphere has changed through time by calculating the ratio of two different types of leaf cell (stomatal and epidermal) for many leaves, from the present and the geological past. We know that the composition of the Earth's atmosphere has changed over time, and that it is changing now. It is important for us to understand what effect climate change might have on life on our planet in the long term.

2. Proxy data is

In paleoclimatology, or the study of past climates, scientists use **what is** known as **proxy data** to reconstruct past climate conditions. ... Paleoclimatologists gather **proxy data** from natural recorders of climate variability such as tree rings, ice cores, fossil pollen, ocean sediments, corals and historical **data**.

3. Stomatal index of ginko trees

4. Stomata

5. Carbon dioxide level, temperature, and humidity.

6. carbon dioxide levels

7. PETM—Paleocene-Eocene Thermal Maximum

8. 150,000 years

9. 56 million years ago

10. During the PETM a very large amount of carbon-dioxide was released into the atmosphere and the average temperature of the planet rapidly increased by about 5 degrees Celsius.

Scientists hope to create a more precise and accurate record of this change in atmospheric CO2 concentration and temperature, that we can compare to changes in the animals and plants at the time to gain a greater understanding of how life on the planet responds to changing climate.

11. Ginkgos are a unique type of plant. They're gymnosperms like conifers, meaning they have seeds but don't produce flowers. The first species of Ginkgo evolved in the Permian, before the dinosaurs. One species is still alive today, so we know that Ginkgos have survived through three mass extinctions, including the one that eventually caused the dinosaurs' demise. There have been many different species of Ginkgo, but they all belong to one genus and the leaves are recognizably similar in all the different species. This makes them an ideal plant to study because they can provide a record from 300 million years ago through to the present.

12. The citizen scientists are asked to count the stomata index from on the images of the fossilized and modern Ginko leaves.

13. At the same time as you're doing all this counting, Rich Barclay is growing Ginkgo trees in specific concentrations of CO2 (up to 1000 ppm - 2.5 times present atmospheric levels) to see how they respond. There have been previous experiments of this kind, but always in lab conditions. This new experiment allows the trees to grow in their natural environment, allowing us to measure how stomatal index varies with environmental conditions in a realistic setting that is more likely to represent how stomatal numbers on leaves would have varied in real life.

14.The sensitivity of climate to CO2 has enormous economic and societal implications because of the effect climate change will have on sea level, food production, storm strength, water availability, and many other factors. By improving our ability to quantify the effects of CO2 on climate, you will be contributing to the basic science underlying projections of future environmental change.