Analyzing Climate Through Tree Cores

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Focus on Inquiry

Identify the sources of tree materials, calculate the carbon stored in the tree, and analyze climate changes using tree rings.

Lesson Summary

In this lesson, students begin by reflecting on their prior knowledge of photosynthesis. They then explore the concept of tree growth by examining an acorn or tree seed and discussing its significance. The teacher guides students to understand photosynthesis and a plant's growth from seed to tree. Students engage in hands-on activities outside, measuring a large tree's circumference and estimating its height to calculate the carbon stored in it. Following this exploration, a guided class discussion revisits the video question, prompting students to consider how their understanding has evolved, particularly regarding carbon sourcing and the significance of tree rings in determining age and climate conditions. Students then analyze tree cores or "cookies," sketching their samples and hypothesizing about climate conditions based on ring size. They create a data table to record their findings and compare their hypotheses with actual climate data from a provided resource. Finally, formative assessments include students' written reflections on photosynthesis and their participation in discussions.

Lesson Content Overview

- Subject: Trees
- Duration: 2 Class Periods
- Setting: Classroom or outside if large tree is available
- Grouping:
  - Individual for calculation of carbon storage and analysis of tree cores/cookies
  - Small Group analyzing tree cores or photos
  - Whole Group for video and seed discussion, and final discussion of tree cores/cookies
- Grade Level: 10th-12th

Louisiana Standards (*Use the Louisiana Student Standards from the Academic Standards Library. Identify the code and full verbiage for the standard(s) used).*

Standard	Description
HS-ESS2-2	Analyze geoscience data to make the claim that one change in Earth's surface can create feedbacks that cause changes in other Earth's systems.

HS-ESS2-4	Analyze and interpret data to explore how variations in the flow of energy into and out of Earth's systems result in changes in atmosphere and climate.
HS-ESS2-6	Develop a quantitative model to describe the cycling of carbon among the hydrosphere, atmosphere, geosphere and biosphere.

Student Learning Objectives

1. Identify the sources of the materials that make up a tree.
2. Calculate the amount of carbon stored in the tree.
3. Use tree rings to analyze climate changes throughout the life of the tree.

Prior Knowledge Needed by Students

Students should be familiar with the concept of photosynthesis. They should know that the reactants of photosynthesis are carbon dioxide and water, that sunlight and chlorophyll are needed for the reaction to occur and that the end products are glucose and oxygen.

- Students may also need to know that the rings of a tree are called "annual rings" because they form each year that the tree is growing. Therefore, the rings will give a "snapshot" of the tree's life.

Background Information for Teachers

Because carbon dioxide is a reactant of photosynthesis, trees/plants sequester carbon by removing it from the atmosphere. When climate is conducive to tree growth, more carbon can be removed from the atmosphere. Tree rings can show when there is a large amount of plant growth (wider rings) and when there is little growth (narrower rings). Therefore, tree cores or tree rings (annual rings) can be used as climate indicators.

Materials Needed

- Acorn and oak tree or any other combination of seed and tree that is available in the school yard. (If seed and tree are not easily accessed, photos of seeds and trees can be used.)
- Are Plants Made From Thin Air? - YouTube
- Metric tape measures
- Measuring Carbon in a Tree instructions: https://drive.google.com/drive/folders/1WCS7r0ZHaB23W6vqGIAF11EGo_pttRCK
- Tree cores and/or tree "cookies" OR photos of tree cores and/or "cookies" (tree cookies are easily obtained at Christmas tree lots)
- Tree core photos: https://www.polartrec.com/expeditions/vegetation-impacts-on-permafrost/journals/2016-07-06
- Paper and pens, or electronic device
- Climate data: https://www.climate.gov/maps-data/dataset/droughtgov-maps-graphs-and-more
- Claim, Evidence, Reasoning writing format https://modelteaching.com/wp-content/uploads/2019/04/CER-Checklist.pdf

Detailed Lesson

1. **Engage** (Time: 10 minutes)

Materials

- Paper
- Pencils
- Acorn
- Video about plants

Directions

- Ask students to write down three things they know/remember about photosynthesis. Use pair/share to have students share and explain their answers.
- Show students an acorn (or seed from a tree in the school yard) and ask them to explain what it is and what they know about it. Accept all reasonable answers.
- Ask students to explain where a plant gets the material that allows it to grow from a seed into a tree. Teacher should guide students to discover that photosynthesis is the key – plants use energy from the sun, carbon dioxide from the air and water from the ground to produce the new growth of the plant.
- Show students one of the videos listed in the materials section. Ask students how they would answer the question posed in the video.

2. **Explore** (Time: 10- 15 minutes)

Materials

- Tape measure
- Worksheet with instructions: https://drive.google.com/drive/folders/1WCS7r0ZHaB23W6vqGIAF11EGo_pttRCK
- Calculator

Directions

- Bring students outside to a large tree. Students will measure the circumference of the tree and estimate its height using the instructions on the attached document.
- From this information, they will calculate the approximate amount of carbon stored in their tree in kilograms.

3. **Explain** (Time: 15 minutes)

Directions

Teacher-guided class discussion:

- How would students NOW answer the question posed in the video?
- Have they changed their answer? Why or why not?
- What element makes up the majority of the solid portion of the tree? (carbon)
- From where do trees get this element? (air/atmosphere)
- How do scientists determine the age of trees? (tree rings, tree cores, cross section of trunk)
- What other information can scientists obtain from trees or tree rings? (fast growth, slow growth, atmosphere conditions, climate)
- How can the tree rings/core be used to tell about weather or climate? (Wider rings = faster growth = climate conditions conductive to growth)

4. **Expand** (Time: 15-20 minutes)

Materials

- Tree cores, tree "cookies" or photos of tree cores/cookies.
- Paper
- Pencils
- Climate data https://www.climate.gov/maps-data/dataset/droughtgov-maps-graphs-and-more

Directions

Give students tree cores, tree "cookies" or photos of tree cores/cookies. (If there is access to borers, the students can do their own tree core on a school yard tree or a tree at home.)

- Students will draw/sketch their tree core or "cookie".

After drawing, students should work in pairs or small groups to analyze their sample.

- They should be able to determine how old the tree is and approximately when it was planted.
- They should note years where the rings are larger or smaller and hypothesize about what those rings might indicate about the climate at that time. (Do they think that the size of the rings indicates warmer or cooler temperatures? More or less precipitation?)

Create a data table for the life of the tree indicating year, approximate size of ring, and their hypothesis about what it indicates.

After creating data table, students should access climate data.

- They should compare their hypotheses to the actual data recorded for each year, indicating which years were warmer, cooler, wetter, drier.

5. Evaluate (Time: TBD)

Materials

- Formative assessment
- Video survey
- Data table
  Essay

Directions

- ***Formative Assessment:*** Student writing of what they know about photosynthesis and where a tree gets the material for growth. Student answers in discussions.

- ***Check for Understanding:*** Student calculations of carbon stored in tree. Student answers in discussion of video survey and their explanation of where trees get their growing materials. Data table for tree ring/core analysis and hypotheses.

- ***Post-Assessments:*** Students will write an essay using CLAIM, EVIDENCE, REASONING format that answers the following question: CER format

- **Why is planting trees good for the environment?** Your answer should include the following:

- An explanation of the relationships between photosynthesis and carbon storage, evidence from the class activity
- An explanation of how these processes relate to climate change and how tree rings/cores can be used to analyze changes in climate over time.

6. Extension (Time: TBD)

Directions

Students can research trees native to the school area and plant one or more of these trees on or near the school grounds.

References

Ask a Biologist. (2018, September 12). *Are Plants Made From Thin Air?* [video]. Youtube. https://www.youtube.com/watch?v=rEdOvBAtyYk&t=103s

Model Teaching. (2019). *CER Checklist*. https://modelteaching.com/wp-content/uploads/2019/04/CER-Checklist.pdf

National Integrated Drought Information System. *Drought.gov - Maps, Graphs, and More* [Data Set]. NOAA. https://www.climate.gov/maps-data/dataset/droughtgov-maps-graphs-and-more

Project Learning Tree. (2019). *Project Learning Tree*. https://www.plt.org/

Skotnicki, S. (2016, July 6). 6 July 2016 Tree Core Samples. *Polartrec*. https://www.polartrec.com/expeditions/vegetation-impacts-on-permafrost/journals/2016-07-06