Lesson Overview

Big Ideas: Trees have diurnal cycles impacting the process of xylem and phloem and altering their diameter.

Guiding Questions:

- **What is a tree?**
- **Does temperature and weather influence the change in diameter of a tree?**
- **What parts of the diurnal cycle will have the greatest differences in tree diameter?**
- **What can studying the changes in a tree's diameter tell us about the biological functions of tree species in our area.**
- **What are some common weather patterns around you?**

Objectives:

Understanding key ideas and concepts will be crucial for this project. Knowing that not all are familiar with diurnal cycles in trees or certain terminology we've provided a set of definitions and terms of your use!

- **Xylem and Phloe**m: The xylem and the phloem make up the vascular tissue of a plant and transports water, sugars, and other important substances around a plant.
  - Xylem tissue is used mostly for transporting water from roots to stems and leaves but also transports other dissolved compounds.
  - Phloem is responsible for transporting food produced from photosynthesis in leaves or needles to parts of a plant such as roots and stems.
- **Transpiration:** Transpiration is the process in which water and nutrients are transported up through a plant via the xylem and phloem. The water is pulled upwards through the tissues by capillary action to replace water that is evaporating out of the plant's leaves.
- **Diurnal:** Diurnal is just a scientific way of saying day/night cycle. This lesson is all about how plants change throughout the day.

Notes for Parents/Teachers

The objective of this lesson is to connect students to ecological systems through interactive inquiry-based learning in their communities. Students will also use data visualization and mathematics skills, in relation to connecting visual data representing change used in examples to their own investigations on local trees and their change in diameter ratios over the course of four weeks. Students will also connect their findings through research and come to understand how temperature and weather play a role in changing the diameter of local trees in their community, by observing meteorological data present in their local area over a period of time.

Age Group:

- 6th-7th grade

Total Time Needed:

- 2 Hours

Materials Needed

- Flexible tape measure
- Access to a computer
- Pencil
- Data table sheet
- String or Rope

See more from MOSS Adventure Learning at moss.uidaho.edu/adventure

Tracking Tree Diameter

Step 1: Interpreting Data

- Let's look at the graphs in the links provided below which show various data sets about two different Douglas Fir trees near the MOSS campus in McCall, Idaho. Pay close attention to when the graphs show the greatest tree diameter and when they show the smallest over the course of one day.

- These graphs display the information in military time. This time system starts at 1am standard time, which equates to 0100 in military time. For every passing hour that number it increases by 100. So, 0200 would be the same as 2am, 1200 would be 12pm. Keep in mind when the graphs display 1300 to represent the time that data was collected that would be equal to 1pm on a standard clock. This system counts all the way up until 2400 which is midnight in military time.

- Using what you noticed in the graphs, decide what two times of day you think you should measure a tree to see the biggest changes in diameter.
  - Write down your two chosen times, you'll need to remember them later!

- Links to Graphs:
  - https://jeitel.shinyapps.io/tree7_all/
  - https://jeitel.shinyapps.io/tree1_all/

This is one of the trees where that data is collected!

Think about....

- What might influence your choice in tree selection?
- What is the ecosystem like in your community that might influence the change in diameter of your tree?
- What other tools might scientists use to understand how trees grow?

See more from MOSS Adventure Learning at moss.uidaho.edu/adventure

Tracking Tree Diameter

Step 2: Choose Your Tree

- Go outside and find a tree you would like to measure the diameter of for this experiment.
- The larger the tree the better! Larger trees are likely to have more significant change in the tree's diameter during its diurnal cycle.

Step 3: How To Measure Your Tree

- Choose what height on the tree you want to measure the diameter at. You will want to take measurements at the same location each time so marking your chosen location on the tree will be beneficial.
  - To mark the location on your tree, get some string, twine, or rope that will be long and sturdy enough to keep taught and tied around your tree. Your marking rope should stay level as it goes around the tree, if it is wobbly or saggy try to get it tighter.
- In our example in we used a string to mark out spot, but you can use a pencil just as effectively to mark your location.

How to find the diameter of your tree:

- To find the tree diameter, we first must measure its circumference. Take your flexible measuring tape and wrap it around your tree just above your marking rope.
- This will tell you what the circumference of the tree is now. You will get your measurement by reading the number closest to the very edge of your tape measure once it has completely circled the tree.
- Once you have measured the circumference divide that number by Pi (3.1416). The result of that equation is the diameter of your tree!

Marking your spot

Measuring Circumference

Think about....

- Will different tree species have similar or completely different diameter sizes?
- How could the size of your tree influence your measurements for diameter change?
- What tools might scientists use in the field to better understand why a tree's diameter changes?

See more from MOSS Adventure Learning at moss.uidaho.edu/adventure

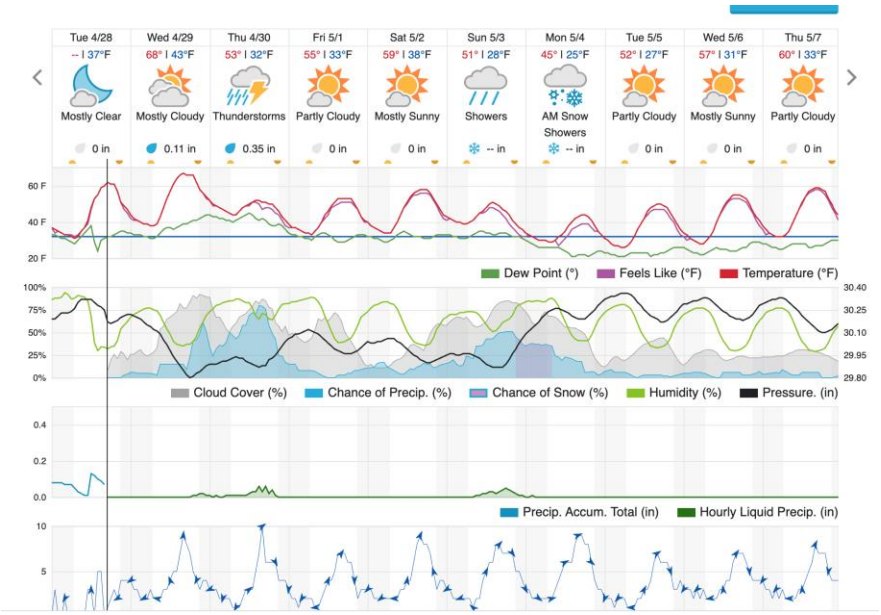
Tracking Tree Diameter

Step 4: Recording Your Data

- Now that we have marked our tree and calculated its diameter it's time to collect data
  - Take measurements of your tree's diameter at your two chosen times of day (which you wrote down in Step 1).
  - Think about the weather your tree has experienced lately and what effect that weather may have had on water availability and transpiration for your chosen tree.

Step 5: Lets Make Some Predictions!

- Now that we know how to read our graphs, let's use some other tools to understand why and how tree diameter might change.
- Use any search engine to find a weather website that shows your local weather.
- We recommend https://www.wunderground.com/
  - With this resource make some predictions about how the current or upcoming weather patterns will affect the diameter of your tree..
  - Do you think your tree diameter will be larger or smaller when you measure it again a few days from now?
  - Try to support your prediction using information from throughout this lesson, such as the graphs, the weather forecast, and any other reasoning behind your prediction.
  - Below is an example of the McCall area's weather forecast. What will yours look like?



Think about....

- How do you think the time of day influenced the change in diameter of your tree?
- What else can have an impact on the diameter of your tree?
- What atmospheric patterns or weather changes might have influenced your data?
- Is water common or scarce in your area?

Tracking Tree Diameter

Step 6: What's Next?

- Now that you know how to take your diameter measurements and have predicted how the weather will impact your tree, set a schedule over the next 3 to 4 weeks to keep checking your tree's diameter.
- It's up to you how often you want to schedule measurements. We recommend you take your measurements every 4 days or every Wednesday and Saturday. If you stick to your schedule you'll collect some useful data.
- Every day that you check your tree diameter (remember to check it twice on your chosen days) check the weather forecast between that day and the next time you plan to take measurements. Try to predict how the weather will impact diameter next time you measure as laid out in step 5! When you write your new prediction, also check your previous prediction and try to determine if you were accurate or not.

Think about....

- What will be different throughout the next set of tests?
- Will the change in diameter be significant as temperatures change with the seasons?
- Will sunlight be a factor?

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Tree Name:

	First Data Collection Day **Date:**		Second Data Collection Day **Date:**	
Diameter:	Measurement #1	Measurement #2	Measurement #1	Measurement #2
Current Weather:				
Prediction For Next Measurement				

	Third Data Collection Day **Date:**		Fourth Data Collection Day **Date:**	
Diameter:	Measurement #1	Measurement #2	Measurement #1	Measurement #2
Current Weather:				
Prediction For Next Measurement				

	Fifth Data Collection Day **Date:**		Sixth Data Collection Day **Date:**	
Diameter:	Measurement #1	Measurement #2	Measurement #1	Measurement #2
Current Weather:				
Prediction For Next Measurement				

	Seventh Data Collection Day **Date:**		Eighth Data Collection Day **Date:**	
Diameter:	Measurement #1	Measurement #2	Measurement #1	Measurement #2
Current Weather:				
Prediction For Next Measurement				