***Note:** sections of the lesson plan template marked with * are optional, but may be useful for your planning.

From Microbes to Mountains: Science in Our Neighborhood! Module: Trees & Water Availability	
Short Description	This is one module that can be taught on its own or as part of a larger field trip exploring geoscience concepts at different scales in Pasadena. The field trip was designed in 2023 to be held at Hahamongna Watershed Park, but can be adapted to other locations. This module is appropriate for grades 6-10.
Standards (NGSS)	MS-LS2 Ecosystems: Interactions, Energy and Dynamics National Earth Science standards can be found at https://www.nextgenscience.org/search-standards?keys=&tid_3%5B%5D=94.
Learning Objectives (Goals)	- Recognize and describe the different benefits trees provide for people and society. - Compare and contrast tree leaves and translate their characteristics to their water requirements (where in the watershed do they grow) - Examine growth rings from a tree cutting and estimate the age of the tree
Time/duration	25 minutes
# students	8-35 students
Location	Hahamongna Watershed Park: https://goo.gl/maps/NwSiQ8BgCTgfdBWd7 This park is within walking distance of La Cañada High School. For any other school, transportation will be needed or the module can be adapted to a different location.

	Proximity to trees is ideal for observations.
***Logistics**	This activity is designed to take place outside, so scheduling during daylight hours and appropriate weather is recommended. Students will be sitting or standing on dirt/grass so they should wear comfortable shoes and clothing for outdoor activities.
Materials and Equipment	• Tree cutting • Oak and sycamore leaves (both are present in the park – most are oaks but closer to the reservoir there are sycamore trees) • Pencil/eraser for each student • Field guide for each student (attached) • Nametags for each student • Snacks & Trash bag
Accessibility	This lesson involves drawing and observing small scale features. For students with fine motor concerns, pair them with another student who can draw the observations they make. For those with visual impairments, bringing a hand lens/magnifying glass is recommended.
Safety Awareness	Hahamongna Watershed Park has areas of uneven ground. Poison oak is common off the trail, so students should be instructed to remain on the trail and grass lawn areas. In addition, this area is an active disc golf course. When choosing a location, remain aware of disc golfers to avoid students being injured.
GO-Outdoors Missions	At GO-Outdoors, we emphasize the following missions: • Instructor/Caltech volunteer will incorporate 10 Essentials of hiking and Leave No Trace etiquette into the trip and encourage students that they can do these things themselves, to make these concepts approachable. • We are looking forward to tailor our trips to student interests. At the start of each of our trips, we will ask each student to share what they hope to learn and we will try to incorporate them into the field trip.

Field trip activities

Trees & Water Availability

- Trees and their benefits (10 mins) – Engage. Bring the students in the shade of a tree and ask them what benefits trees provide people.
    - Examples: shade, food, wood, housing, soil stabilization, clean water, beauty, improved air quality)
    - Discuss how trees take up water through “evapotranspiration”, which helps cool the air

- Leaf Observations (10 mins) – Explore. Show students examples of two different kinds of tree leaves (Oak and Sycamore) and have them draw their observations of different characteristics (shape, size, texture, features like spikes or hairs). Once students have made observations, ask them which tree they think lives closer to water? (answer; sycamore, which have large, deciduous leaves which can photosynthesize more but loses water faster. They are near the bottom of the watershed, while oaks (which don't lose their leaves) live further away where they get less water, but their leaves are smaller and waxier, leading to less water loss)
- Tree rings and growth (5 minutes) – Explore. Hand out the tree rings and discuss how trees grow primarily in the spring and summer, which show up as light and dark rings. The set of rings equals one year of growth. Have students observe the number of rings, and any other features they observe.
- Wrap-up (5 minutes) – Have students recall the benefits trees provide, and consider how water needs make certain trees more likely to survive in different climates. Discuss how with climate change (drought/floods), some trees are better to plant in different settings so they can survive.

***Optional extension activities**

This field trip module can be paired with other GO-Outdoors modules within the Microbes to Mountains field trip.

https://www.treepeople.org/learn/

Instructor support

- Since trees have no muscles, water is drawn up like a straw by having the water at the leaves evaporate, pulling up the water behind them all the way down to the soil. Plants evaporate >90% of the water they take up!
- The bulk of the wood in a tree's trunk is made up of special water-conducting tubular cells called **Xylem**. Xylem transports water and dissolved nutrients up into the canopy of a tree where it is needed in the leaves. The actively conducting xylem is collectively known as the **Sapwood** (lighter colored wood). The darker interior wood is called the **Heartwood**, and it is old xylem tissue which has been clogged up with resin, oils, and tannins. This, in effect, adds strength and rigidity to the tree as it reaches upward toward the sun. Notice the long radial cells in the cutting, these are called **rays** and are responsible for transporting "food" (carbohydrates/starches) deeper into the trunk for storage. They also help to wall off any invading pests and pathogens

Common misconceptions about the concepts

"Big leaves are always better" – Tree leaves come in all shapes and sizes and they all have tradeoffs. Big leaves can photosynthesize more, but they lose water faster. Small leaves will not photosynthesize as much but have better water retention.

Trees and Water Availability

How does **water** affect the **morphology** (physical characteristics) of trees?

Compare and contrast the leaf characteristics present (Oak and Sycamore) to view different water saving strategies. **Draw the leaves and label their morphology differences (shape, texture, etc.)!**

OAK LEAF	**SYCAMORE LEAF**
Where can an oak tree live in the watershed?	**Where can a sycamore tree live in the watershed?**

We can tell the age of a tree by counting its internal growth rings!

If you look closely, you will notice the difference in color of the spring and summer wood.

Spring wood is _____ **light / dark** _____

Summer wood is _____ **light / dark** _____

Count the rings and guess the age of the 2 samples:

years	years

Trees are important in our native ecosystem, but also in our cities and neighborhoods. **List some benefits that trees provide when planted in our cities and neighborhoods:**