LESSON 2
Leaf Evolution

OBJECTIVE
Teach students to distinguish between the different leaf characteristics that are optimal for different types of environments/environmental conditions.

TIME AMOUNT
1 Hour

MATERIALS
- Pine needles (4)
- Aloe leaves (4)
- Chestnut oak leaves (4)
- Pawpaw leaves (4)
- Tulip poplar leaves (4)
- Maple leaves (4)

HELPFUL LINKS
Leaf Shapes and Strategies - https://www.psu.edu/dept/nkbiology/naturetrail/leaves.htm
Chestnut oak - https://www.poughkeepsiejournal.com/story/tech/science/environment/2016/01/07/environment-species-spotlight-chestnut-oak-acorn/78416890/

PROCEDURES
0-15 min
Discuss variations in leaves that have developed over time such as size, shape, and composition (waxy/not).

- **Size** – Leaf size is typically larger in understory, low-light inhabiting species. This is common in riparian (i.e., near a river/creek) zone habitats. *Can compare size of leaf to collect sunlight to the size of varying sized buckets used to catch rain falling from the sky. If the bucket opening is larger, then it will collect more water. If the surface area of the leaf is larger, then it will collect more sunlight (i.e., energy for the plant).* Similarly, smaller leaf area is okay for higher light areas like the upper-canopy.
- **Shape** – Leaf shape can vary in the typical ways we expect (e.g., oaks vs maples) where the leaves are broad, but curve differently. Additionally, some may be *very* different from the typical leaves we imagine (e.g., pine needle). The more narrowly shaped a leaf, the less light it will be able to absorb (e.g., pine needle vs tulip poplar leaf).
- **Composition** – Some leaves may be soft and non-waxy, while others may have a waxy coating. A waxy coating helps a leaf reduce water loss (e.g., evaporation/evapotranspiration). Waxy leaves are well suited for areas with low rainfall (e.g., desserts).

These variations allow plants to thrive in specific environments. Leaf specialization occurs over many generations of plants. The plants with better-suited leaves for a specific environment will continue to produce offspring that will eventually grow into mature plants, and then produce their own offspring. Alternatively, plants that have leaves less well-suited to survive in an

environment are less likely to produce offspring that will be able to compete with the plants that have better suited leaves. This process promotes the persistence of plants with the better-suited leaf type.

15-25 min
Split into 4 groups; begin activity by splitting 6 leaves into 3 groups based on a single characteristic (i.e., 3 groups of 2 leaves). Then, have students try to identify each individual leaf using the tree ID guides provided. This will allow students to focus on the specific characteristics that differentiate each leaf from its similar counterpart.

25-35 min
Reveal the identity of the 6 leaves, discussing the characteristics that allow each leaf type to prosper in its environment.

- **Pine needle** – typically found in drier climates, in our area higher on hilltops that experience more windy conditions (i.e., smaller shape creates less drag, so tree is less likely to fall over) and more direct sunlight (i.e., waxy coating protects from water loss by hot sun).
- **Aloe leaves** – typically found in dessert environments where water is sparse. To cope with these conditions, this plant has thick and waxy leaves to retain moisture.
- **Chestnut oak** – can be found growing in dry soils along rocky ridges, or near streams. The broad size of this leaf allows it to exist in lower elevations near streams, but the thick semi-waxy coating of the leaf allows it to also inhabit drier habitats high on mountains.
- **Pawpaw** – typically found in riparian zones (i.e., near a creek/stream). Streams form in areas of lower elevation relative to the surrounding area (i.e., water flows downstream then pools at the lowest point). The large size of this leaf allows it to gather as much light as possible at these lower points in the forest.
- **Tulip poplar** – typically found in deep, rich, well-drained but moist soil and full sun on lower on mountain slopes. Semi thick leaves hold moisture, while large leaves help gather sunlight.
- **Maple** – typically found in shaded, understory areas. Broad leaves help collect as much sunlight as possible.

35-50 min
Now that we know the types of leaf characteristics that are most suitable for different habitats and climates, as a group, come up with your own habitat and design a leaf that would be well suited to live in it.
Note: Remember the types of characteristics useful for different habitats (e.g., broad leaves for lower light, waxy coating for dry conditions, etc.).

50-60 min
Each group will present their new leaf to the entire group and explain why they designed it the way they did. *Try to keep is presentation under 2 minutes.*