



Plant Detectives

Native vs. Invasive- Can YOU tell the difference?

Background:

Lake Tahoe is one of the most pristine alpine lakes in the world. Its waters are so clear that objects can be seen at depths of more than 70 feet. Unfortunately even in a pristine environment such as Lake Tahoe, ecosystems have been altered due to invasive species being introduced to the area. Aquatic invasive species (AIS), introduced to Tahoe by humans, have taken over areas of Lake Tahoe and are changing the Lake we love. They are degrading water quality, disrupting the Lake's ecology and opening the door for more invasive species to take hold. Warming waters caused by climate change are creating additional habitat along Tahoe's shoreline for AIS to take over.

The most prevalent AIS currently in Lake Tahoe are Eurasian watermilfoil, curlyleaf pondweed and Asian Clams. First found in Lake Tahoe in the early 2000's, these were introduced into our ecosystem by visitors that had encountered these species in other water bodies and unknowingly had remaining live fragments or individuals on their watercrafts when they entered Lake Tahoe.

Agencies around Lake Tahoe, including the League to Save Lake Tahoe, are working hard to control the spread of aquatic invasive species and prevent the introduction of new invasive species. Starting in 2008, every single motorized boat that enters Lake Tahoe is required to be inspected. If boat inspectors find AIS or if the boat has come from infested waters, the boat will be quarantined and/or decontaminated until it is deemed safe to enter Lake Tahoe.

One of the most important aspects of stopping Eurasian watermilfoil and curlyleaf pondweed from spreading around Lake Tahoe is to first know what they look like and then to find out where they already are. The League's Eyes on the Lake program trains volunteers and students how to identify these invasive plants and asks them to report any sightings when they are enjoying Lake Tahoe.

Once we know what the plants look like and where they are, they can be removed by a variety of methods. This includes hand removal by scuba divers, placing bottom-barriers over the infestation that block out sunlight, preventing the plants from growing or by shining UV-C light onto the plants causing damage to the cellular structure and DNA. In addition, "bubble curtains", literally a line of dense air bubbles across a marina or boat channel, are used to keep floating invasive plant fragments out of the Lake. To restore mucky and nutrient-rich areas to a more natural sandy and low-nutrient state, a habitat that is harder for plants to attach and grow in, a Laminar Flow Aeration (LFA) device is installed which cycles oxygen evenly throughout the water column including deep in the muck layer where bacteria use that oxygen to consume the muck.

Activity:

Today we are going to learn about native and invasive species in an ecosystem and how to identify them. Native species are organisms that were present in an ecosystem before humans. Because they have slowly evolved and adapted with other native species in that ecosystem they are considered ecologically stable. Invasive species on the other hand, are organisms that are not a part of that natural ecosystem, but have been introduced, most often by humans. These invasive species tend to be well adapted to a wide range of environmental conditions and since they have no natural predators in the ecosystem they invade, they grow rapidly and spread very easily. Because of this, invasive species can quickly throw off the balance of an ecosystem, changing that local environment and even causing some native species to die off.

The first step to addressing invasive species is being able to identify them when you see them. Today, students will be learning how to properly identify plants by heading out into their local environment to find a plant to study and preserve. They will then use their knowledge to study the current AIS that are damaging our pristine Lake Tahoe environment.

Students are then encouraged to research what methods are currently in effect to decrease the impact of these invasive plants and then use their findings to propose their own solutions to the problem.

NGSS standards:

- **MS-LS2-5**
Evaluate competing design solutions for maintaining biodiversity and ecosystem services.
- **MS-ESS3-3**
Apply scientific principles to design a method for monitoring and minimizing a human impact on the environment.
- **HS-LS2-7**
Design, evaluate, and refine a solution for reducing the impacts of human activities on the environment and biodiversity.

Supplies:

1. A small plant, terrestrial or aquatic (Be careful to avoid toxic or rash inducing plants)
2. Gel hand sanitizer (Clear is best)
3. A clear sided container with a lid, larger (width and height) than your plant of choice
4. Chopstick, bamboo skewer, or tweezers

**Activity:**

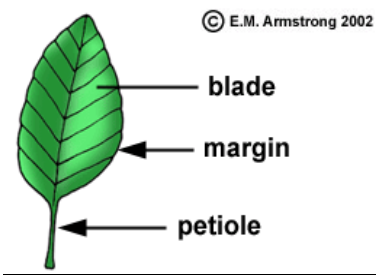
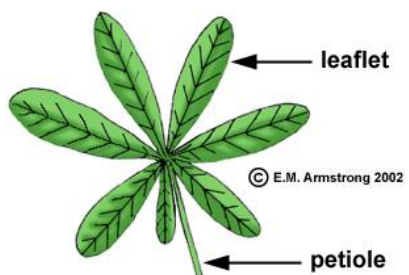
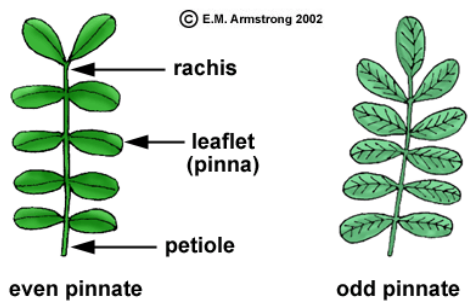
1. **Find a plant to study.** You can use any aquatic or terrestrial plant. If you can, get outside nearby to find a local plant! Be careful to avoid toxic or rash inducing plants.
2. **Sketch your plant in the space below.** Use the Leaf Botany Term list and the Botany Vocabulary Glossary to label your sketch. You should have one label from each column of the Botany Term List on your sketch. Include close up or alternate angle views if needed.

Leaf Botany Terms - Label your sketch with the matching botany term from each column below.

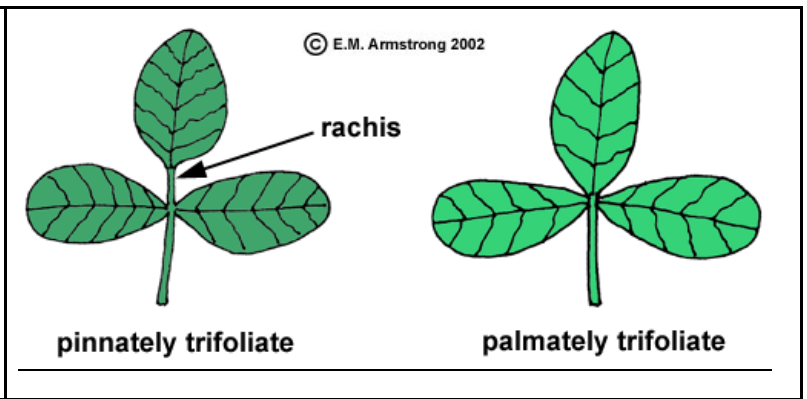
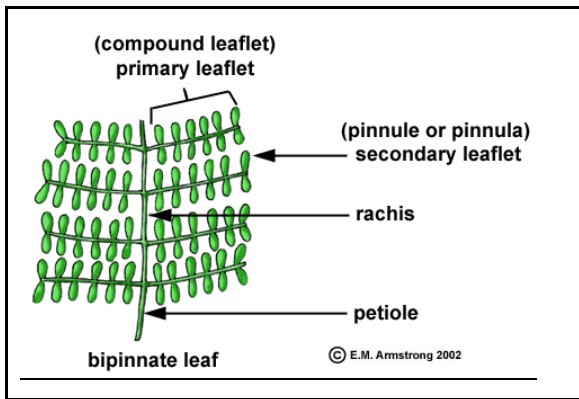
Type	Arrangement	Attachment	Shape	Margins	Surface
<ul style="list-style-type: none"> - Simple - Palmately Compound - Pinnately Compound (even or odd) - Twice Pinnately Compound - Pinnately Trifoliate - Palmately Trifoliate 	<ul style="list-style-type: none"> - Alternate - Opposite - Whorled 	<ul style="list-style-type: none"> - Exstipulate - Stipulate - Sessile - Clasping Base 	<ul style="list-style-type: none"> - Linear - Lanceolate - Oblong - Elliptical - Ovate - Cordate - Oblanceolate - Obovate - Obcordate - spatulate - cuneate - falcate - auriculate - hastate - deltoid - reniform - petlate 	<ul style="list-style-type: none"> - Entire - Doubly Serrate - Undulate - Serrulate - Dentate - Sinuate - Serrate - Crenate - Incised 	<ul style="list-style-type: none"> - Glaucous - Farinose - Scurfy - Viscid / Glutinous - Punctate - Papillate - Tuberculate / Verrucose - Rugrose - Glabrous - Pubescent

Botany Vocabulary Glossary

Leaf Type

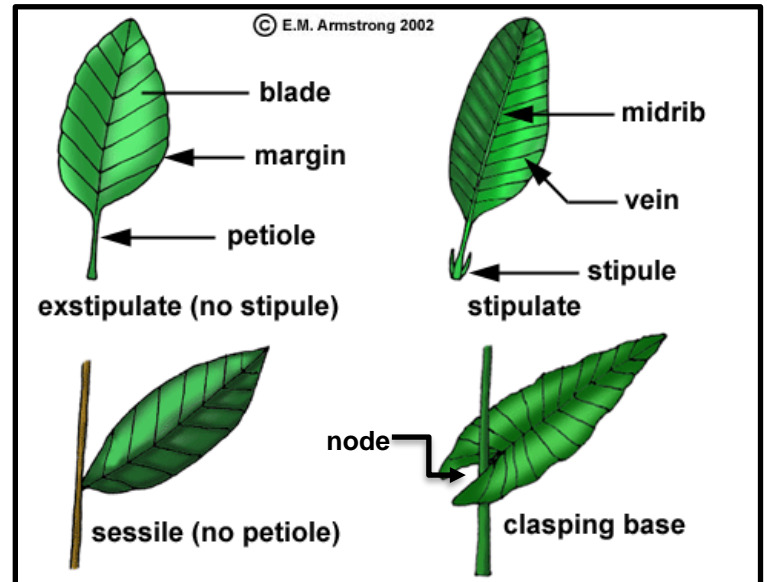
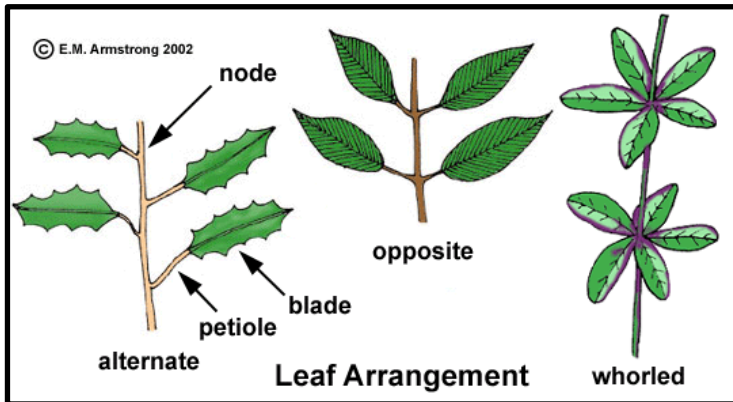
Simple (one leaf)	Palmately Compound	Pinnately Compound
		

Twice Pinnately Compound	Pinnately or Palmately Trifoliate
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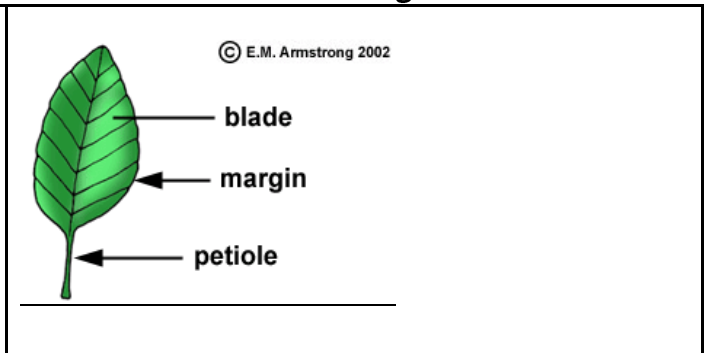
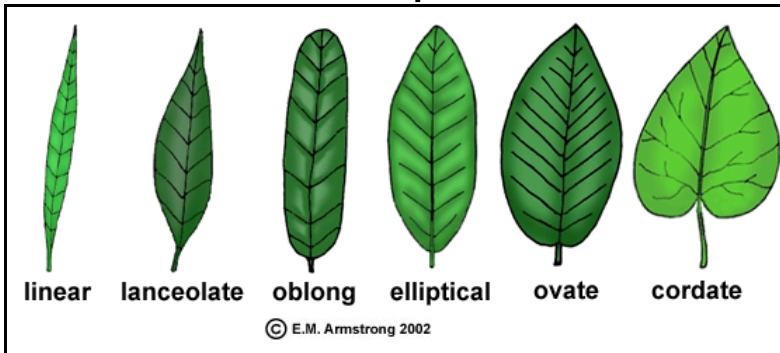
Leaf Arrangement

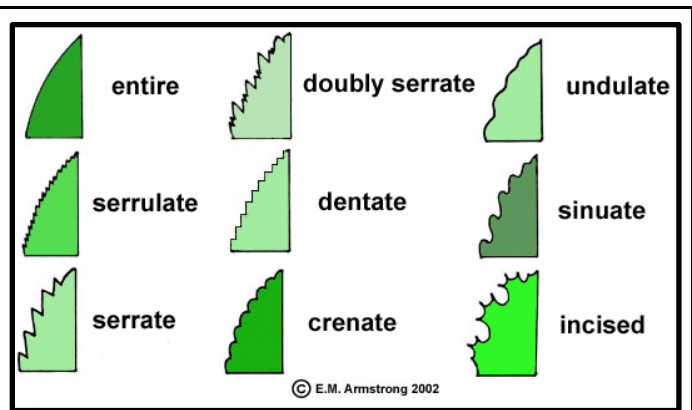
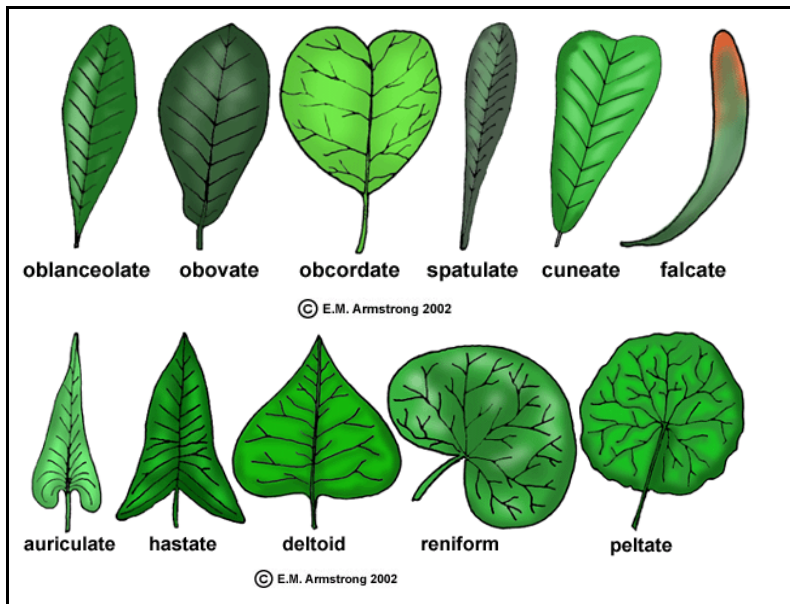
Leaf Attachment



Leaf Shape

Leaf Margins





Leaf Surface

- Glaucous: Covered with a whitish powder or waxy coating.
- Farinose: Covered with a meal-like powder or minute particles.
- Scurfy: Covered with small scalelike particles.
- Viscid (Viscous): Covered with sticky or resinous secretion.
- Glutinous: About the same as viscid.
- Punctate: Dotted with minute pits or translucent dots.
- Papillate (Papillose): Bearing minute, pimplelike protuberances.
- Tuberculate: Bearing tubercles or warty protuberances.
- Verrucose: About the same as tuberculate
- Rugose: Wrinkled--typical leaves of the mint family (Lamiaceae)
- Glabrous: Without hairs of any kind.
- Pubescent: With a hairy surface--there are many kinds of hairiness

(© W.P. Armstrong)

- 3. Preserve your plant!** For this activity you can use the plant that you drew above or any other plant you would like (bonus points if it is an invasive plant)! This is where you will need the hand sanitizer, a clear container large enough to hold your plant piece and something that can be used to manipulate the plant in the hand sanitizer (ie. a chopstick, tweezers, skewer, etc.).

Step 1: Pour sanitizer into your clear container until it is about halfway full



Step 2: Gently push your plant into the sanitizer with your chopstick so at least half of the plant is submerged.



Step 3: Carefully adjust the plant in the sanitizer until it is in the position you would like it to be in.



Step 4: Slowly pour sanitizer until your container is full. Then adjust your plant again as necessary. Voila!



4. Watch our short video on AIS in Lake Tahoe- at keptahoeblue.org/eyes. Then use the Botany Term List from earlier to label these common invasive plants that threaten Lake Tahoe.

Curlyleaf pondweed



Type: _____

Arrangement: _____

Attachment: _____

Shape: _____

Margins: _____

Key characteristics: Leaf margins are very wavy, flowers are above water, and turions form near leaf nodes

Eurasian watermilfoil



Type: _____

Arrangement: _____

Attachment: _____

Shape: _____

Margins: _____

Key characteristics: End of leaf is typically flat, there are 13 or more leaflet pairs per leaf, and the stem collapses out of water.

Follow up questions:

1. Why do you think invasive species are such a threat to local environments? Be specific.
2. Do some research on invasive plants in your area. What are they and how did they get there? What threats have they posed on your local environment? What steps are being taken to tackle this issue in your area?
3. Agencies all around Lake Tahoe work together to reduce the spread of already present aquatic invasive species and prevent the introduction of new invasives to the area. Research the various ways these agencies are tackling the issue and make an argument as to which method you think is most effective.
4. Then, based on this research, propose a new way to help tackle the issue of invasive species for a particular environment.