Plants Underwater:

All About Aquatic Adaptations

GRADES: 3 - 6

TIME FRAME: 50 minutes

SETTING: Indoors

MATERIALS:

Printed “Plant ID Cards”, blank paper for each student, colored pencils

LEARNING OBJECTIVES:

- To learn about the adaptations that allow plants to live in an aquatic environment
- To understand the role of aquatic plants in a stream ecosystem
- To become familiar with some local species they might encounter during a stream study

OVERVIEW:

Students will learn about the specific challenges that plants face when they live in an aquatic habitat. Through a creative drawing activity, they will discover the ways aquatic plants have adapted to living in water. Familiarity with local flora will help students fully understand the ecology of stream habitats and create deeper connections when doing stream studies.

NJ SCIENCE STANDARDS:

3-LS4-3 Construct an argument with evidence that in a particular habitat some organisms can survive well, some survive less well, and some cannot survive at all.

4-LS1-1 Construct an argument that plants and animals have internal and external structures that function to support survival, growth, behavior, and reproduction.

MS-LS1-4 Use argument based on empirical evidence and scientific reasoning to support an explanation for how characteristic animal behaviors and specialized plant structures affect the probability of successful reproduction of animals and plants respectively.

PREPARE AHEAD:

Print the Plant ID Cards at the end of the lesson. Make enough for each group of 3-5 students to have a copy of each.

BACKGROUND:

Plants evolved from algae in the oceans over 700 million years ago. These early plants still occupy many aquatic habitats today and are a part of a group known as non-vascular plants, a primitive group that does not have a root system. Plants then moved onto land around 400 million years ago and began to develop root systems as a strategy to attain water without having to live in it. Plants with roots are known as vascular plants. Some of them evolved from land back into the water. Aquatic plants all have the same needs as land plants, listed in the "Plant Needs" box. Distinguishing pollination, a plant's method of sexual reproduction through pollen distribution, and seed dispersal, a plant's method of spreading seeds away from the parent plant, is an important thing to remember when teaching about plant adaptations. Specific conditions that aquatic plants must overcome through adaptation are listed in the "Aquatic Habitat Challenges" box. Plants grow in a variety of freshwater aquatic habitats including rivers, lakes, ponds, and marshes. Some species are specialists and only survive in a specific habitat; others are generalists and can be found in several habitats.

Aquatic Plant Adaptations

Energy: Broad floating leaves, coatings to protect from the Sun

Defense: Bad smells, coatings of lime

Structure: Long stems, oval-shaped submerged leaves, air-filled sacs to float

Pollination: Flowers rise high above the water and have long stems to reach water surface

Seed Dispersal: Seeds sink to be eaten and spread by fish, or can float to be taken downstream

Just as in terrestrial habitats, aquatic plants provide critical food and shelter for animals in the water. Large organisms like fish and diving ducks eat submerged aquatic plants. Many macroinvertebrates eat living plant material as well, including species of Trichoptera (caddisflies), Coleoptera (beetles), Orthoptera (dragonflies). Fish hide and lay eggs in submerged plants, and both macroinvertebrates and microorganisms attach to roots and stalks to protect themselves from the current or hide from predators. Terrestrial animals like deer and caterpillars eat emergent aquatic plants, and birds nest in them.

Aquatic plants are important to the abiotic elements of their environments as well. The oxygen produced as a product of photosynthesis is incorporated into the surrounding water and is necessary for life in these habitats. Higher oxygen levels can lead to more diverse macroinvertebrate communities. Plants that are rooted in a riverbed or along a shoreline can slow down erosion, maintaining a more stable habitat. The large biomass of aquatic vegetation has a high potential for carbon sequestration and can effectively store carbon taken in from the atmosphere.

Aquatic Habitat Challenges

Getting swept away, having enough light to grow, herbivory by fish, needing to make flowers above the water, spreading seeds, water pollution.

ENGAGE:

Ask students where they have seen plants growing. What kinds of habitats do plants live in? Do plants live in water? Discuss the aquatic environments that they mention (oceans, rivers, lakes, ponds, marshes, etc.) Ask them to discuss how all of these habitats, terrestrial and aquatic, are different. Be sure to discuss the stream habitat if you have already conducted any stream activities. Have they ever seen plants in streams? Define these as aquatic plants and introduce them as the topic of the lesson.

PROCEDURE:

Brainstorm: Put the question on the board, "what unique problems do plants that live in streams face?" Start this conversation by asking what things plants need to survive and make a separate list on the side of the board to stimulate their ideas for the main question. Make sure to thoroughly discuss the "Plant Needs" before having students tackle the main question. Give examples of how land plants do some of these things. Then, as they give answers about aquatic plants, put them on the board. See the "Aquatic Plant Adaptations" list in the background section for reference. The point is not to get all the possible answers here, just the ones authentically generated from discussion to help with the challenge below. Prompt them with the "plant needs" list or with picturing a stream environment if they get stuck, but don't put up answers they didn't generate, you will cover these later during the Culmination section.

Plant Needs

Energy: Use leaves to generate energy from sunlight

Defense: Need to deter animals and bugs that want to eat it (plants can't run away!)

Pollination: need a way for pollen to be spread between flowers

Seed Dispersal: Need a way to spread seeds

Challenge: Put students in small groups of 2 or 3 with paper and colored pencils and introduce their challenge. Students are to come up with their own aquatic plant that is adapted for living in a river: what type of features will it have? Have them consider all the “Plant Needs” when coming up with their plants and write down all their group ideas before they start drawing their final plant. After they finish (10-20 minutes), tell each group to choose three of their plant’s adaptations to share, and have groups present their plants. You may want to make a list of adaptations on the board as they go.

Culmination: Ask students for additional ideas to add to the board. Share that they will now meet some of the native aquatic plants that live in New Jersey streams. Hand out the Plant ID Cards, one per group, and have them discuss the images and their adaptations. You may have them take notes on each species, draw each species, or simply have a discussion. Pass these around until every group has seen each species.

Wrap-Up: Come back together as a group and ask if there was anything surprising that anyone learned about these aquatic plant species. If you have seen or will see any species you discussed, point out how to identify them. You can also talk about why plants are important in a stream (habitat creation, oxygen, filtration, shade, biodiversity, food source, temperature regulation). When doing stream activities in the future, ask them to look at the aquatic plants and discuss how they influence the stream ecosystem.

Long-Leaved Pondweed

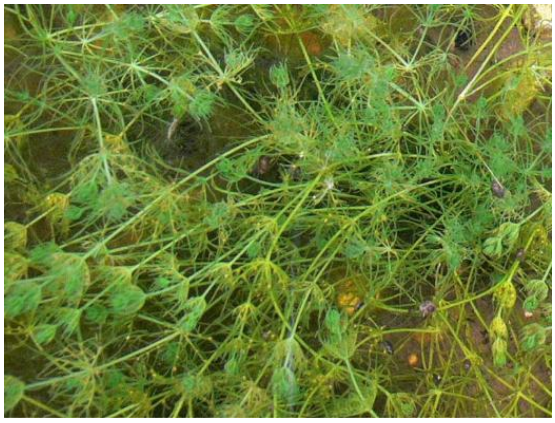
Potamogeton nodosus

- Long petioles on elliptical shaped leaves
- Some leaves submerged, some leaves float on top of the water
- Flowers stick up 6 inches from the water surface

Stoneworts

Chara spp.

- Are green algae, a non-vascular plant
- Creates a thick coating of lime around itself from the surrounding water
- Musky odor when crushed
- Leaves stay submerged so are long and flexible



American Eelgrass

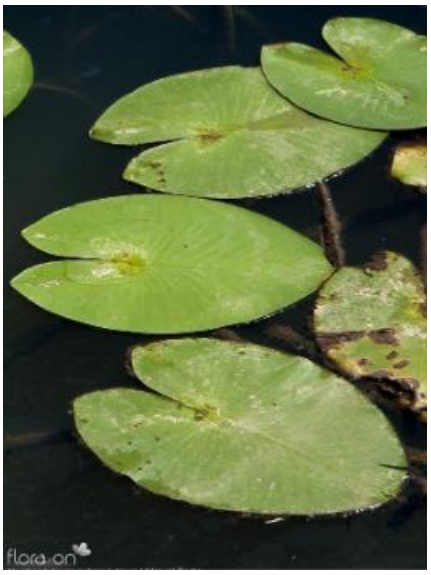
Vallisneria americana

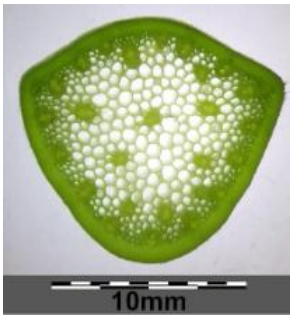
- After flowers are fertilized, the flower stalks curl into spirals and pull the flowers under the surface. An important source of food for turtles and other aquatic wildlife. Good for wetland gardens and habitat.
- Long slender limp submerged leaves
- Flowers float to surface for pollination
- Salt tolerant
- The flowers are sent up to the surface with incredibly long stems, up to 10 feet

Yellow Water Lilly

Nuphar lutea

- Not a native species
- Flat floating leaves
- Stems thick and air-filled to assist floating





Bladderworts

Utricularia sp.

- Carnivorous plants that have “bladders” under the water surface to suck up aquatic invertebrates and eat them
- Flowers rise high above water surface for pollination
- Leaves spread out and float on top of the water surface
- New Jersey has over 10 species of bladderworts!