

Module 1 ~ Silent Invaders (MS/HS)

Gross Plant Anatomy – An Inquiry Lab



~ **gross anatomy** (of plants) ~
the study of parts and/or structure of plants, that is visible to the naked eye.

Introduction: In our never-ending quest to encourage students to spend more time looking at plants, we've developed this inquiry-based lab activity. Ideally this would be done with live plants. However, because many teachers don't always have access to live plants or an aquatic environment, we've assembled a **Freshwater Artificial Plant Kit** for use in the classroom, **available on loan**. (For more information, contact: caip-education@ufl.edu)

Note: If using live plants, be sure to follow guidelines for obtaining or possessing live plants. See *Aquatic Plants in the Classroom*, located in the resource section of our website, plants.ifas.ufl.edu/education.

Essential Questions:

- 1) What can we learn by looking at the structure or “gross anatomy” of a plant (i.e., an aquatic plant)?
- 2) Are there clues that can help us track down the identity of an aquatic plant?
- 3) Can a plant's leaf arrangement, habit, or other characteristics tell us anything about the plant?

Science Subject: biology, botany, environmental science, life science

Grade Level: 6th -12th

Science Concepts: See suggested state standards at the end of this document.

Overall Time Estimate: 1-2 class periods (60-80 minutes)

Learning Styles: Visual, auditory, and kinesthetic

Vocabulary: emersed, submersed, free-floating, floating-leaved, habit, leaf arrangement, leaf attachment, leaf base, leaf margin, leaf shape, leaf tip (See definitions on page 3.)

Lesson Summary: Students will work together to discover ten plants commonly found in Florida's freshwater environments. While doing so, they will also learn a basic classification system used to help categorize the plants and ultimately identify them. This will be done through observation and the creation of a drawing or collage depicting the anatomy or structure of their chosen plant specimen. Once complete, the class will work together to analyze their observations and try to classify or categorize the plants into the following categories (emersed, floating and/or floating-leaved, or submersed). Finally, students will take an even closer look and use plant characteristics (leaf arrangement, leaf shape, etc.) to try and determine common characteristics shared by plants in each category.

Note: Artificial plant kits do not contain an example of a “grass-like” plant. This plant category is not included here, as they involve a level of complexity beyond the scope of this activity.

Student Learning Objectives:

1. Students will sharpen observation skills by creating a drawing OR coloring a botanical illustration OR creating a collage of their specific plant specimen.
2. They will discover special characteristics that allow specific plant species to grow as emersed plants, free floating or floating-leaved plants, or submersed plants.
3. Students will discover that plants have a wide variety of leaf shapes, leaf arrangements and “habits.”



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Materials (teacher):

Printed materials available to download and print from our website: [plants.ifas.edu/education](http://plants.ifas.ufl.edu/education) and also upon request, contact: caip-education@ufl.edu

- Interactive “smartboard” (if possible) OR computer w/LED projector OR overhead projector
- Freshwater Artificial Plant Kit – features 10 plants (listed by common name: fanwort, frog’s bit, hydrilla, hygrophylla, red ludwigia, eel grass, limnophila, water hyacinth, water lettuce and water lily)
- Freshwater Artificial Plant Kit Answer Key (includes plant list by common and scientific name, line drawings, and their status as native, non-native or invasive, along with product name/number, from manufacturer).
- Illustrated Plant Structures (line drawings of various plant parts: leaf shapes, flower parts, roots, and stems)
- Freshwater Plant Habitat Guide (8.5" x 14")
- Freshwater Plants of the SE United States / Recognition Guide (11" x 17")
 - Emersed
 - Floating
 - Submersed
 - Grass-like
- Plant ID Table (pg 6 of this document)
- Venn Diagram (pg 7 of this document)

Materials (students):

- 1-2 sheets of drawing paper (8.5" x 11" or larger)
- Pencil and eraser for drawing OR colored paper, pencils, scissors and/or glue for making collage
- OPTIONAL: Flashcards – *Native Plants You Should Know* and also *Invasive and Non-native Plants You Should Know* Located in the resource section of our website: <http://plants.ifas.ufl.edu/education>.
Note: Free print copies available upon request, caip-education@ufl.edu

Resource links:

- Aquatic, Wetland and Invasive Plants Line Drawings : <http://plants.ifas.ufl.edu/plant-directory/plant-line-drawings/>
- For a basic introduction to aquatic and wetland plants in Florida and also information on native, non-native, and invasive plants, see Section 1 of the Plant Management in Florida Waters website. For more information on scientific and common names see Section 5: <http://plants.is.ufl.edu/manage>
- See resource section of CAIP Education Initiative website for the following documents (<http://plants.ifas.ufl.edu/education>)
 - Freshwater Plant Habitat Guide (8.5" x 14")
 - Botany Handbook for Florida
 - Illustrated Plant Structures
 - Flash Cards (*Native Plants You Should Know* and *Invasive Non-native Plants You Should Know*)

Background Information:

See resource links (above) and website for these individual plant pages: <http://plants.ifas.ufl.edu>

Listed by common name:

- | | | |
|---------------|------------------|-----------------|
| ▪ fanwort | ▪ red ludwigia | ▪ water lettuce |
| ▪ frog’s bit | ▪ eel grass | ▪ water lily |
| ▪ hydrilla | ▪ limnophila | |
| ▪ hygrophylla | ▪ water hyacinth | |

And see Plants listed by category: <http://plants.ifas.ufl.edu/category>



Florida Invasive Plant Education Initiative • <http://plants.ifas.ufl.edu/education>
A Collaboration of the UF/IFAS Center for Aquatic and Invasive Plants
and the Florida Fish and Wildlife Conservation Commission / Invasive Plant Management Section

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Advance Preparation:

- Review resource material and background information.
- Assemble student material (download and print) from CAIP education website or request classroom sets (caip-education@ufl.edu).
- Prepare computer equipment, overhead projector or “smartboard.”

Vocabulary Definitions

compound - composed of two or more similar and united parts (as a leaf with 2 or more leaflets)

emersed plants - are rooted in shallow water with much of the growth above the water. Example: pickerel weed

floating-leaved plants - are primarily rooted to sediments and also have leaves that float on the water's surface. Example: waterlilies, spatterdock, and the American lotus

free-floating plants – are not anchored in the sediment; they get their nutrients directly from the water. Example: duckweeds, bladderwort, coontail, water hyacinth

grass-like - mostly herbaceous flowering plants with jointed stems, slender sheathing leaves; plants that look similar to grasses but contain members of the sedge or rush family

habit - the characteristic appearance of a plant and its stems/leaves (including size, shape, color, pattern of growth etc.). Example: tall, erect, spreading, etc.

herbaceous - soft, grassy, non-woody plants that according to season (autumn) lose their above-ground growth but leave intact roots and produce new growth in the new season (spring)

leaf arrangement – refers to the various ways plants will have their leaves positioned on the stalk; they are commonly in pairs, opposite one another on the stem, or they are produced singly in an alternate arrangement

leaf attachment - the way leaves are attached to the stem of plant

leaf base - the lowest part of a leaf (near the petiole or stem); the bottom of the leaf where it attaches to the plant

leaf margin - the edge or border of a leaf; whether it is smooth, toothed, wavy, etc; it is a helpful feature in plant identification

leaf shape - any of the various shapes that the blades (leaves) of plants can assume

leaf tip - the point on a leaf furthest from the stem

petal - the colored parts of the corolla (most of the time), usually arranged in a circle; most visible part of the flower

pistil - the female reproductive organ of a flower; may be comprised of a single carpel (consisting of stigma, style and ovary) or two or more carpels united

root - the part of a plant, usually below ground, that holds the plant in position, draws water and nutrients from the soil, stores food, and is typically non-green, without buds or leaves

sepal - any of the leaf divisions of the calyx; part of the outer floral leaves, usually green

stamen - the male reproductive organ of a flower; situated within the petals and in most cases is composed of the filament and the anther, that produces pollen

stem - the main axis of a plant, typically above the soil surface; generally supports the leaves

stigma - the upper tip or part of the pistil of a flower receiving the pollen. It is generally situated at the upper extremity of the style

submersed plants – grow with their roots, stems, leaves completely under the surface

woody - plants that have woody stems and grow continuously throughout the year, many years in a row, without losing their above-ground growth with the change of seasons



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Procedure and Discussion

Part 1 —

(10-15 minutes)

- Arrange classroom so students can work in groups of three or four individuals with plenty of elbow room.
Begin by familiarizing students with the names and identities of the plants in the kit:
- Project illustrations from the **Answer Key** (found in the Freshwater Artificial Plant Kit or download and print) and the **Plant ID table** (see page 6) on a smartboard OR an overhead projector OR on a screen using a computer and LED projector.
- Ask students to refer to the line illustration (on the Answer Key) to identify the plants in the kit. The teacher or students will write the plant names on the **Plant ID table**. If there is time, use this opportunity to discuss common and scientific plant names and the benefits of learning scientific names: <http://plants.ifas.ufl.edu/node/22>

Note: The artificial plant samples aren't going to "match" the line illustrations exactly; ask students to use their imagination and compare the basic shape and elements of the plant when comparing to the illustrations.

Part 2 — To sharpen observation skills, students create their own line drawing of the plant itself

(15-25 minutes)

OR... students color a botanical line drawing (download from this web page:

<http://plants.ifas.ufl.edu/plant-directory/plant-line-drawings/>

OR... students create a collage using colored paper shapes to visually describe the plant.

Suggested reference materials for Step 2:

- Line drawings from individual plant information pages: <http://plants.ifas.ufl.edu>
- Flash cards – available on the resource section of our website: <http://plants.ifas.ufl.edu/education>

Part 3 — When the creative observation activity is complete, review definitions and images from:

(10 minutes)

- Freshwater Plant Habitats and/or
- Freshwater Plants of the SE United States / Recognition Guide

(Note: consider projecting these documents on the smartboard or using computer/projector)

Talking Points:

- Discuss the definition of the various types of aquatic plants (emersed, submersed, etc.), if using a smartboard, refer to this web page for more information: <http://plants.ifas.ufl.edu/manage/why-manage-plants/native-plants>
- Discuss how this system is used as the first "tier" of classifying aquatic plants — a basic way of categorizing by their location/placement in the habitat (i.e., above the water, below the water surface, floating etc.)
- Clarify the difference between a **free-floating plant** and a **floating-leaved plant** (roots still connected to the bottom, with leaves on the surface). Be sure to discuss how some of these plants may be fit into more than one category depending on the environment and water levels. For example: frog's bit, a Florida native plant, is an emersed plant that may also be found as a floating plant. For fun, see which of these plants might be classified into more than one category? What would cause this to happen? Hint: water levels play a large role. (See the answer key or refer to individual plant information pages: <http://plants.ifas.ufl.edu>)



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(10-15 minutes)

Part 4 — After discussion (above), complete the “plant type” category column on the Plant ID table together with students. Ask them to make an educated guess, based on what they’ve learned. Note: If this activity is done with live plants, you will have to make your own answer key and plant list for students to use as a guide.

Refer to Artificial Plant Kit -- Answer Key.

Part 5 — Now that students have observed and drawn the plants, it’s time to finish the exploration and discussion (from Step 4). Together, use the VENN diagram (pg 7) to list and describe characteristics used by botanists/taxonomists to distinguish plants from one another.

(10-15 minutes)

Directions for Step 5 Venn diagram: Choose two plants from the same aquatic plant category (emersed, free floating, submersed, etc) and complete the Diagram.

1. Write the name of Plant #1 on the first line, in the circle on the left.
2. Write the name of plant #2 on the first line, in the circle on the right.
3. Use the Illustrated Glossary of Leaf Shapes to identify the various characteristics of each plant (leaf arrangement, leaf shapes, etc.). List your observations for each plant.
4. When done with each list, look for similar traits and write these in the center space.

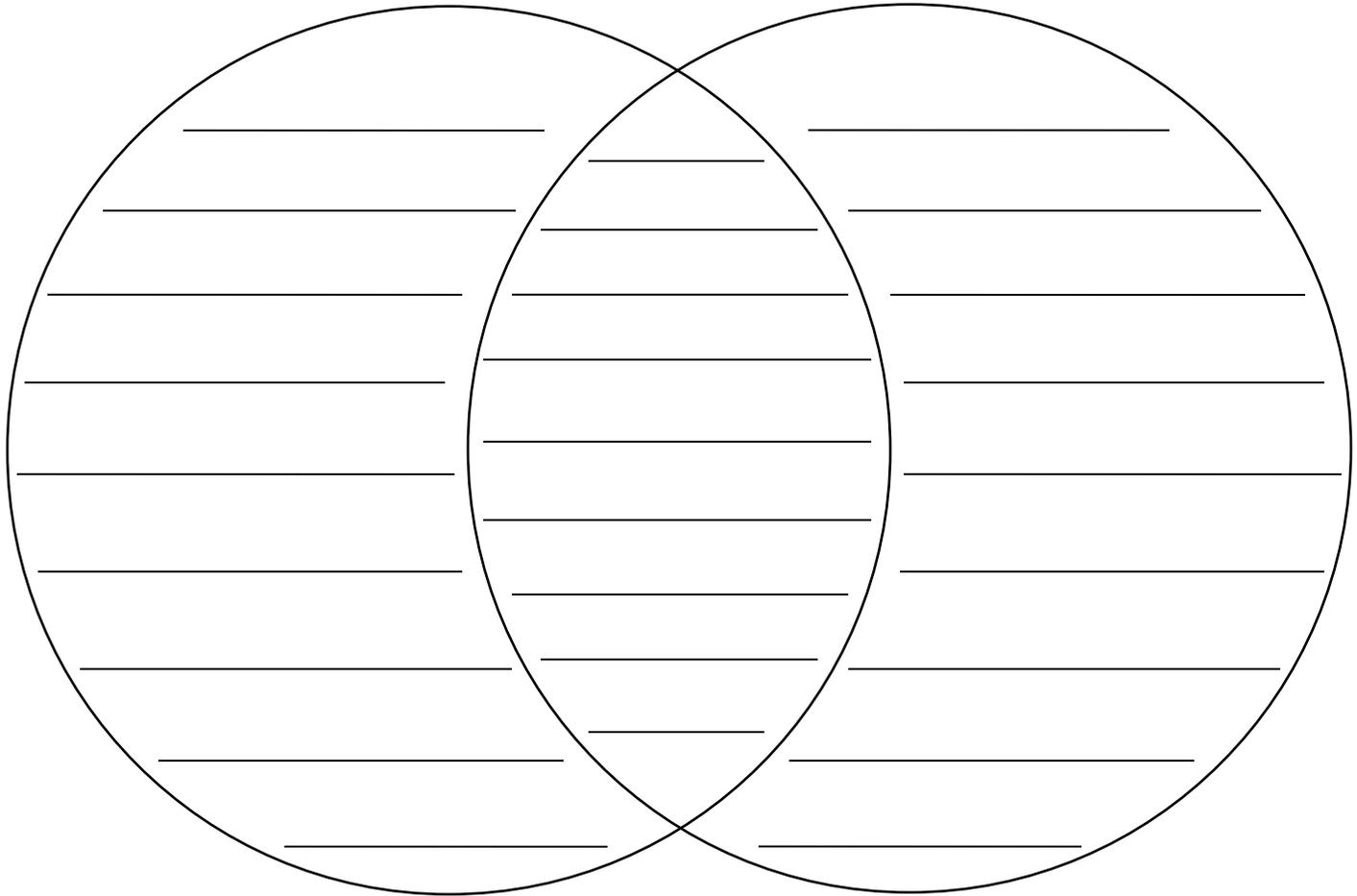
Assessment Suggestions: Once students have completed all five steps of this activity, ask them to label their drawing, colored line illustration, or collage — using terminology from the *Illustrated Glossary of Leaf Shapes*. Or ask students to use their illustration to guide them as they write a descriptive piece about their plant as if they were a botanist and discovered the plant for the first time.



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Venn Diagram



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The following is a list of suggested standards that pertain to this activity. This list is provided as a reference to incorporate and expand upon as needed.

Next Generation Sunshine State Standards

6th Grade

SC.6.L.15.1: Analyze and describe how and why organisms are classified according to shared characteristics with emphasis on the Linnaean system combined with the concept of Domains.

SC.6.N.1.4: Discuss, compare, and negotiate methods used, results obtained, and explanations among groups of students conducting the same investigation.

9th - 12th Grades

SC.912.L.14.7: Relate the structure of each of the major plant organs and tissues to physiological processes.

SC.912.L.14.53: Discuss basic classification & characteristics of plants. Identify bryophytes, pteridophytes, gymnosperms, and angiosperms.

Common Core State Standards

6th Grade

Common Core Code	FL Common Core Code	Common Core Standard
RI.6.7	LAFS.6.RI.3.7	Integrate information presented in different media or formats (e.g., visually, quantitatively) as well as in words to develop a coherent understanding of a topic or issue.
SL.6.1	LAFS.6.SL.1.1	Engage effectively in a range of collaborative discussions (one-on-one, in groups, teacher-led) with diverse partners on grade 6 topics, texts, and issues, building on others' ideas and expressing their own clearly.
L.6.3	LAFS.6.L.2.3	Use knowledge of language and its conventions when writing, speaking, reading, or listening.
L.6.4	LAFS.6.L.3.4	Determine or clarify the meaning of unknown and multiple-meaning words and phrases based on grade 6 reading and content, choosing flexibly from a range of strategies.
L.6.6	LAFS.6.L.3.6	Acquire and use accurately grade-appropriate general academic and domain-specific words and phrases; gather vocabulary knowledge when considering a word or phrase important to comprehension or expression.
RST.6-8.4	LAFS.68.RST.2.4	Determine the meaning of symbols, key terms, and other domain-specific words and phrases as they are used in a specific scientific or technical context relevant to grades 6–8 texts and topics.
RST.6-8.7	LAFS.68.RST.3.7	Integrate quantitative or technical information expressed in words in a text with a version of that information expressed visually (e.g., in a flowchart, diagram, model, graph, or table).

7th Grade

SL.7.1	LAFS.7.SL.1.1	Engage effectively in a range of collaborative discussions (one-on-one, in groups, teacher-led) with diverse partners on grade 7 topics, texts, and issues, building on others' ideas and expressing their own clearly.
L.7.3	LAFS.7.L.2.3	Use knowledge of language and its conventions when writing, speaking, reading, or listening.
L.7.4	LAFS.7.L.3.4	Determine or clarify the meaning of unknown and multiple-meaning words and phrases based on grade 7 reading and content, choosing flexibly from a range of strategies.
L.7.6	LAFS.7.L.3.6	Acquire and use accurately grade-appropriate general academic and domain-specific words and phrases; gather vocabulary knowledge when considering a word or phrase important to comprehension or expression.
RST.6-8.4	LAFS.68.RST.2.4	Determine the meaning of symbols, key terms, and other domain-specific words and phrases as they are used in a specific scientific or technical context relevant to grades 6–8 texts and topics.
RST.6-8.7	LAFS.68.RST.3.7	Integrate quantitative or technical information expressed in words in a text with a version of that information expressed visually (e.g., in a flowchart, diagram, model, graph, or table).

8th Grade

SL.8.1	LAFS.8.SL.1.1	Engage effectively in a range of collaborative discussions (one-on-one, in groups, teacher-led) with diverse partners on grade 8 topics, texts, and issues, building on others' ideas and expressing their own clearly.
L.8.3	LAFS.8.L.2.3	Use knowledge of language and its conventions when writing, speaking, reading, or listening.



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L.8.4	LAFS.8.L.3.4	Determine or clarify the meaning of unknown and multiple-meaning words or phrases based on grade 8 reading and content, choosing flexibly from a range of strategies.
L.8.6	LAFS.8.L.3.6	Acquire and use accurately grade-appropriate general academic and domain-specific words and phrases; gather vocabulary knowledge when considering a word or phrase important to comprehension or expression.
RST.6-8.4	LAFS.68.RST.2.4	Determine the meaning of symbols, key terms, and other domain-specific words and phrases as they are used in a specific scientific or technical context relevant to grades 6–8 texts and topics.
RST.6-8.7	LAFS.68.RST.3.7	Integrate quantitative or technical information expressed in words in a text with a version of that information expressed visually (e.g., in a flowchart, diagram, model, graph, or table).

9th – 10th Grade

SL.9-10.1	LAFS.910.SL.1.1	Initiate and participate effectively in a range of collaborative discussions (one-on-one, in groups, and teacher-led) with diverse partners on grades 9–10 topics, texts, and issues, building on others' ideas and expressing their own clearly and persuasively.
L.9-10.4	LAFS.910.L.3.4	Determine or clarify the meaning of unknown and multiple-meaning words and phrases based on grades 9–10 reading and content, choosing flexibly from a range of strategies.
L.9-10.6	LAFS.910.L.3.6	Acquire and use accurately general academic and domain-specific words and phrases, sufficient for reading, writing, speaking, and listening at the college and career readiness level; demonstrate independence in gathering vocabulary knowledge when considering a word or phrase important to comprehension or expression
RST.9-10.4	LAFS.910.RST.2.4	Determine the meaning of symbols, key terms, and other domain-specific words and phrases as they are used in a specific scientific or technical context relevant to grades 9–10 texts and topics.
RST.9-10.7	LAFS.910.RST.3.7	Translate quantitative or technical information expressed in words in a text into visual form (e.g., a table or chart) and translate information expressed visually or mathematically (e.g., in an equation) into words.

11th – 12th Grade

RI.11-12.7	LAFS.1112.RI.3.7	Integrate and evaluate multiple sources of information presented in different media or formats (e.g., visually, quantitatively) as well as in words in order to address a question or solve a problem.
SL.11-12.1	LAFS.1112.SL.1.1	Initiate and participate effectively in a range of collaborative discussions (one-on-one, in groups, and teacher-led) with diverse partners on grades 11–12 topics, texts, and issues, building on others' ideas and expressing their own clearly and persuasively.
L.11-12.4	LAFS.1112.L.3.4	Determine or clarify the meaning of unknown and multiple-meaning words and phrases based on grades 11–12 reading and content, choosing flexibly from a range of strategies.
L.11-12.6	LAFS.1112.L.3.6	Acquire and use accurately general academic and domain-specific words and phrases, sufficient for reading, writing, speaking, and listening at the college and career readiness level; demonstrate independence in gathering vocabulary knowledge when considering a word or phrase important to comprehension or expression.
RST.11-12-8.4	LAFS.1112.RST.2.4	Determine the meaning of symbols, key terms, and other domain-specific words and phrases as they are used in a specific scientific or technical context relevant to grades 11–12 texts and topics.
RST.11-12-8.7	LAFS.1112.RST.3.7	Integrate and evaluate multiple sources of information presented in diverse formats and media (e.g., quantitative data, video, multimedia) in order to address a question or solve a problem.

