**Module 2 Instructional Plan**

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| **General Information**  |
| **Lesson Title:** Opening Your Eyes to the Diversity of Plants |
| **Overview:** This activity picks up from Module 1 where students chose the plant they wanted to represent their botanical history. In that module, they each identified their plant’s family and were given its scientific name. Module 2 provides students with an overview of the four major groups of land plants (bryophytes, ferns and allies, gymnosperms, and angiosperms), as well as familiarizing students with organisms that are often mistaken for plants (e.g., fungi, lichens, algae). Students will also be introduced to the Linnaean hierarchy as applied to major plant groups. Once students become familiar with plant characteristics and distinguishing features for major groups, they will be able to identify the group their own plant belongs to.  |
| **Subject(s):** Biology, Botany |
| **Grade Level/Setting:** Grades 9-12/ Biology or Ecology Science classroom and outdoor lab |
| **Prerequisite Skills/Prior Knowledge:**Students should have a basic understanding of plants and their basic organs (leaves, stems, roots, and reproductive organs).  |
| **Three Dimensions**  |
| **Disciplinary Core Ideas:**Life Sciences: LS4 - Biological Evolution: Unity and Diversity |
| **Science & Engineering Practices:**Engaging in Argument from Evidence  |
| **Crosscutting Concepts:**PatternsStructure and Function  |
| **Integration:**Through interactive activities, students will explore the diversity of plants by learning about the characteristics that define the four major groups of plants from each other and from non-plants. Students will apply Linnaean hierarchical classification to groups they learn about and to their chosen plant by gathering evidence and constructing arguments to support their classification of their chosen plant. They will review common plant structures and their functions, including organs and modes of reproduction.  |
| **Standards and Objectives**  |
| **NGSS Performance Expectations:**HS-LS4-1. Communicate scientific information that common ancestry and biological evolution are supported by multiple lines of empirical evidence. |
| **Tennessee Science Standards:**BIO2.LS4.12- Analyze evolutionary relationships among algae and major groups of plants. In this analysis, consider adaptations necessary for survival in terrestrial habitatsBIO2.LS4.13- Interpret data supporting current plant classification schemes. Use a dichotomous key to identify plants based on variations in characteristics. |
| **Learning Objective(s):** **The learner will:**1. Distinguish plants from non-plants.
2. Describe the differences between the four major groups of plants.
3. Apply and utilize the Linnaean hierarchy to identify the major groups of plants.
4. Identify important characteristics used to distinguish the major groups of plants.
5. Use a dichotomous key to differentiate among major plant groups.

**Guiding Question:** How do we characterize and organize plants on Earth?  |
| **Materials /Resources** | **Technology** |
| * Botanical card-sorting game **(PowerPoint)** and answer key
* Live plant material outdoors or in greenhouse
* What is a Plant? Mind Mapping Worksheet **(Handout 2.1)**
* Introduction to Land Plants Presentation
* Scavenger hunt worksheet (**Handout 2.2**)
* Dichotomous key to the land plants (**Handout 2.3**)
* Wikipedia Plant Search **(Handout 2.4)**
* Plant questionnaire **(Handout 2.5)**
* How are plants used today? **(E2.1)**
* Types of land plants **(E2.2)**
* Dichotomous key practice **(E2.3)**
 | Internet access (e.g., computer or cell phone)  |
| **Safety Concerns** |
| Typical precautions for outdoor lab activities should be taken if going outdoors.  |
| **Academic Language** |
| **Vocabulary:**Non-plants: fungi, lichens, seaweeds, algae.Plants: mosses, ferns and allies, gymnosperms (conifers), angiosperms (flowering plants), “early” angiosperms, monocot, eudicot, roots, stems, leaves; bark; rhizomes; flowers, cones, spores, seeds, kingdom, division, class, order, family, genus, species. |
| **Other Language Demands:**Syntax: Linnaean taxonomic hierarchy, binomial nomenclatureDiscourse: class discussions and/or written responses to guiding questions  |

**5E Instructional Strategies and Learning Tasks**

**Engagement**

Working in groups, students are asked to collaborate in crafting a definition that answers the question, “What is a plant?” using **Handout 2.1: What is a plant?** (with teacher notes). Once the group has written down a definition, they will work to complete a card-sorting activity where they will apply this definition. Each group will then compare results with the class by sharing their definition with the class and discussing specific cards that were hard to place. The cards are available in PowerPoint format, and an answer key is also provided.

**Enrichment:** Students may complete the “How are plants used today” enrichment handout (**E2.1**). This can extend class time if needed or be used as supplementary work.

**Exploration**

The teacher will give a short presentation (**Introduction to Land Plants**) on the characteristics that distinguish the major groups of plants and the Linnaean hierarchy as it applies to these groups, particularly at the family, genus, and species level. Students should take notes during the presentation, paying careful attention to details that will help them distinguish among each group.

Students will complete a botanical “scavenger hunt” worksheet (**Handout 2.2:** **Plant Scavenger Hunt**)that will require them to identify important features of each plant group. Students will work in groups and go outdoors to find plant material to complete the table. Alternatively, fresh material could be provided by the teacher to ensure all plants and plant parts are available. NOTE: If fresh material is inaccessible, printed images of plants/plant parts could be provided for students to complete the table.

Students can glue or tape plant material to their table in the handout. Discuss any plant structures the students placed incorrectly in their tables and discuss where they should go. Questions to discuss with the class after they complete the scavenger hunt:

* Which groups of plants have spores? Which have seeds?
* Describe some of the different ways that seeds and/or fruits are dispersed.
* Which plant groups have members that are “woody”?
* Which plant groups rely on water for reproduction? Which uses wind? Insects?

**Enrichment:** Students may complete the “Types of land plants” enrichment handout (**E2.2**) for further explanation on the land plants. This is useful for students who may be behind or require extra support.

**Explanation**

Students will now apply what they learned about plant groups to the plant they chose for their family botanical history. The teacher will provide each student with a dichotomous key (**Handout 2.3: Dichotomous Key to the Land Plants**) to the major groups of plants (+ three angiosperm subgroups). Students will then work through the dichotomous key to determine what major group of plants their species belongs to using visualization and images found of their species.

Students should not “guess” while working through the key. They can search for images using the species name and key words. For example, doing a Google image search with the terms “*Magnolia grandiflora* seed” would allow the student to view photos to answer questions about seeds and/or fruit in the key. Once the students have keyed out their plant and determined which major group it belongs to, the students will provide justification using the specific evidence they obtained (from direct observations, images, or fresh material). The teacher should offer corrections as needed to ensure students have keyed their plant correctly. This part of the assignment could be completed as homework.

**Enrichment:** If students still do not understand how to use a dichotomous key or what they are used for after this activity, the students may complete the “dichotomous key practice” enrichment handout (**E2.3**). This can also be used as supplementary work to extend class time.

**Elaboration**

Students will work through the taxonomy of their chosen species by completing a worksheet and using web resources. **Handout 2.4: Wikipedia Plant Search** will guide students through using Wikipedia to learn more about the taxonomic position of their species. Questions on the handout will prompt students to find additional information about their plant using the resources available on Wikipedia. Students could then share this information with the class or turn in materials directly to the teacher.

Questions to discuss with the class after they complete the handout:

* What is the difference between a scientific name and a common name?
* Discuss the advantages of using scientific names for plants, particularly when crossing language and cultural barriers.
* What new information did you learn about your plant from your research?

**Extension**: Additional time may be spent further discussing taxonomy with students. Prompt students to propose reasons why classification systems are important and how science – and the general public – can benefit by grouping organisms together in specific ways.

**Evaluation**

Utilizing the tasks and research students have completed, they will now complete **Handout 2.5: Plant Questionnaire**,where they will provide important information about their plants (e.g., family, important plant relatives, the distribution of those plants, etc.) to use later.