Mississippi Science

Botany

Plant Morphology, Cell Structure, and Function BOT.1	**Conceptual Understanding: Plants are a diverse and important part of the biosphere, providing oxygen, food, and shelter required for other organisms. The diversity of the plant kingdom is characterized by unique traits that are observed to identify the various plant divisions.**

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A Students will investigate the morphology, anatomy, and physiology of plants. BOT.1A

1 Analyze models (3-D, paper, and/or computer-based) to distinguish the basic morphology of the plant kingdom, with attention to structures and their related functions. Use cladograms or phylogenetic trees to identify evolutionary features that distinguish the plant kingdom from other kingdoms. BOT.1A.1

2 Using microscopes, observe, identify, record, and analyze (e.g., see and draw) cells and cell structures unique to plants. Use data measurements obtained from microscopy to compare the plant cells and organelle sizes between various examples (e.g., elodea, onion, or algae). BOT.1A.2

3 Describe the relationship between the structure and purpose of plant organs (e.g., roots, stems, and leaves). BOT.1A.3

4 Evaluate and explain how bacteria and fungi work symbiotically to enhance plant root function. BOT.1A.4

5 Calculate surface area of leaves/roots and compare surface areas of various plant specimens to explain adaptations of the various plant types. BOT.1A.5

6 Demonstrate through model development and manipulation an understanding of plant biochemistry. BOT.1A.6

7 Conduct investigations, collect and analyze data, and communicate results that explain the processes of photosynthesis and cellular respiration (e.g., light intensity, light color, light distance, temperature, altering pH, oxygen availability, and carbon dioxide concentration). BOT.1A.7

8 Enrichment: Use an engineering design process to manipulate a variable of choice to refine a protocol to optimize output of photosynthesis or cellular respiration. * BOT.1A.8

9 Communicate the importance of carbon, hydrogen, oxygen, phosphorus, and nitrogen cycles to plant physiology through graphics such as poster or computer presentations. BOT.1A.9

10 Identify and compare various live plant examples to explore plant morphological diversity, including leaf number, structure, and arrangement; root modifications; and flower structure and arrangement. Produce a visual product (e.g., an electronic presentation) to identify and communicate patterns of similarity and differences between the lab specimens. BOT.1A.10

11 Compare and contrast functions of the various characteristics found in plant divisions and utilize dichotomous keys to identify plant species. BOT.1A.11

Plant Evolution BOT.2

Conceptual Understanding: Plants have been naturally selected to survive in a variety of habitats, from aquatic to arboreal. The development of these characteristics is used to construct cladograms that illustrate the evolution of plants.

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A Students will identify evolutionary modifications necessary for the terrestrial survival of plants. BOT.2A

1 Summarize and justify the characteristics of nonvascular algae (blue-green and green algae) and bryophytes that provide evidence of evolution within the plant kingdom. BOT.2A.1

2 Referencing the USDA plants database, identify, compare, and contrast seedless, naked seed, and enclosed-seed modifications for reproduction. Calculate the occurrence of seed types in given habitats. BOT.2A.2

3 Summarize and justify the characteristics of angiosperms and gymnosperms that lead to their success as terrestrial plants. BOT.2A.3

4 Research information to develop, produce, and communicate a scientifically justifiable argument for the rapid amplification and success of angiosperm compared to other plant divisions. BOT.2A.4

5 Enrichment: Referencing the National Center for Biotechnology Information's gene/protein databases, propose and design a scientifically supportable cladogram or phylogenetic tree that illustrates the evolutionary modifications of the plant kingdom using genetic (DNA) or protein sequence comparisons/alignments. BOT.2A.5

Plant Reproduction BOT.3

Conceptual Understanding: Reproduction in plants occurs through different methods. Understanding the reproductive methods of plants allows humans to use these methods in agriculture and food development.

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A Students will characterize the reproductive strategies of plants. BOT.3A

1 Describe the various processes of asexual reproduction and vegetative propagation used by plants. Communicate the importance of these reproductive methods in regard to human food production. BOT.3A.1

2 Enrichment: Research and present an agronomically important crop (e.g., potato, sweet potato, pineapple, or strawberry) that is produced via vegetative propagation (non-GMOs) for human consumption. Include evidence-based arguments that identify the potential benefits and negative effects of this method of crop production. BOT.3A.2

3 Compare and contrast the consequences of the following reproductive methods: asexual reproduction, vegetative propagation, and sexual reproduction. BOT.3A.3

4 Plan and conduct comparative flower dissection to identify reproductive structures within the flower. BOT.3A.4

5 Compare the similarities between corresponding plant reproductive structures from a variety of species. Record via drawings of observed dissection specimens and explain the similarities and differences observed. BOT.3A.5

6 Identify differences in flower structure and shape. Provide a rationale that explains the value of these differences in flower structure to reproductive success (e.g., pollinators, flower shape, smell, color, size, orientation). BOT.3A.6

7 Plan, conduct, and communicate the results of a comparative laboratory investigation of differing fruit types. BOT.3A.7

8 Using laboratory data, correctly categorize fruits, vegetables, nuts, modified stems, or other plant parts. Compare the scientific definitions of these terms to those used by the general public/society and the USDA to categorize food. BOT.3A.8

Society's Reliance on Plants BOT.4

Conceptual Understanding: Human reliance on plants and plant products began with food and building materials. This use has expanded to include medicine, industrial clean up (phytoremediation) of human-generated byproducts and toxic waste, and plant examples used in biomimicry for solving human problems.

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A Students will explore the global value of plants and the interaction between humans and plants. BOT.4A

1 Identify plants used in the bioremediation of an area due to natural processes (e.g., fire), industrial pollution, or wars, and develop and communicate a plan to remediate a habitat impacted by human interactions (e.g., carbon sinks, phytoremediation, or heavy metal detoxification). BOT.4A.1

2 Use an engineering design process to define a problem, design, construct, evaluate, and improve a habitat impacted by human interactions. * BOT.4A.2

3 Investigate historical and modern medicinal uses of plants. BOT.4A.3

4 Investigate the industrial use of plants. BOT.4A.4

5 Explore the impacts (both positive and negative) of plant biotechnology/GMOs on human society. Present findings using digital media or technology and include evidence using graphs or charts. BOT.4A.5

6 Enrichment: Use an engineering design process to design and conduct an investigation that uses biomimicry to provide a plant-based solution to an environmental challenge. * BOT.4A.6

Plant Adaptations to Varying Habitats BOT.5

Conceptual Understanding: Before animal life forms can survive within a habitat, there must be an existing plant population. Plants have specific adaptations that allow them to survive in habitats.

A Students will explore adaptations that allow plants to survive in various habitats. BOT.5A

1 Research plants found in various habitats. Analyze how plants use adaptations for survival in these habitats including extreme habitats. BOT.5A.1

2 Relate atmospheric factors to biodiversity (e.g., climate as determined by temperature and precipitation). BOT.5A.2

3 Construct a model using technology that illustrates the levels of succession within a habitat (e.g., graveyard exploration, forest fire area, or reclamation sites). BOT.5A.3

4 Enrichment: Use an engineering design process to design and build a plant model based on extreme environment criteria to overcome the difficulties presented by this environment. Identify revisions to the proposed model over time. * BOT.5A.4

Local Plant Investigations BOT.6

Conceptual Understanding: The plant diversity within the local environment impacts the health of the ecosystem. The ability to identify the plants within an ecosystem is a skill that will benefit students throughout life.

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A Students will ask questions, plan, and conduct field investigations on local plant communities. BOT.6A

1 Conduct transects/plot studies to determine species, biodiversity, or health of a plant community. (Plots may be linear or a quadrat (square or circular) depending on the habitat. (Typically, relative density, relative dominance, and relative frequency of each species are calculated to infer an important value of the species in the plot.) BOT.6A.1

2 Compare and contrast genomes using plant genetic databases (e.g., BLAST or plant GDB). BOT.6A.2

3 Enrichment: Use an engineering design process to define a problem, design, construct, evaluate, and improve a societal concern with the aid of plants (e.g., irrigation, water conservation, urban shading, green-space development, food deserts, or other local needs or issues). * BOT.6A.3