

Temperate Forest Foundation Lesson Plan

An Aspect of Forestry Stewardship

Competition Among Plants-Classifying the best environment for a plant or tree to thrive

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This lesson is appropriate for **high school biology** or **advanced 7th Graders studying life sciences/plants**. Although this is often used for ruderal plant placement, it is appropriate for cycads and can be used in essence for all plants.

Keywords

Competitive, favorable habitat, stress tolerance, resource limits, opportunistic, ruderal, taxonomic grouping, characteristics, adaptive strategy, global zonobiome, principle of constancy

Description

All plants/trees have a zonobiome and/or ecosystem that is best for the plant or trees success in growth and maturity. Sustainable forestry requires an intimate knowledge of these ideal biomes so that plants can be farmed purposefully. Since trees require decades of growth, it is most important to get the data correct as an incorrect planting can have a multi-year ripple effect. This lesson allows students the opportunity to think through the processes used in forestry and farming for maximizing a harvest without resorting to GMO's or non-organic methods of nurturing plant growth (see attached .pdf).

Time and Setting

Depending on whether or not this assignment is done in class with realia samples or via an actual field trip would determine the amount of time for the lesson. In addition, if focus of samples are limited to trees vs. all plants from algae to cycads, there will be a time differential.

Ideally this lesson would be done at a site where there is access to a variety of plant life. At a minimum, it would be invaluable to have realia (Carolina Biological) if a field trip is not possible. Photos do not necessarily represent the necessary dimensions for observation and would require much more teacher research to provide the background (see attached .pdf).

Objective- Students will be able to examine structural (morphological) adaptations and functional plant/tree anatomy in order to identify the ecophysiology of plants and trees in the major global habitats.

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California State Standards Addressed

www.cde.ca.gov

Grade 7

Genetics

A typical cell of any organism contains genetic instructions that specify its traits. Those traits may be modified by environmental influences. As a basis for understanding this concept:

- a. *Students know* the differences between the life cycles and reproduction methods of sexual and asexual organisms.
- b. *Students know* sexual reproduction produces offspring that inherit half their genes from each parent.
- c. *Students know* an inherited trait can be determined by one or more genes.
- d. *Students know* plant and animal cells contain many thousands of different genes and typically have two copies of every gene. The two copies (or alleles) of the gene may or may not be identical, and one may be dominant in determining the phenotype while the other is recessive.
- e. *Students know* DNA (deoxyribonucleic acid) is the genetic material of living organisms and is located in the chromosomes of each cell.

Evolution

Biological evolution accounts for the diversity of species developed through gradual processes over many generations. As a basis for understanding this concept:

- a. *Students know* both genetic variation and environmental factors are causes of evolution and diversity of organisms.
- b. *Students know* the reasoning used by Charles Darwin in reaching his conclusion that natural selection is the mechanism of evolution.
- c. *Students know* how independent lines of evidence from geology, fossils, and comparative anatomy provide the bases for the theory of evolution.
- d. *Students know* how to construct a simple branching diagram to classify living groups of organisms by shared derived characteristics and how to expand the diagram to include fossil organisms.
- e. *Students know* that extinction of a species occurs when the environment changes and the adaptive characteristics of a species are insufficient for its survival.

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Structure and Function in Living Systems

The anatomy and physiology of plants and animals illustrate the complementary nature of structure and function. As a basis for understanding this concept:

- a *Students know* plants and animals have levels of organization for structure and function, including cells, tissues, organs, organ systems, and the whole organism.
- b *Students know* organ systems function because of the contributions of individual organs, tissues, and cells. The failure of any part can affect the entire system.
- c *Students know* how the reproductive organs of the human female and male generate eggs and sperm and how sexual activity may lead to fertilization and pregnancy.
- d *Students know* the structures and processes by which flowering plants generate pollen, ovules, seeds, and fruit.
- e *Students know* how to relate the structures of the eye and ear to their functions.

Investigation and Experimentation

Scientific progress is made by asking meaningful questions and conducting careful investigations. As a basis for understanding this concept and addressing the content in the other three strands, students should develop their own questions and perform investigations. Students will:

- a. Select and use appropriate tools and technology (including calculators, computers, balances, spring scales, microscopes, and binoculars) to perform tests, collect data, and display data.
- b. Use a variety of print and electronic resources (including the World Wide Web) to collect information and evidence as part of a research project.
- c. Communicate the logical connection among hypotheses, science concepts, tests conducted, data collected, and conclusions drawn from the scientific evidence.
- d. Construct scale models, maps, and appropriately labeled diagrams to communicate scientific knowledge (e.g., motion of Earth's plates and cell structure).
- e. Communicate the steps and results from an investigation in written reports and oral presentations.

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High School Biology

Cell Biology

- a The fundamental life processes of plants and animals depend on a variety of chemical reactions that occur in specialized areas of the organism's cells. As a basis for understanding this concept:
- b *Students know* enzymes are proteins that catalyze biochemical reactions without altering the reaction equilibrium and the activities of enzymes depend on the temperature, ionic conditions, and the pH of the surroundings.
- c *Students know* usable energy is captured from sunlight by chloroplasts and is stored through the synthesis of sugar from carbon dioxide.

Ecology

Stability in an ecosystem is a balance between competing effects. As a basis for understanding this concept:

- a *Students know* biodiversity is the sum total of different kinds of organisms and is affected by alterations of habitats.
- b *Students know* how to analyze changes in an ecosystem resulting from changes in climate, human activity, introduction of nonnative species, or changes in population size.
- c *Students know* how fluctuations in population size in an ecosystem are determined by the relative rates of birth, immigration, emigration, and death.
- d *Students know* how water, carbon, and nitrogen cycle between abiotic resources and organic matter in the ecosystem and how oxygen cycles through photosynthesis and respiration.
- e *Students know* a vital part of an ecosystem is the stability of its producers and decomposers.
- f *Students know* at each link in a food web some energy is stored in newly made structures but much energy is dissipated into the environment as heat. This dissipation may be represented in an energy pyramid.
- g * *Students know* how to distinguish between the accommodation of an individual organism to its environment and the gradual adaptation of a lineage of organisms through genetic change.

Evolution

- a The frequency of an allele in a gene pool of a population depends on many factors and may be stable or unstable over time. As a basis for understanding this concept:
- b *Students know* why natural selection acts on the phenotype rather than the genotype of an organism.

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- c *Students know* new mutations are constantly being generated in a gene pool.
- d *Students know* variation within a species increases the likelihood that at least some members of a species will survive under changed environmental conditions.
- e * *Students know* the conditions for Hardy-Weinberg equilibrium in a population and why these conditions are not likely to appear in nature.
- f * *Students know* how to solve the Hardy-Weinberg equation to predict the frequency of genotypes in a population, given the frequency of phenotypes

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National Science Education Standards Addressed

www.nap.edu

Life Science Middle School

CONTENT STANDARD C: As a result of their activities in grades 5-8, all students should develop understanding of

- Structure and function in living systems
- Reproduction and heredity
- Regulation and behavior
- Populations and ecosystems
- Diversity and adaptations of organisms

Life Science High School

CONTENT STANDARD C: As a result of their activities in grades 9-12, all students should develop understanding of

- The cell
- Molecular basis of heredity
- Biological evolution
- Interdependence of organisms
- Matter, energy, and organization in living systems
- Behavior of organisms

Procedure

After studying unit(s) on plants, have students review characteristics of different plants and have access to notes and quality resource materials to identify plant morphology/anatomy. Good examples include a variety of plant and tree books (Dorling Kinderly is highly recommended) and science text with graphics.

Students will go on field trip or be given a variety of plant/tree samples to sort on triangle graph. There are three characteristics on the graph – competitive (sunlight, water, nutrients), stress tolerance and opportunistic growth (short growing season vs. evergreens). Each category is a gradient scale from 0-100% on one edge of the triangle. Students identify characteristics of each plant in order to make a decision about where the plant could best be graphed on the triangle.

A sample of plants falling 80-99% in each of three categories as well as a plant in the center of all three categories is included in the attached copy with the following sample explanation (see .PDF attachment).

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Examples: A springtime growing flower is highly competitive for sunlight, low stress tolerance and very opportunistic as it has a short growing season. Compare this to a desert succulent which is not very competitive for sunlight, has low stress tolerance as it stores water and grows slowly part of the year and more quickly with added sunlight. A Douglas Fir Tree is competitive for sunlight and nutrients (must be separated/thinned for adequate sunlight to photosynthesize), stress tolerance is medium once tree has reached maturity (tree growth rings will demonstrate stresses over time). Douglas firs are evergreen, not really opportunistic.

By comparing these three plants/trees, a student would see they require different zonobiomes/ecosystems.

Students should have an opportunity to explore, compare and contrast plants from algae to cycads and do reflection on how evolution is the progression of plants being very well adapted/suited to an environment. This process also demonstrates plant growth succession when triangle graphs are laid out from simple to complex plants/trees.

***Ideally, teacher can make a master set with answers on overhead projector sheets so students can self correct by laying projector sheet over their triangle. It would be valuable to have younger students work in pairs or small groups to have a frank discussion around the various qualities of each plant/tree.*

Assessment

Testing students on triangle graphs could be done in a variety of ways, depending on what information the educator is after (see attached .PDF for graph copy).

Example: graphing on the triangle graph and reasonably putting plants in appropriate section would not be as complex as having to defend graph by explaining what makes a particular plant competitive, stress tolerant or opportunistic. Educator should determine what information is being measured and where on Bloom's Taxonomy they would like to assess students.

Asking students to do a mock garden lay out as a result of their graphs, when given a garden with certain characteristics is application/synthesis level.

Literature

The majority of the concept for this lab was derived from a graduate level botany class. I have used this assignment with a variety of students in a variety of settings. Typically I go through the attached .PDF file of paperwork with students and practice a couple triangle graphs in class before the field trip or lab practical.

Books that always seem to be useful and purposeful are DK.

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Trees

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Eyewitness Explorers Trees

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