EVERGLADES CURRICULUM

Adaptations in Everglades Ecosystems - Lesson 2

Design a Perfect Beast

Grade Level: 9th-12th

Objective:

Students will be able to:

- Identify structural and behavioral adaptations that help organisms survive in their ecosystem.

Standards:

- SC.912.L.17.7 –Characterize the biotic and abiotic components that define freshwater systems, marine systems and terrestrial systems.
- LAFS.910.SL.1.1 - Initiate and participate effectively in a range of collaborative discussions with diverse partners on grades 9-10 topics, texts, and issues, building on others' ideas and expressing their own clearly and persuasively.

Everglades Literacy Conceptual Framework Connections:

- Fundamental Concept 6
- Fundamental Concept 7

Duration: 60 minutes

At A Glance:

Students become "bioengineers" and use the engineering process to design a "perfect beast" that is adapted to a specific Everglades ecosystem.

Background:

Many diverse animals live in the larger Everglades **ecosystem**, including hundreds of different kinds of mammals, fish, birds, reptiles, and amphibians. The physical, biological and/or behavioral adaptations of many of these organisms suit them to successful live in the various Everglades environments.

An ecosystem is the interaction of the biological **community** (all living things) and the physical environment (water, air, and minerals). It consists of a given area's physical features (**abiotic factors**, such as water, soil type, elevation, rocks, temperature, etc.) and living organisms (**biotic factors,** such as plants and animals). An ecosystem can be large or it can be as small as a cup of water. The organisms living together in an ecosystem are often referred to as a community, much like people living together in a neighborhood are called a community. Different ecosystems are often connected by their living and non-living components. For example, a crayfish from a pond ecosystem can be eaten by a forest ecosystem's raccoon. Water in a river may begin at a source that is miles away, and then meander through forests, grasslands and eventually emerge in marshes that border the ocean.

A **species** is defined as a genetically and adaptively unique plant or animal which can reproduce itself and to evolve. Members of the same species share a common gene pool. Because of this, a genetic change that occurs in one individual can spread throughout the population.

Species are either **generalists** or **specialists**, depending on how specific their needs are in terms of ecosystem, diversity of food source, and tolerance of changes to their environment. For example, the Snail Kite is a specialist. It feeds exclusively on apple snails, and lives exclusively in environments where apple snails are available. On the other hand, the American alligator is a generalist. It has a wide variety of food sources and can live in many areas throughout the Everglades.

Certain animals are known as **keystone species** because they have a critical effect on other organisms in their ecosystem. For example, American alligators are a keystone species because they excavate holes that become refuge for other animals during the dry season.

In this lesson, students will use the engineering design process to design a fictitious animal that is adapted for a particular ecosystem. The core idea of engineering design includes three component ideas:

Materials:

- Everglades Ecosystems Information Sheets (1 ecosystem per group)
- Everglades Ecosystems PowerPoint
- Student Page and Worksheet (1 per group)
- Presentation Grading Rubric
- Assessment Grading Rubric
- Student science journals or data sheets
- Pencils/markers/crayons
- Modeling clay – 2 colors for each group and ~2-3 oz. of each
- Toothpicks or other tool for sculpting

Vocabulary:

- **Abiotic factors** - Non-living factors in an ecosystem.
- **Biological engineering or bioengineering** - The application of concepts and methods of biology and other science concepts to solve real-world problems related to the life sciences.
- **Biotic factors** - Living factors in an ecosystem.
- **Community** - Populations of all species living and interacting in an area at a particular time.
- **Ecosystem** - The interaction of the biological community (all living things) and the physical environment (water, air, and minerals).
- **Generalist** - A species which can survive in multiple ecosystems or eats food from multiple sources.
- **Keystone species** - A species that plays a role that affects many other species in an ecosystem.
- **Specialists** - A species which has a very specific ecosystem or has very limited variety of food sources.
- **Species** - A genetically and adaptively unique plant or animal which can reproduce itself and to evolve. For example: all human beings are of the same species.

- Defining and delimiting engineering problems involves stating the problem to be solved as clearly as possible in terms of criteria for success, and constraints or limits.
- Designing solutions to engineering problems begins with generating several different possible solutions, and then evaluating potential solutions to see which ones best meet the criteria and constraints of the problem.
- Optimizing the design solution involves a process in which solutions are systematically tested and refined and the final design is improved by trading off less important features for those that are more important.

Biological engineering or **bioengineering** is the application of concepts and methods of biology and other science concepts to solve real-world problems related to the life sciences.

Preparation:

1. Print out Everglades Ecosystems Information Sheets.
2. Make copies of the Student Page and Worksheet (1 per group).
3. Load the Everglades Ecosystems PowerPoint.

Procedure:

1. Assess prior knowledge by asking students:
   - What is an ecosystem? *The interaction of the biological community (all living things) and the physical environment (water, air, and minerals*).
   - What are the factors that determine an ecosystem? *Abiotic factors, such as water, soil type, elevation, rocks, temperature, etc. and biotic factors, such as plants and animals*.
   - What types of adaptations would help organisms live in a particular ecosystem, such as a sawgrass marsh?
   - Would the adaptations of organisms that live in a different ecosystem, such as a forest, be different?
2. Go through the Everglades Ecosystems PowerPoint with class.
3. Explain to students about keystone species, and that some species are essential to the survival of others in an ecosystem.
4. Explain that some animals are specialists, with very specific needs and some are generalists, and can feed from and survive in a broader range.
5. Tell students, they are going to be "bioengineers" and have been hired to create a realistic but fictitious creature (or "beast") for a movie set in the Everglades. Tell them they will be given one Everglades ecosystem that will be the focal point for the movie.
6. Tell the students that they will work in teams to complete the worksheet. Using the Student Page and Worksheet as their guide, students will:
   - Discuss the Needs and Constraints for their new creature.
   - Research the Problem by reading through the Everglades Ecosystems Information Sheets. If students have internet access, they may also research their ecosystem online. There are recommended web sites included on each Everglades Ecosystem Information Sheet Packet. They will complete the Abiotic and Biotic Factors to Consider on their worksheet.

- Develop Possible Solutions where they will brainstorm ideas and possible design solutions for their creature. Those ideas will be listed on their worksheet.
- Select a Solution. The students must select the best solution for their beast, remembering to address the Needs and Constraints from step 1.
- Sketch their perfect beast and label its key adaptations for their assigned ecosystem.
- Build a Prototype. You will use modeling clay to create your design.
- Presentation. Your team will "pitch" your design of the "perfect beast" to your client. They should make sure to address all the questions in step 6. A rubric for their presentations is provided.

7. Divide the class into six teams. Give each team one of the ecosystems in the Everglades Ecosystem Information Sheets Packet.
8. Once students have completed all the steps on their worksheet, have the teams present their "perfect beast" to the class, making sure to address all the questions in step 6.

Optional Extend: After all the groups have presented, ask students to switch ecosystem cards with another team. Tell students to evaluate how well their animal would survive in the new ecosystem. Ask them to make two lists: one with the ways the animal would thrive and one with the ways the animal would not thrive.

Assessment:

1. In their science journals, students should write a 1-page essay that:
   - Lists at least three traits for their beast and provides evidence for why their beast is the perfect design for their assigned ecosystem given the ecosystem's abiotic and biotic factors.
   - Discusses one trade-off that their team made for their beast and provides a rationale for why they didn't select that trait.

Resources:

FAU/Pine Jog Environmental Education Center.

Lane, J., Robinson, G.B., & Robinson, S.C. (1996). Build a Perfect Beast. In *Discover a Watershed: The Everglades* (202-206). Bozeman, MT: The Watercourse, Montana State University.