Section 1: Aquatic & Marine Ecosystem Connections Study Guide

The following is an excerpt from the Aquatic & Marine Ecosystems Leaders Guide, Introduction of Lesson 1: Aquatic & Marine Ecosystem Connections (2013). The activity lesson plans associated with this section are not currently available (i.e., the "DO" section below). The following is intended to guide 4-H leaders and youth in specific areas to gain knowledge in leading up to the 4-H State Aquatic & Marine Ecosystems Contest.

"OBJECTIVES

For youth to:

- Describe and identify Florida's aquatic/marine ecosystems.
- Describe the stages of the hydrologic cycle.
- Discover the effects of abiotic factors on aquatic/marine ecosystems.
- Develop an understanding of energy flow and how food chains function.
- Discover interrelationships between living and nonliving components of aquatic/marine ecosystems.
- Identify stages of aquatic succession.
- Describe ways in which humans value and depend upon aquatic/marine ecosystems.

PURPOSE:

To become familiar with and differentiate between basic physical and biological factors common to all aquatic/ marine systems.

DO:

Here are some learning activities and suggested ways to implement the activities in Lesson 1.

1.1 Discover and understand Florida's many diverse aquatic/marine ecosystems with WHAT'S AN ECOSYSTEM?

1.2 Learn how one critical factor affects different ecosystem communities using SALT OR NO SALT, WHAT'S THE DIFFERENCE?

1.3 Identify the stages of the hydrologic cycle with WATER BASICS.

1.4 Play ABIOTIC INFLUENCE,

1.5 AQUATIC FOOD CHAINS, and

1.6 FOODWEBS: STRINGS ATTACHED to discover the relationships and interdependence between the living and non-living parts of ecosystems.

1.7 Discover some different stages of AQUATIC SUCCESSION.

1.8 Complete AQUATIC / MARINE VALUES to identify the many ways aquatic/marine ecosystems are important to humans.

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REFLECT:

After completing each activity in this lesson, help youth reflect on what they have learned with these questions:

- How many different aquatic/marine ecosystems can you name?

  Swamps, marshes, bogs, rivers, streams, springs, lakes, ponds, bays, beaches, estuaries, mangroves, gulfs, oceans, coral reefs.

- What are four stages of the hydrologic cycle?

  Precipitation, transpiration, evaporation, and condensation.

- Define "abiotic factor" and list some examples.

  A *nonliving part of an ecosystem. Some examples are water temperature, depth, salinity, wave motion, and sunlight.*

- What is a food chain?

  The transfer of energy from the sun to primary producers to consumers.

- What happens if one component of a food chain is removed?

  The other components may also be affected.

APPLY:

Help youth to apply what they have learned to their daily lives.

- What human values are associated with aquatic/marine ecosystems?

  Aquatic/marine ecosystems are important resources for many reasons including economic values (food and transportation), aesthetic values (beauty and serenity), recreation values (fishing and boating), education values (marine science and botany), and health values (nutrition and drinking water).

- How does human activity affect these aquatic/marine ecosystems?

  Marine debris, storm water runoff, pollution, dams, and coastal development are some examples of human impacts on aquatic/marine ecosystems.

- How can we conserve our aquatic/marine ecosystems?

  By taking responsibility for our actions on aquatic/marine ecosystems to ensure our continued use and enjoyment, as well as for the survival of all species that depend on these ecosystems.

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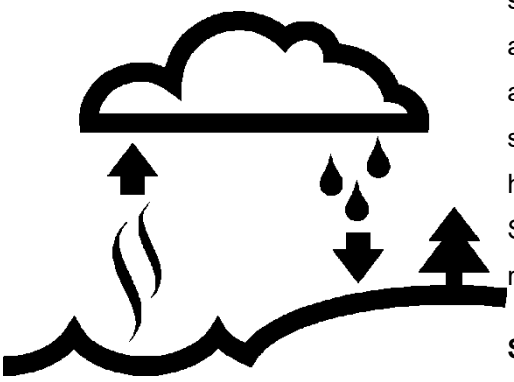
BACKGROUND BASICS

Water.. . Earth's unique and precious resource. Earth is the only planet in our solar system with the necessary atmospheric conditions to allow water to exist as we know it. Water is essential to all life on earth. Plants and animals are composed mostly of water. Human bodies are made up of 95% water. Humans may survive for long periods of time without food, but can survive no longer than a few days without water. We depend on water not only for the physical makeup of our bodies, but also for the environment it provides while moving through its three states. Water is the only substance found on earth that occurs naturally in three forms, solid, liquid, and vapor.

The water cycle

The water cycle is a familiar, yet a dynamic mechanism which continually moves throughout all ecosystems. It is a natural process which has no beginning or end. The cycle is driven by energy from the sun that causes the evaporation of water from land and water surfaces and transpiration of water from plants. **Transpiration** occurs when water absorbed by plant roots is drawn through the body of a plant and then evaporates from the surface of leaves and stems. As water vapor rises, it cools, and condenses into clouds. When the water once again falls to the Earth's surface as rain, snow, sleet, and hail, it is called **precipitation.** Once on the surface, the water may immediately evaporate back into the atmosphere or run off into streams, rivers, and other water bodies. Surface water may also infiltrate the ground where it will eventually reenter the cycle through groundwater discharge or transpiration by plants.

In Florida, precipitation falls almost exclusively as rain, with occasional snow and hail. The dry season extends from October through May, and the wet season from June through September. Convective rains or thunderstorms occur in late afternoon in the spring and summer. Tropical low pressure storms from the Atlantic Ocean and the Caribbean Sea occur from late summer into early autumn. Fronts from the North American continent sweep the state during the fall, winter, and early spring. Tropical storms and hurricanes may cause heavy rainfall during the wet season. Seasonal fluctuations in precipitation can greatly affect water resources.



Surface runoff is the water which directly flows across the land into streams, rivers, or lakes. As water moves over the land, it may be seen as sheet runoff, or rills and gullies. Sheet runoff can be easily seen on a parking lot, whereas rills and gullies may be best observed on a slope of bare soil. Water that does not run off **infiltrates** (soaks into) the ground. When it travels through the soil, it may be **absorbed** (taken up) by the root systems of plants and used for their physiological processes.

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Water not used by plants either adheres to soil particles or continues to move through the soil in all directions. Eventually the water will reach bedrock or a totally saturated zone in the soil. The top of this zone is called the **water table.** Water below the water table is called **groundwater.** Where the water table reaches the ground surface, it may appear as a spring or it may move directly into a flowing stream. This concept is important because without the subsurface movement of water and subsequent recharge of surface water, many streams would not flow between precipitation events. Subsurface drainage may be fast or very slow depending on soil types, depth to bedrock, slope and other climatic and geologic factors.

Water that reaches bedrock can move through cracks and fissures in the rock structure. It may move slowly through the rock formation or remain in place for hundreds of thousands of years. A rock formation that holds vast amounts of water is called an **aquifer,** a term derived from the two Latin words "aqua," meaning water, and "ferre," meaning to bear or carry. In Florida, we have the huge and deep Floridan Aquifer and the more shallow Biscayne Aquifer, which together provide nearly 90 percent of the state's drinking water, irrigation water, recreational water, and waste disposal water (Myers and Ewell, 1990).

People withdraw water from groundwater and surface water resources for their daily domestic and economic needs. These uses of water can greatly affect the natural recharge of stream flows and groundwater. Development projects that involve the removal of natural land areas and paving over large soil surface areas may have adverse environmental impacts on soil erosion, stream flow levels, and the natural recharge of groundwater resources. Our utilization of this resource is a necessity, and with careful planning, adverse environmental impacts resulting from our interruption of the natural water cycle can be minimized.

Ecosystems

All plants and animals require water, but in varying amounts. The amount of water and other nonliving factors in an area determine the types of plants and animals that can exist there. A **community** is all of the living things in a given area. The community and the nonliving environment function together as an **ecosystem.** Ecosystems are made up of both the living, **biotic** component, and the nonliving, **abiotic,** component. The abiotic component of an area largely determines what types of life forms can exist there. Water is one abiotic component, but there are many others such as soil type, elevation, temperature, salinity, etc.

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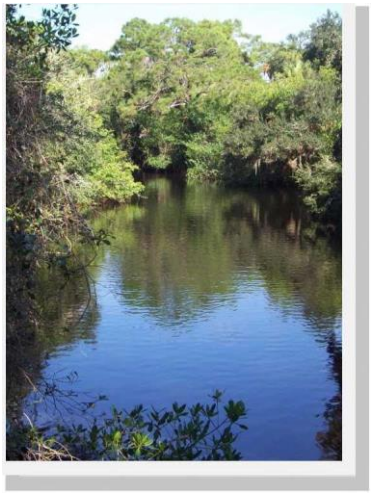
Florida has many very diverse types of ecosystems. One of the reasons for this diversity is that the northern part of the state is situated in the temperate zone and the southern part of Florida extends into the subtropics. Although the State does not have diverse topography, changes in elevation have a significant effect on Florida's ecosystems. In the higher elevations are pine flatwoods, dry prairies, scrub and high pine habitats, and temperate hardwood forests. In south Florida, rockland ecosystems consist of pinelands and tropical hardwood hammocks. In the lower areas are swamps and freshwater marshes. Along the coast, are dunes and maritime forests. Florida has approximately 7700 lakes, more than 1700 rivers, and over 300 artesian springs (Myers and Ewell, 1990). Most of the larger rivers discharge at the oceans, emptying into estuaries, salt marshes, and mangroves. Florida's coastal areas and marine ecosystems are also quite diverse, from the beach dune community to several different offshore reef communities.

Aquatic/Marine Ecosystems



Aquatic/Marine ecosystems are located in areas that are either covered with water for part of the year, or are underwater all of the time. These ecosystems may be divided into four main groups: freshwater wetlands, including swamps, marshes, and bogs; other freshwater ecosystems, including rivers, springs, lakes, and ponds; coastal ecosystems, including estuaries, beaches, mangroves, salt marshes and mud flats; marine ecosystems, including oceans, coral reefs and sea grass beds (which can be estuarine as well). Each of these ecosystems will be studied in upcoming, individual lessons.

Although the various ecosystems may seem very different and isolated from each other, it is important to realize how they are interrelated. For example, many of the rivers in Florida are brown in color from the tannin released by decaying vegetation that comes from surrounding swamps and forests. Rivers carry detritus (partially decomposed plants and other organisms) downstream, where the nutrients are emptied into estuaries which support the nurseries of the sea. Many forms of wildlife utilize and depend on more than one ecosystem for survival. An osprey may nest in a hardwood swamp, but catch fish for its food in the ocean. Many species of saltwater fish spend most of their adult lives in the ocean but depend on estuaries or rivers for their breeding and spawning grounds.

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Energy Flow in the Ecosystems

There are complex relationships not only among different ecosystems, but also within each ecosystem. Many of these relationships involve the transfer of energy. The source of energy for ecosystems is the sun. This flow of energy from one organism to the next is known as a **food chain.** A **food web** is the interconnected pattern of separate food chains in a community. Green plants, called **producers,** utilize sunlight to make their own food through the process of photosynthesis. Animals that feed on the producers are called **primary consumers,** also called first order consumers. **Secondary consumers,** also called second order consumers, feed on the primary consumers. Third and fourth order consumers may also exist within an ecosystem.

The last major category is the **decomposers** which consist mainly of bacteria and fungi. These

organisms break down organic matter or detritus into nutrients which may be recycled through the ecosystem. There are a number of factors which influence the amount and types of organisms that a aquatic/marine ecosystem will support. It is important to understand the major factors and to be able to communicate to the youth just how these factors fit together. Vertebrate, invertebrate, and plant populations in an aquatic ecosystem are not only influenced by the size of the area, but by a variety of abiotic factors including soil fertility, water depth, turbidity, temperature, and water quality.

Populations are also affected by the relationships within an ecosystem's food web. For example, various fish populations have different food requirements. A bass would require small fish and large invertebrates such as crayfish. A bluegill would depend on small invertebrates such as aquatic insects, or zooplankton. Therefore, the number of individuals within a population of bass and bluegills that a pond could support directly depends on the amount of food available.

It must be understood that a pond, like other ecosystems, will have a balance between predators and prey, and this balance is necessary to maintain the **homeostatic** (relatively stable state of equilibrium) nature of the ecosystem. It can be said that an ecosystem maintains a state of dynamic equilibrium.

Numbers and species of organisms within the system constantly change. Populations increase and decrease, dependent upon food supply and other biotic and abiotic factors. Even with this dynamic system, a state of balance is almost always maintained through a variety of self-regulating factors that include predator/prey relationships, death rates, birth rates, and amount of habitat. **Ecological succession** is the progressive change in the plants and animals (biotic), and nonliving (abiotic) factors of an ecosystem over time. The new plant and animal community is typically more stable and complex than the previous one. During succession, a community modifies its physical environment so much that it creates conditions which are unsuitable for itself. Subsequently, a different group of species will eventually dominate the community. The change from one community to another takes place gradually, as the composition of an ecosystem changes. Early stages in certain successional patterns might evolve over a relatively short period of time, sometimes in as few as ten years. Later successional stages may take much longer to evolve into new and unique communities. Succession occurs in both aquatic and terrestrial ecosystems. In aquatic ecosystems such as ponds and lakes, succession takes place as sediments accumulate. In salt marshes sedimentation rates may vary due to tides and storms, however, succession still occurs. Early marsh plant species trap sand and soil to build land upon which new plant communities may grow. An example of succession in a coastal ecosystem is the change from bare sand dunes to those covered with sea oats. The sea oats may then trap and hold soil and support additional plant life. **Eutrophication** is the "aging" of a water body due to the addition of organic matter. Although it is a natural process, human activities can accelerate the eutrophication of a water body. Sewage and agricultural runoff can add nutrients and sediments to the water. Thus, succession may occur much faster than normal. Soil erosion in surrounding areas may contribute to eutrophication as well, by adding soil to the sediment layer."