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Wild about the Wetlands

Investigating Niches, Trophic Levels, and Energy Flow

The Florida Everglades is a wetland ecosystem vital to the freshwater system of southern Florida. Much of the wetland is covered by saw grass and, for that reason, this expansive area of grass is termed "The River of Grass." The Everglades is also home to a variety of other plant species and many animal species that play an important role in the ecosystem.

In the Everglades, organisms depend upon one another to supply the carbon-based glucose molecule that will be used to obtain energy. Each organism has specific energy demands and relies upon homeostasis within ecological systems to meet these demands. Producers such as plants use photosynthesis to synthesize glucose and other carbon-based molecules and use them for their own energy. Producers also provide a source of energy to consumers.

PROCEDURE

PART I: INVESTIGATING THE DIVERSITY OF THE EVERGLADES WETLAND ECOSYSTEM

1. You will use the resources designated by your teacher to research the Everglades ecosystem and determine the following:

   a. What are the climate conditions of the ecosystem?

   b. What organisms can be found living in this ecosystem?

   c. What are some of the biotic and abiotic factors in this ecosystem?

   d. What are the threats that currently exist to this ecosystem?

   e. How have humans impacted this ecosystem?

   f. Describe three examples of the interdependence of organisms in this ecosystem.

2. Arrange the organisms that you find into groups based on their role in the ecosystem: producers, primary consumers, secondary consumers, tertiary consumers, quaternary consumers, and decomposers. Use Table 1 to list your organisms and discuss their role in the ecosystem (niche).

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Table 1. Roles of Organisms in Ecological Systems		
Organism Role	**Names of Organisms**	**Niche**
Producer		
Primary Consumer		
Secondary Consumer		
Tertiary Consumer		
Quaternary Consumer		
Decomposer		

3. Use your research to answer the questions below.

    a. Of the roles listed in Part I, which is the most essential in an ecosystem? Justify your answer.

    b. Explain the recycling of nutrients of the organisms in an ecosystem. Which two roles are involved primarily in the recycling of nutrients?

    c. Must all ecosystems have quaternary consumers? Why or why not?

    d. What sets primary consumers apart from other consumers?

    e. Based on your understanding of the roles of organisms in ecosystems, predict what may happen to an ecosystem if all primary consumers were removed.

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PART II: CREATING FOOD CHAINS AND FOOD WEBS

1. Based on your research, choose at least eight organisms (including at least one decomposer) to create a working food web. Draw and label your food web in the space provided below. Make sure you label and name each organism as well as the role of that organism (decomposer, producer, primary consumer, secondary consumer, and so on).

   Everglades Food Web:

2. Based on your research, choose four organisms to create a working food chain. Draw and label your food chain in the space provided below. Make sure you label the name of each organism and the role of that organism (producer, primary consumer, secondary consumer, and so on).

   Everglades Food Chain:

3. Answer the questions below.
   a. Explain the relationships between the organisms in your food chain.

   b. What would happen to the food chain if the species in Level 2 were eliminated? How would it affect the population of other species in that food chain?

   c. Explain the relationships among the organisms in your food web.

   d. What would happen to the food web structure if all decomposers were eliminated? Be specific.

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PART III: CREATING AN ENERGY PYRAMID

1. Obtain a sheet of butcher paper or poster board from your teacher. Draw a large energy pyramid on it that contains five trophic levels.
2. Using the energy pyramid, you have made, arrange all of the organisms you found into their appropriate trophic level based on your ideas from Part I.
3. Put the name and the ecological role (producer, primary consumers, and soon) to the left of each trophic level.
4. Ask your teacher to approve your pyramid before moving to the next step.
5. Based on your pyramid, answer the questions below.

    a. Why are producers found at the bottom of the energy pyramid? What does the arrangement of your pyramid tell you about the mass of the producers compared to the consumers?

    b. What do you conclude happens to the numbers of organisms in the ecosystem as one moves from producers to the top consumer of the pyramid (biomass pyramid)? Provide a reasonable explanation for your answer.

    c. Would you put decomposers at the top or bottom of the energy pyramid? Justify your answer.

    d. Predict what may happen to the arrangement of your energy pyramid if predator-prey relationships caused the numbers of secondary consumers to increase.

PART IV: CALCULATING ENERGY TRANSFER

1. The Sun has provided your producers with 11,382,400 kilojoules (kJ) of energy. Based on this information, determine the amount of energy available at each trophic level of your energy pyramid. Write each level's available energy to the right of the trophic level on your energy pyramid. Remember that from one trophic level to the next, there is an average energy loss of 90%. Make sure you label that energy amount on your energy pyramid.

2. Based on your calculations, answer the questions below.

    a. Analyze your energy pyramid energy numbers. What is the reason for the decreased availability of energy as the pyramid moves from producer to top consumer?

    b. If the Sun contributes 11,382,400 kJ of energy and the producers were only able to assimilate 1% of that energy, how many joules would they be able to use?

c. What is the relationship between a decrease in available energy to the producers and the overall ecosystem? In the English Channel, a small number of autotrophs (phytoplankton) are able to sustain a larger number of zooplankton (primary consumers). Essentially, this turns the biomass pyramid "upside down." Explain how this might be possible.

d. Explain how the carbon cycle is involved in the flow of energy up the energy pyramid.

PART V: SCENARIO-BASED DECISION MAKING

1. Your teacher will assign a scenario to you to analyze. Read your scenario carefully.
2. Manipulate and redesign your pyramid to match your scenario.
3. Analyze the changes that have been made in your pyramid and ecosystem situation and answer the following questions:
4. What was the primary consequence of the effects of your scenario on the energy pyramid?
5. Based on your scenario, what do you believe was the source of the change? Justify your answer.
6. Develop a plan to correct the effects of your scenario. Outline a plan and write an essay on how you would implement your plan. Include in your essay the methods you would take to correct the effects and what resources would be available for you to do this.
7. Share your results with the class. Fill in Table 2 as other groups are discussing the other scenarios.

Table 2. Scenario Changes

Change	Reason for Change	Effect of Change
1		
2		
3		
4		
5		

6. Determine the new energy available at each trophic level based on your scenario. Explain your reasoning.

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Scenario 1
The organisms in your energy pyramid represent an interdependence pattern in a wetland ecosystem. Assume that global climate changes have caused a severe drought in the area where those organisms live. The drought lasted through an entire summer. Determine the impact of this event on your energy pyramid.

Scenario 2
The organisms in your energy pyramid represent an interdependence pattern in a wetland ecosystem. Assume that the region where these organisms are found contains an enormous supply of valuable wood. Because of the value of the wood, trees are being harvested for commercial use. Within one month, over 75% of the trees have been removed. Determine the impact of this event on your energy pyramid.

Scenario 3
The organisms in your energy pyramid represent an interdependence pattern in a wetland ecosystem. Specifically, the snakes found in the region depend upon the frogs and toads for a primary source of food. The reproductive pattern of the snakes has changed significantly, resulting in a lower number of eggs being produced. As a result, the snake population drastically declines with no immediate solutions to the issue. Determine the impact of this event on your energy pyramid.

Scenario 4
The organisms in your energy pyramid represent an interdependence pattern in a wetland ecosystem. A tribe of nonnative people have moved in and occupied this region of the wetland. With the tribe came their primary source of food—a plant that grows low to the ground and produces a particular fruit. The tribe quickly planted the seeds of this plant, covering every open region of the forest floor. Within a year, the plant had quickly overtaken the native plants in the area. Determine the impact of this event on your energy pyramid.

Scenario 5
The organisms in your energy pyramid represent an interdependence pattern in a wetland ecosystem. The source of food for the quaternary consumer is plentiful and environmental conditions are favorable. The leopard population is very healthy, living longer than expected and reproducing more quickly than expected, and the number of leopards in the area is rapidly increasing. Determine the impact of this event on your energy pyramid.

EXTENSION – *Extra Credit*
Assume you are a student biologist working for a research professor in the Everglades. Your research professor is concerned about the effects of the diminishing Florida panther population on the biodiversity of the Everglades ecosystem. You have been assigned the task of measuring the conditions of a population of Florida panthers, evaluating the data you gather, and then reporting back to your research professor. Design a plan to complete this task.

Assume that at the end of your study you see that there truly is a need to conserve the Florida panther. Make sure you include in your plan good scientific methodology, and be specific on how you would measure the conditions and a plan on how to conserve the biodiversity in that ecosystem. This should be turned in as a science research poster (your teacher will give you more instructions on this) and should be concise and well-designed.