Cycling of Matter in Ecosystems-SWS

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Printed: April 22, 2014

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CHAPTER 1

Cycling of Matter in Ecosystems-SWS

- Describe how matter cycles within ecosystems.
- Compare and contrast the cycling of matter with the flow of energy in ecosystems.

What is an Ecosystem?

Ecology is the study of ecosystems. That is, ecology is the study of how living organisms interact with each other and with the nonliving part of their environment. An **ecosystem** consists of all the nonliving factors and living organisms interacting in the same **habitat**. Recall that living organisms are **biotic factors**. The biotic factors of an ecosystem include all the **populations** in a habitat, such as all the species of plants, animals, and fungi, as well as all the micro-organisms. Also recall that the nonliving factors are called **abiotic factors**. Abiotic factors include temperature, water, soil, and air. Living organisms cannot exist without the nonliving aspects of the environment. For example: air, water, and sunlight, which are all nonliving, are all essential to living organisms. Both nonliving and living things make up an ecosystem.

Roles of Organisms in the Ecosystem

Every ecosystem contains species that have the same general roles. It's just the organisms that fill those **niches** are different.

The organisms that produce food are extremely important in every ecosystem. Organisms that produce their own food are called **producers** or **autotrophs**. There are two ways of producing food energy:

- Photosynthesis: plants on land, phytoplankton in the surface ocean, and some other organisms.
- Chemosynthesis: bacteria at hydrothermal vents.

Organisms that obtain energy from another organism are called **heterotrophs**. Consumers and decomposers are examples of heterotrophs.

There are many types of consumers:

- **Herbivores** eat producers directly. These animals break down the plant structures to get the materials and energy they need.
- **Carnivores** eat animals; they can eat herbivores or other carnivores.
- **Omnivores** eat plants and animals as well as fungi, bacteria, and organisms from the other kingdoms.

Organisms obtain the energy and food they need in many different ways. There are many types of feeding relationships (**Figure** below **Food chains** and **food webs** are diagrams that help to show these feeding relationships and can be used to trace matter and energy through an ecosystem. A **predator** is an animal that kills and eats another animal, known as its **prey**. **Scavengers** are animals, such as vultures and hyenas, that eat organisms that are already dead. **Decomposers** break apart dead organisms or the waste material of living organisms, returning the nutrients to the ecosystem.

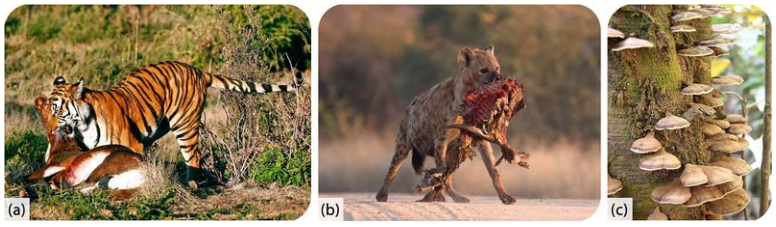

FIGURE 1.1

Flow of Matter in Ecosystems

The flow of matter in an ecosystem is not like energy flow. Matter enters an ecosystem at any level and leaves at any level. Matter cycles freely between trophic levels and between the ecosystem and the physical environment (**Figure** 1.3).

Living things need abiotic, nonliving, matter as well as energy. What do you think matter is used for? One thing is to build bodies. Living things also need matter to carry out the processes of life. Any nonliving matter that living things need is called a **nutrient**. Carbon and nitrogen are examples of nutrients. Unlike energy, matter is recycled in ecosystems.

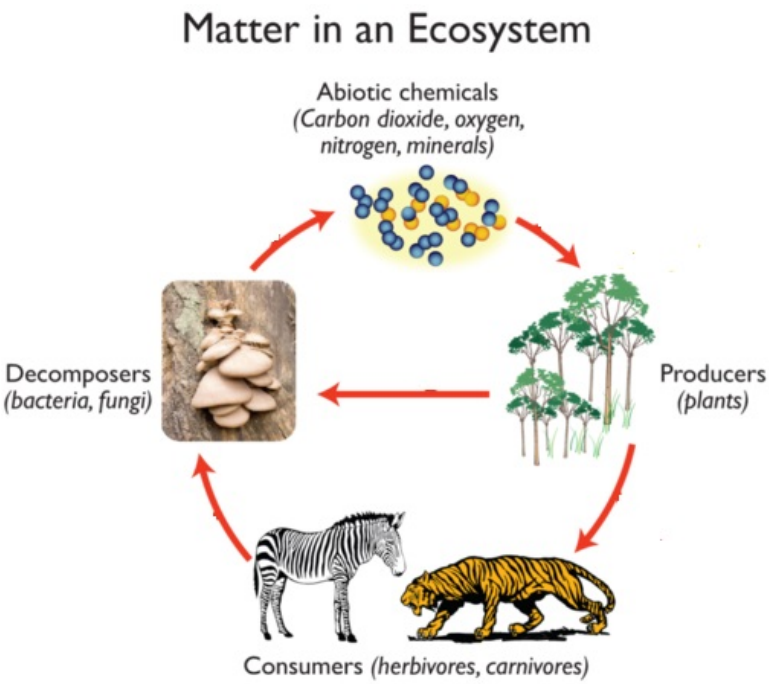

FIGURE 1.2

This diagram shows the cycle of matter in an ecosystem. Compare this to the flow of energy in an ecosystem as shown in a food web. Why does the sun keep adding energy to an ecosystem? Why is matter recycled?

Decomposers release nutrients when they break down dead organisms.

- The nutrients are taken up by plants through their roots.
- The nutrients pass to primary consumers when they eat the plants.
- The nutrients pass to higher level consumers when they eat lower level consumers.
- When living things die, the cycle repeats.

Case Study: What killed millions of sailors in the 15th through 18th centuries?

Millions of sailors in the 15th through 18th centuries died mysteriously. They developed a disease called scurvy. The scurvy, it turns out, was due to the lack of vitamin C in their diets. It wasn't until 1932 that the link between scurvy and vitamin C was made. Without the right nutrients in the right amounts, you can't live. Other animals and plants also need the right nutrients to live too.

Nutrients

Nutrients are ions that are crucial to the growth of living organisms. Nutrients such as nitrogen and phosphorous are important for plant cell growth. Animals use silica and calcium to build shells and skeletons. Cells need nitrates and phosphates to create proteins and other biochemicals. From nutrients, organisms make tissues and complex molecules such as carbohydrates, lipids, proteins, and nucleic acids.

What are the sources of nutrients in an ecosystem? Rocks and minerals break down to release nutrients. Some enter the soil and are taken up by plants. Nutrients can be brought in from other regions, carried by wind or water. When one organism eats another organism, it receives all of its nutrients. Nutrients can also cycle out of an ecosystem. Decaying leaves may be transported out of an ecosystem by a stream. Wind or water carries nutrients out of an ecosystem. Animal waste deposits leftover or unused nutrients back to the ground.

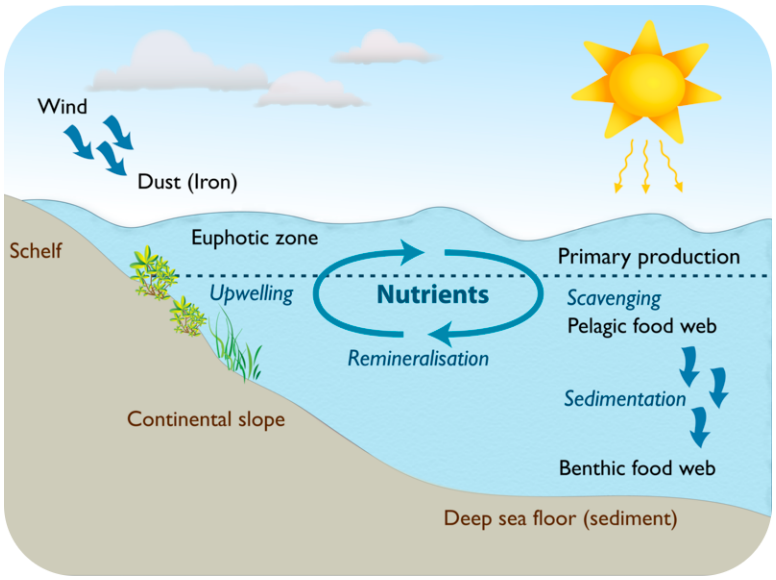

FIGURE 1.3

Nutrients cycle through ocean food webs.

Decomposers play a key role in making nutrients available to organisms. Decomposers break down dead organisms into nutrients and carbon dioxide, which they respire into the air. If dead tissue would remain as it is, eventually nutrients would run out. Without decomposers, life on Earth would have died out long ago.

Review Questions

1. Identify important vocabulary terms in this article. Write their definitions and an example in your vocabulary chart.

2. Compare/Contrast: How does the flow of matter differ from the flow of energy through an ecosystem?

3. Identify and explain 2 ways nutrients could enter the Tropical Rainforest Biome?

4. Identify and explain 2 ways nutrients could exit the Tropical Rainforest Biome?

5. Evaluate: What would happen to life on Earth if there were no decomposers?
6. Extend: Write 2 questions you have after reading this article.
7. Diagram: Draw a food web with 5 organisms in it and trace the flow of matter and energy in that food web.

References

1. CK-12 Foundation. . CC-BY-NC-SA 3.0