Energy and Ecosystems: Part 2

Last week we shared an assessment item that focused on energy in **ecosystems**. As we discuss what understanding is required to correctly respond to the item, we must begin with the definition of **energy** as it applies to **ecosystems**.

In previous emails, we have provided the following definition:

> **Energy** is the ability to do **work**.

There's nothing incorrect about this definition; it's valid for use with **ecosystems**. However, it's much easier to see how this applies in physics than in life science. Let's therefore expand upon this definition for the purposes of this email series…

Background

In the early days of ecology, scientists looked at populations of organisms and changes that occurred over time. Curiosity arose over these changes: how and why did they take place? To answer these questions, the first step was to examine the observations made…

As ecologists observed "who ate what" within an **ecosystem**, they began thinking how **energy** and chemical substances moved through the system. A new view of ecology arose: "you gotta keep your eye on the **energy**."

Energy flow

OK, so let's take a look at how present-day ecologists see **energy** flowing through an ecosystem:

- Plants convert light **energy** from the sun into stored chemical energy through the process of photosynthesis. The **energy** is stored as high-energy compounds in the leaves, roots, fruits, and nuts the plant synthesizes.
- Many organisms within an ecosystem will eat the plants, and this stored chemical **energy** is "transferred from the plants to the animals."[1] For instance:
  - In a woodlands ecosystem, squirrels eat acorns.
  - In an aquatic ecosystem, mayflies eat algae.
  - In a desert ecosystem, kangaroo rats eat desert grass.

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Other animals eat the plant-eating animals, so again, stored chemical **energy** is transferred. For instance:

- In a woodlands ecosystem, hawks eat squirrels.
- In an aquatic ecosystem, alewives eat mayflies.
- In a desert ecosystem, snakes eat kangaroo rats.

This animal-eating-animal scenario can repeat again and again, thus affecting the transfer of **energy** to other organisms. The cycle of **energy** transfer continues when organisms die and are decomposed by bacteria and fungi. "The energy transformation…starts all over again." [1] We'll examine this **energy** transfer in more detail in an upcoming email on **energy** chains and **energy** webs.

The bottom line

Let's think about presenting these ideas to students. Are we just looking at "who eats whom?" Well, no; it's not that simple. There's a much bigger picture if we're discussing an **ecosystem**. No species of plant or animal is in isolation; everything is part of a larger system (hence the name!). Rabbits are of no importance standing alone within a woodlands ecosystem. Rabbits *are* important when considering the entire context… the animals gain high-energy compounds from plants (which produced the compounds from inorganic matter). Rabbits also provide energy to predators such as wolves or hawks, which in turn may transfer **energy** to other predators and eventually to decomposers. Then the cycle continues. If we miss the complex relationships among organisms we reduce the ecosystem to teeth, claws, and leaves.

Consider:

1. How would your students define *ecosystem*?
2. What characteristics would they identify?
3. What components would they include?
4. Would they recognize the **energy** flow as essential to the ecosystem, or would they just notice the organisms?

Coming up

Next week we'll return to the original **ecosystems** assessment item and examine what a complete and accurate response might look like. Upcoming emails will include:

- The content students need to know to satisfactorily complete this ecosystem item.
- Other assessment items that address specific content.
- The challenges that students face when learning specific content.

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What do the New York State standards say?

In the Elementary Core Curriculum, Standard 4, The Living Environment,

Major Understandings state:

- 6.1c Animals that eat plants for food may in turn become food for other animals. This sequence is called a food chain.
- 6.2a Plants manufacture food by utilizing air, water, and energy from the sun.
- 6.2d The Sun's energy is transferred on Earth from plants to animals through he food chain

In the Intermediate Core Curriculum, Standard 4, The Living Environment,

Major Understandings state:

- 6.1a Energy flows through ecosystems in one direction, usually from the Sun, through producers to consumers and then to decomposers. This process may be visualized with food chains or energy pyramids .
- 6.1b Food webs identify feeding relationships among producers, consumers, and decomposers in an ecosystem.

[1] http://www.arcytech.org/java/population/facts_fo.html

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