

Energy and Ecosystems: Part 4

Last week we presented an assessment item on photosynthesis, since it is both vital to energy transfer in an **ecosystem** and difficult for students to grasp...

Photosynthesis is a process that:

1. **converts light energy into stored chemical energy.**
2. **converts energy stored in sugars and starches into CO₂ and H₂O.**
3. **converts chemical energy into light energy.**
4. **converts energy stored in CO₂ and H₂O into sugars and starches.**

The correct answer is #1, “**converts light energy into stored chemical energy.**”

When we create multiple choice assessment items, it is just as important to provide good distracters (wrong answers) as it is to have the correct answer available. Distracters should not be too obviously wrong or so close to the correct answer that readers are confused.

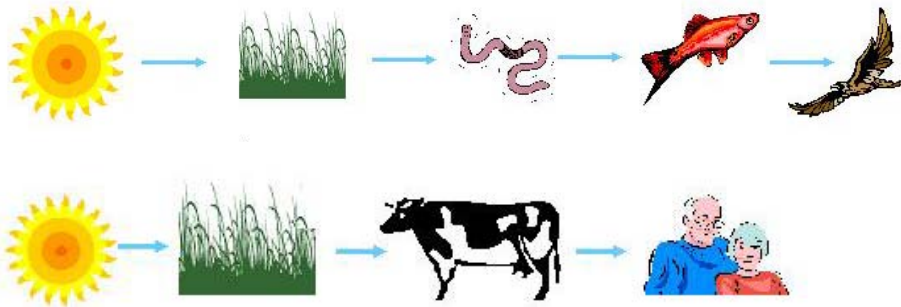
The distracters above are good ones for several reasons:

1. They focus on **energy**, which students normally understand as important to photosynthesis.
2. They use **other vocabulary** (sugar, starches, CO₂ and H₂O) **that students have heard** in reference to photosynthesis.
3. They focus on **energy conversion**, which is right on target when explaining photosynthesis. The distracters, however, misidentify both the original source of energy and the product of the conversion.

Now that we have chemical energy stored in plants within our ecosystem, let's continue our exploration of energy transfer...

Energy chain

“Photosynthesis is only the beginning of a chain of energy conversions. There are many types of animals that will eat the products of the photosynthesis process. Examples are deer eating shrub leaves, rabbits eating carrots, or worms eating grass. When these animals eat these plant products,...energy and organic compounds are transferred from the plants to the animals. These animals are in turn eaten by other animals, again transferring energy and organic compounds from one animal to another. Examples would be lions eating deer, foxes eating rabbits, or birds eating worms.”¹



The organisms within the system can be categorized depending upon their part in the process:

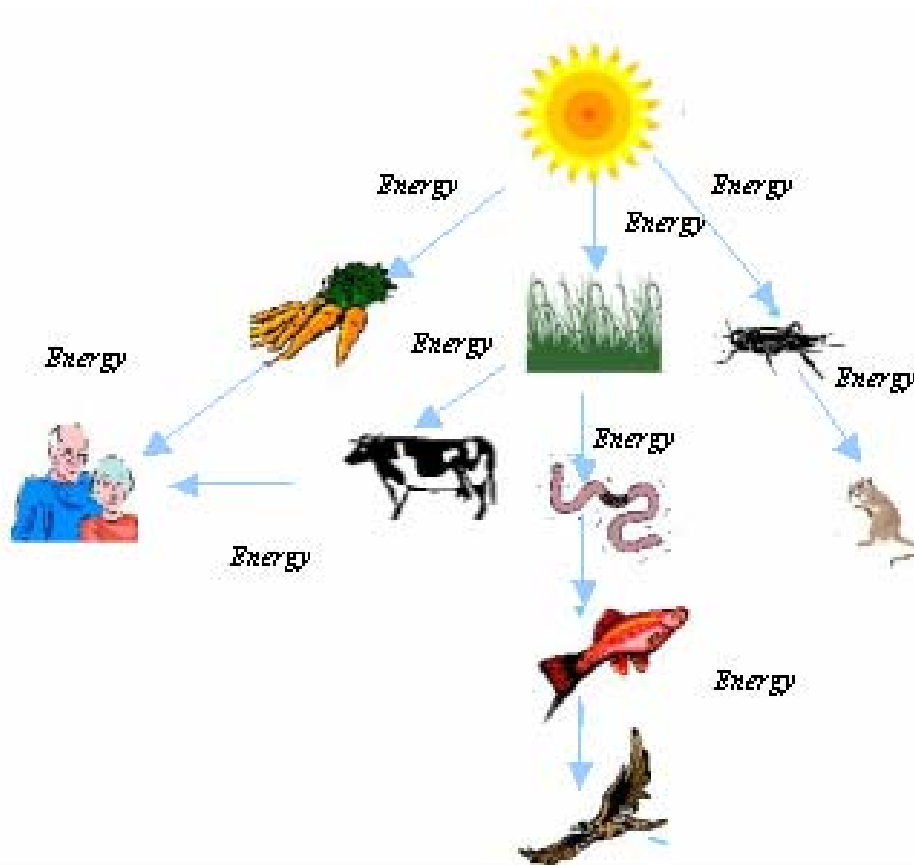
- **Producers** are organisms that convert inorganic compounds into organic compounds. They convert light energy into stored chemical energy. “They are called **producers** because all of the species of the ecosystem depend on them.”¹
- **Consumers** depend upon other organisms for their source of energy.
 - **Primary consumers:** consumers that get their energy directly from producers. Primary consumers include cows and rabbits.
 - **Secondary consumers:** consumers that get their energy directly from primary consumers. Secondary consumers include fish and hawks.
 - **Tertiary consumers:** consumers that get their energy directly from secondary consumers. Tertiary consumers include wolves and hawks.

Since many organisms have more than one type of energy source, they can be classified in more than one category. For instance, when a field mouse eats seeds, it can be labeled a primary consumer. However, when the mouse eats insects, it is acting as a secondary consumer. What are other examples of organisms that can fit two categories? Can your students come up with some ideas? We’d love to hear them!

Energy web

An **energy chain** is useful for beginning a discussion of energy flow in an ecosystem, but it's a very small part of a much larger picture. The nice, straight line from is only one possible way energy can transfer. Within an ecosystem, there are many, many more possible combinations.

We can attempt to illustrate these combinations using an **energy web**.



This is a *model* of energy transfer, and that's an important distinction. We use **energy chains** and **energy webs** to help students understand how energy flows in an ecosystem, but we don't want them to think that the system is limited to the diagrams we present. For the sake of clarity, **energy webs** are commonly limited to *several* interrelated organisms; *all* the possible relationships are not illustrated, because the diagram then would be very difficult to interpret.

Energy or food?

We've been referring these systems as **energy chains** and **energy webs**, but you and your students might also know them as **food chains** and **food webs**. Why the difference in terminology?

Well, like the rest of science, ecology requires clear vocabulary. Food has different meanings, depending upon the context. In everyday language, we think of *food* in terms of pizza, cereal, watermelon, cat food, and the like. Scientists, however, have a more specific definition for the term *food*: *energy and raw materials needed for growth and repair*.² That's a very different focus than when we decide which *foods* to get at the grocery store or when our students say their favorite *foods* are tacos or chicken nuggets. If we use the term **energy chain**, we focus on the all-important **energy** transfer within the ecosystem.

It should be noted, however, that the New York State Core Curricula use the terms **food chain** and **food web**. We do not, therefore, recommend the exclusive use of **energy chain** and **energy web**, since it is very likely that students will be faced with **food chain** and **food web** on high stakes exams. Students need to be aware of all terms and how they can be interchanged.

Coming up

Next week we examine another visual representation of energy flow in an ecosystem: the **energy pyramid**. Until then, consider:

An **energy pyramid** illustrates the relationships among **producers** and **consumers**. So does an **energy web**.

1. Why then do we need these different models?
2. What additional information does an **energy pyramid** supply?

Feel free to share your thoughts on the matter.

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 the 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.

¹http://www.arcytech.org/java/population/facts_foodchain.html

²See the March 26, 2003 email, *Food, Glorious Food* at <http://crsep.org/ScienceInquiriesByEmail.htm>