Flow of Energy in an Ecosystem

Summary: In this lesson, students take a deep dive into exploring how energy moves through a garden ecosystem. First, students define and observe examples of energy in the garden ecosystem. Then they examine where the energy in a garden ecosystem comes from, and whether it could ever run out. In the next lesson, students will explore how matter moves through an ecosystem. Students will use what they learn in both lessons in order to form the foundation for the following lesson, *Compost*, in which students will explore the role of compost and decomposition in a garden ecosystem.

This is the ninth of a 12-lesson series in which students will explore the basic ecological principle of interdependence through the lens of common organic farming practices.

Time: 30-45 minutes

Teacher Notes:

- For sections that instruct students to READ, you can record yourself reading aloud and send it to students. Invite them to read along with the recording. This is a helpful strategy for differentiating learning that supports all students, especially English Language Learners.
- If you are teaching this lesson in the garden, we suggest completing the sections as a whole glass or in small groups. The garden is a great place for discussion-based lessons.

Authored by: Molly Rose-Williams and Raque Vigil | www.edibleschoolyard.org

Teacher Notes Continued:

- This lesson is designed both to help students start to wrap their heads around this project in a more structured way, but also to prompt excitement and enthusiasm about the driving question. Encourage students to really get all their thinking on the table here, especially during the brainstorm section. At this stage in the process, the more possibilities the better! You never know what kind of creative solutions or ideas may arise from something that at first seems completely unrealistic or "out there".
- The first PAIR SHARE in this lesson asks students to track the sources of energy in their own bodies, and in crops. Students should have a basic idea about how to answer these questions based on things they learned in elementary school science classes. However, we recommend you use this pair-share as a way to gauge your students' level of prior knowledge and identify any significant misconceptions. Science instruction in elementary school tends to be inconsistent, and so there may be less background knowledge for some students than others.

Flow of Energy in an Ecosystem

Vocabulary

- **Energy:** the capacity for doing work. Different forms of energy include potential, kinetic, thermal, electrical, chemical, nuclear, or other various forms. Although energy may change forms, it cannot be created or destroyed.

READ: All living things need energy to survive. Most organisms, including humans, get their energy from food. Plants and certain kinds of bacteria get their energy from the sun through the process of **photosynthesis**. But regardless of where an organism gets their energy, energy of some kind is necessary for survival. Today we will explore how **energy** moves through an ecosystem. Where does the energy different organisms need to survive come from? How does it move through an ecosystem? And how could understanding the answers to all these questions help you develop a planting plan for the garden?

Let's start with a basic definition of energy. Read the article, L10_RESOURCE: What is Energy?. As you read, you may want to Talk to the Text in order to help you understand the main ideas and track your questions.

OBSERVE: Take some time to visit the bed that you planted in L3_Cultivation. Write or draw your observations about the plants and soil on the Plant Start Investigation worksheet.

- Do you notice any differences between plant growth in the cultivated vs. uncultivated areas? In the areas with compost vs. without compost?
- What other observations can you make?

Authored by: Molly Rose-Williams and Raquel Vigil | www.edibleschoolyard.org

Flow of Energy in an Ecosystem

Now focus on making observations about this garden bed related to **energy**.

- Where did the energy these crops need to survive come from?
- Do you see any other organisms in or around this garden bed? Where did the energy they need to survive come from? Where did it come from before that? Try to trace it back as far as you can.
- When you planted this bed, you used energy to do the work of tilling or cultivating the ground, digging in the soil, spreading compost etc. Where did the energy that you needed to do that come from? Where did it come from before that?
- Can you observe any other examples or evidence of energy in this garden bed? (Hint: Do you see evidence of any human impact, or activities by other organisms that required energy in order to occur?)
- Where will the energy contained in the crops go when they are done growing? Where did the energy you used to plant this bed go? Can energy ever disappear?

MODEL: Return to your food web diagram from the previous lesson. Use arrows to indicate the flow of energy through the food web. In other words, where does the energy that each organism needs come from? Where does it go after that? See how complete you can make your diagram.

PAIR-SHARE: Compare your food web diagram with a partner, including the flow of matter that you added to the diagram.

- How are your two diagrams similar?
- How are they different?
- Do either of you want to change anything about your diagrams after having had a chance to talk about it? If so, take a moment to make those revisions.

READ: Read L1O_RESOURCE: How Energy Moves Through An Ecosystem. As you read, you may want to Talk to the Text in order to help you understand the main ideas and track your questions. After you read, take a moment to make any revisions to your food web model that you would like to.

Authored by: Molly Rose-Williams and Raque Vigil | www.edibleschoolyard.org

Student Reading: What is Energy

What is Energy?

In science, **energy** is defined as the capacity for doing "work". When we dig in the garden, our muscles use energy to do the "work" of digging. But even when we're resting, our bodies still use energy to keep our heart pumping, lungs breathing, and intestines digesting our most recent meal. All living things—including plants, animals, bacteria, and fungi—use energy to grow and carry out the basic biological functions that keep them alive.

The examples above are illustrations of *chemical energy*—the energy released when bonds between atoms are broken, such as when we digest and metabolize food. However, there are many other forms of energy, including:

- potential energy (the energy of an object based on it's position and potential for movement)
- kinetic energy (the energy of motion)
- thermal energy (the energy of the movement of molecules within a substance)
- electrical energy (the energy contained within the different charges of atoms)
- nuclear energy (the energy contained in the nucleus, or core, or an atom)

A basic rule of thumb is that anytime you observe *motion*, *light*, *a change in an object's position*, or *a change in temperature*, that indicates that energy is being used or released. In the garden, one of the most common indications that energy is being used is when you see organisms growing. Without energy, growth is impossible. So where does this energy come from? Understanding the answer to this basic question is key to understanding how an entire ecosystem works.

Authored by: Molly Rose-Williams www.edibleschoolyard.org

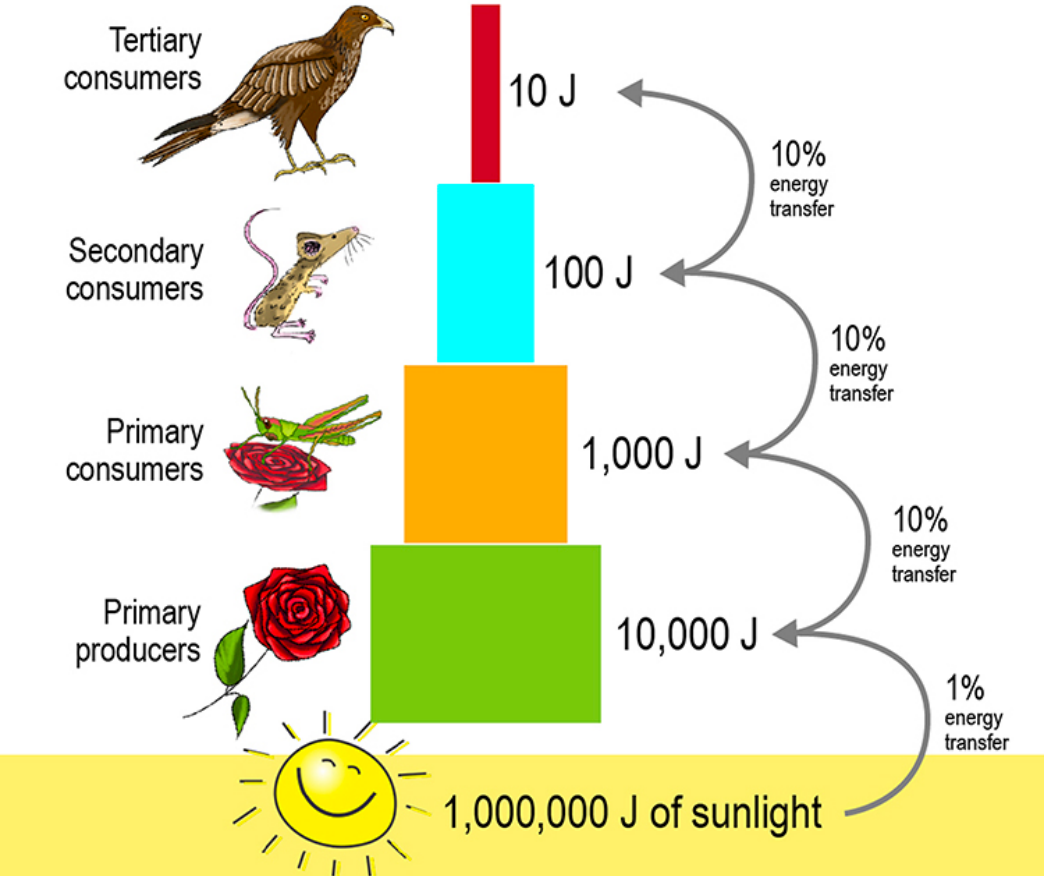
How Energy Moves Through an Ecosystem

Nearly all energy on Earth comes originally from the sun. When sunlight hits the Earth's surface, it transfers energy to whatever it hits—it causes water to heat up or evaporate, air to heat and rise, rocks and soil to heat and warm the air above them, and ice to heat up and melt.

Sunlight is also the main source of energy for all life on Earth. Plants and other primary producers use energy from the sun to synthesize food for themselves through the process of photosynthesis. When animals eat plants, the energy and matter in the plants is transferred to the animals' bodies. When animals eat other animals, the energy and matter in the prey's body is similarly transferred to the predator's body.

At each step in this process, some energy is transferred from prey to predator, and some is lost to the atmosphere as radiant heat. For example, when a rabbit eats a carrot, only about 10% of the energy that the carrot originally contained gets transferred to the rabbit's body. The rest is transformed into heat energy in the atmosphere. Similarly, when a fox eats that rabbit, 10% of the energy in the rabbit's body will be transferred to the fox—or 1% of the energy from the original carrot. See the diagram below for an illustration of this process.

Authored by: Molly-Rose Williams



Even though this energy transfer is inefficient, the supply of energy from the Sun is far greater than the energy required to support Earth's ecosystems. As long as the sun exists, ecosystems on Earth will continue to have plenty of energy.

Image credit: "Energy Flow: Transfer of Energy Between Trophic Levels" from mammothmemory.net

Authored by: Molly Rose-Williams