**Section 2:** \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_**Flow in Ecosystems**

|  |
| --- |
|  |

**Key Ideas**

|  |  |
| --- | --- |
| http://my.hrw.com/sh2/sh07_10/student/images/common/chevron_bio.gif | How does energy flow through an ecosystem? |
| http://my.hrw.com/sh2/sh07_10/student/images/common/chevron_bio.gif | What happens to energy as it is transferred between trophic levels in a community? |

**Why It Matters**

The way in which energy \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_through an ecosystem is critical to the ecosystem’s productivity and ability to support its species. By understanding this flow of energy, we can learn how to \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_food more efficiently.

|  |
| --- |
|  |

\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_that organisms do requires energy. \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_, breathing, and even sleeping require energy. Every species must somehow get food for energy. A zebra grazes on savanna grass. A lion chases down the \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_and eats it. The lion eventually dies and is eaten by \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_. The rest of the carcass is decomposed by bacteria and other microbes. At each step in this process, energy flows through the \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_.

**Trophic Levels**

An \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_eating another \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_is the most obvious interaction in a community. This interaction transfers energy through an ecosystem. The way in which energy flows through an ecosystem determines how many species and individuals live in the \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_.

The primary source of energy for an \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_is the sun. \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_organisms, such as plants and algae, change light energy from the sun into energy that they can use to grow. These \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_organisms are \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_**,** the basic food source for an ecosystem. \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_are organisms that eat other organisms instead of producing their own food. \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_**,** such as bacteria and fungi, are organisms that break down the remains of animals.  **In an ecosystem,** \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_**flows from the sun to producers to consumers** to decomposers. Each step in the transfer of energy through an ecosystem is called a \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_**level****. Figure 5** shows the trophic levels through which energy passes to a blue jay.

|  |  |
| --- | --- |
| **Food Chains** In \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_, energy flows from one trophic level to the next, forming a *food* \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_*.* The first trophic level of \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_is made up of producers. Plants, algae, and some bacteria use the energy in sunlight to build energy-rich carbohydrates. The \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_trophic level of a food chain is made up of *herbivores,* which eat producers. Cows are an example of an \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_. The third trophic level includes animals that eat herbivores. Any animal that eats another animal is a \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_. Some carnivores are on the third trophic level because they eat herbivores. For example, small birds eat \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_, which feed on plant leaves. Other \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_are on the fourth trophic level or an even higher trophic level because they eat other carnivores. For example, hawks eat small birds. \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_*,* such as bears, are animals that are both herbivores and carnivores.**Food Web** In most \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_, energy does not follow a simple food chain. Energy flow is much more complicated. Ecosystems almost always have many more species than a single \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_chain has. In addition, most organisms eat more than one kind of food. For example, hawks eat fish, small birds, and rabbits. Rabbits are food not only for hawks but also for wolves, \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_lions, and many other \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_. This complicated, \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_group of food chains, such as the group in **Figure 6,** is called a *food web*.

|  |
| --- |
| Food web |

 |

**Loss of** \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_a zebra eats 20 lb of grass, the zebra does not gain 20 lb. A lot of the energy that was stored in the grass is lost. Where did the energy go?  **Energy is stored at each link in a food web. But** **some** \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_**that is used** \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_**as heat into the** \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_**and is not recycled.**

**The Ten** \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_**Rule** When a \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_eats grass, some of the \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_in the grass is stored in the zebra. The energy may be stored as fat or as tissue. However, most of the \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_does not stay in the zebra. As the zebra uses energy from the grass to run and grow, the energy is changed into heat \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_. Then, the heat energy is \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_into the environment. Thus, the zebra does not keep 90% of the energy that it gets from the grass. Only about \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_% of the \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_in the grass becomes part of the zebra’s body. This amount of stored energy is all that is available to \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_at the next trophic level that consume the zebra. For example, a 100 kg lion needs 1,000 kg of zebras. And \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_, the zebras need 10,000 kg of plants!

By understanding energy flow between \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_levels, we can learn how to feed more \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_. If people eat big fish that are in the third \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_level, it takes 1,000 kg of producers to build 1 kg of human. If people eat cows that are in the second trophic level, 100 kg of producers are needed for 1 kg of human. If people, such as the girl in **Figure 7,** eat \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_—such as vegetables, \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_, and grains— only 10 kg of producers are needed to produce 1 kg of human.

**Energy Pyramid** A \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_diagram that shows an ecosystem’s loss of energy, which results as energy passes through the ecosystem’s food chain, is called an **energy pyramid****.** An energy pyramid is shown in **Figure 8.** Each layer in the energy pyramid represents one trophic level. Producers form the pyramid’s \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_, which is the lowest trophic level. The lowest level has the most energy in the pyramid. Herbivores \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_less energy and make up the second level. \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_that feed on herbivores make up the higher level. The energy stored by the organisms at each \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_level is about one-tenth the energy stored by the organisms in the level below. So, the diagram takes the shape of a \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_.