

Unit 5 - Food

The Amazon rainforest, also known as Amazonia, is one of the world's greatest natural resources. Because its vegetation continuously recycles carbon dioxide into oxygen, it has been described as the "Lungs of our Planet." About 20% of earth's oxygen is produced by the Amazon rainforest.

The Amazon rainforest gets its name from the Amazon River, the life force of the rainforest. The Amazon River begins in the Peruvian Andes; in fact, most of the Amazon River's water comes from the Peruvian Andes' annual snowmelt. From the Andes, the river winds its way east over the northern half of South America. It meets the Atlantic Ocean at Belem, Brazil. The main river is about 4,080 miles long. Its drainage basin covers 2,722,000 million square miles, and lies in the countries of Brazil, French Guyana, Suriname, Guyana, Venezuela, Colombia, Ecuador, Peru, and Bolivia. 20% of the world's fresh water flows through the Amazon delta. Twenty eight billion gallons of water flow into the Atlantic every minute, diluting the salinity of the ocean for more than 100 miles offshore. The Amazon rainforest watershed is home to the world's highest level of biodiversity.



Image: <http://images.encarta.msn.com/xrefmedia/aencmed/targets/maps/map/T041429A.gif>

Some 15 million years ago, the Amazon River flowed westward into the Pacific Ocean. When the South American plate moved into another tectonic plate, the Andes Mountains slowly rose up and blocked the flow of the river. As the river system backed up, freshwater lakes were formed, and the environment of the Amazon basin changed drastically. Then about 10 million years ago the river found its way eastward towards the Atlantic.

The northern half of the South American continent is shaped like a shallow dish. About 1,100 tributaries, seventeen of which are over 1,000 miles long, drain into this depression. Whenever rain falls in the river basin, it all drains into Amazon rainforest and into the Amazon River. All of this flow makes the Amazon the largest river system in the world. At some points, the Amazon River is one mile wide, while at other points it can be thirty-five miles wide. At Belem, where the river flows into the Atlantic Ocean, it can be 200 to 300 miles across, depending on the season. Some of the animals that make their home here are river otters, freshwater river dolphins, turtles, piranha, manatees, electric eels, and a remarkable, giant air-breathing fish called the piraracu.

Amazonia receives about nine feet of rain every year. Fifty percent of this returns to the atmosphere through the foliage of trees. Between June and October, the water level in the Amazon River rises by 30 to 45 feet. Tens of millions of acres of rainforest are covered by water as the flood advances, reaching as far as 12 miles inland from the main channel.

Food Starts with the Sun

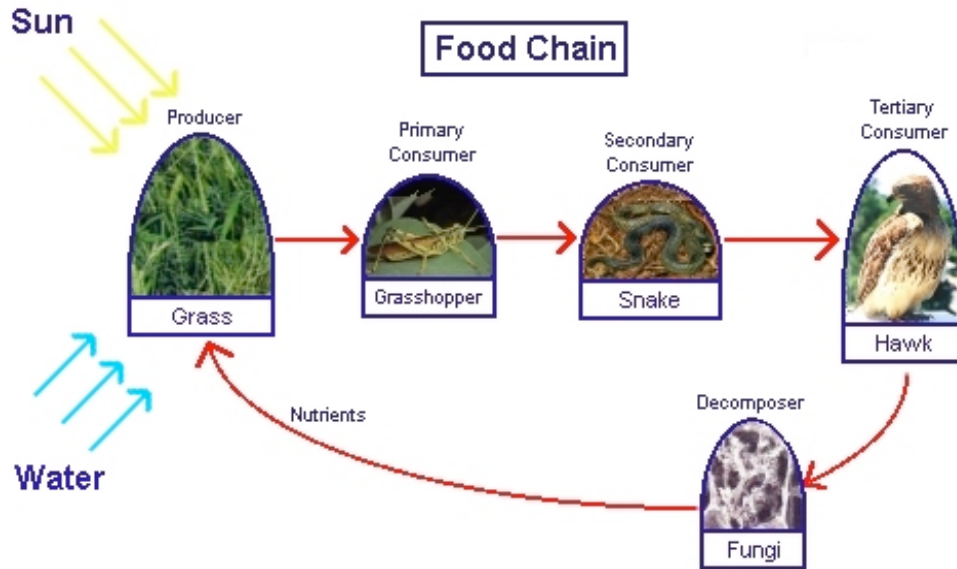
In the Peruvian rainforest ecosystem (or any ecosystem for that matter), plants capture the sun's energy and use it to convert inorganic compounds into energy-rich organic compounds. This process of using the sun's energy to convert minerals (such as magnesium or nitrogen) is called photosynthesis.

In photosynthesis, the main process is the conversion of the carbon dioxide and water (CO_2 and H_2O) in carbohydrates (CH_2O) and oxygen (O_2). Light energy starts photosynthesis' chemical reactions that transform light energy into chemical energy stored in carbohydrates. For example, the grass in a forest absorbs light and stores it as chemical energy in carbohydrates. An insect, when feeding on grass, gains the grass' stored energy. Therefore, grass energy comes directly from sun, and sun energy reach insects indirectly through grass.

There are many types of animals that will eat the products of the photosynthesis process. Examples include a sloth eating tree leaves, a tapir eating fruit, or a hummingbird eating nectar. When these animals eat these plant products, food energy and organic compounds are transferred from the plants to the animals. When these animals are eaten by other animals (e.g., a jaguar eating a tapir, a harpy eagle eating a sloth, or a snake eating a hummingbird), energy and organic compounds are transferred from one animal to another.

This chain of energy transferring from one species to another can continue several more times, but it eventually ends when the animals die. The dead animals are broken down and used as food or nutrition by bacteria and fungi. As these organisms, referred to as decomposers, feed on the dead animals, they break down the complex organic compounds into simple nutrients.

Decomposers play a very important role in all habitats, because they take care of breaking down (cleaning) many dead material. There are more than 100,000 different types of decomposer organisms! The simpler nutrients that the decomposers produce are returned to the soil and can be used again by the plants. The energy transformation chain starts all over again.



A characteristic of all ecosystems is that their organisms can be grouped according to what they eat, that is, the way that they get energy.

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| <p>Producers. Organisms that produce their own food, such as plants, are called producers. Producers convert inorganic compounds into organic compounds. They are called producers because all of the species of the ecosystem depend on them.</p> | <p>Consumers. All the organisms that cannot make their own food (and need producers) are called consumers because they depend on other organisms for their food source. There are different levels of consumers. Those that feed directly from producers (i.e., organisms that eat plant or plant products) are called primary consumers. In the figure above the grasshopper is the primary consumer.</p> |
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Organisms that feed on primary consumers are called **secondary consumers**, and those who feed on secondary consumers are called **tertiary consumers**. In the figure above the snake acts as a secondary consumer and the hawk as a tertiary consumer. Of course, some organisms can function at different levels depending on what they eat for lunch! When the dusky titi monkey eats leaves, for example, it is a primary consumer; however, when it eats insects, it is a secondary consumer or a tertiary consumer (depending on the insect it eats).

Consumers are also classified depending on what they eat:

Herbivores

Creatures that eat only plants or plant products. Examples include caterpillars, sloths and tapirs.

Carnivores

Animals that eat only other animals. Examples of carnivores are jaguars, snakes, eagles, and spiders.

Omnivores

Animals that eat both plants (acting a primary consumers) and meat (acting as secondary or tertiary consumers). Examples of omnivores are turtles, monkeys and capybaras.

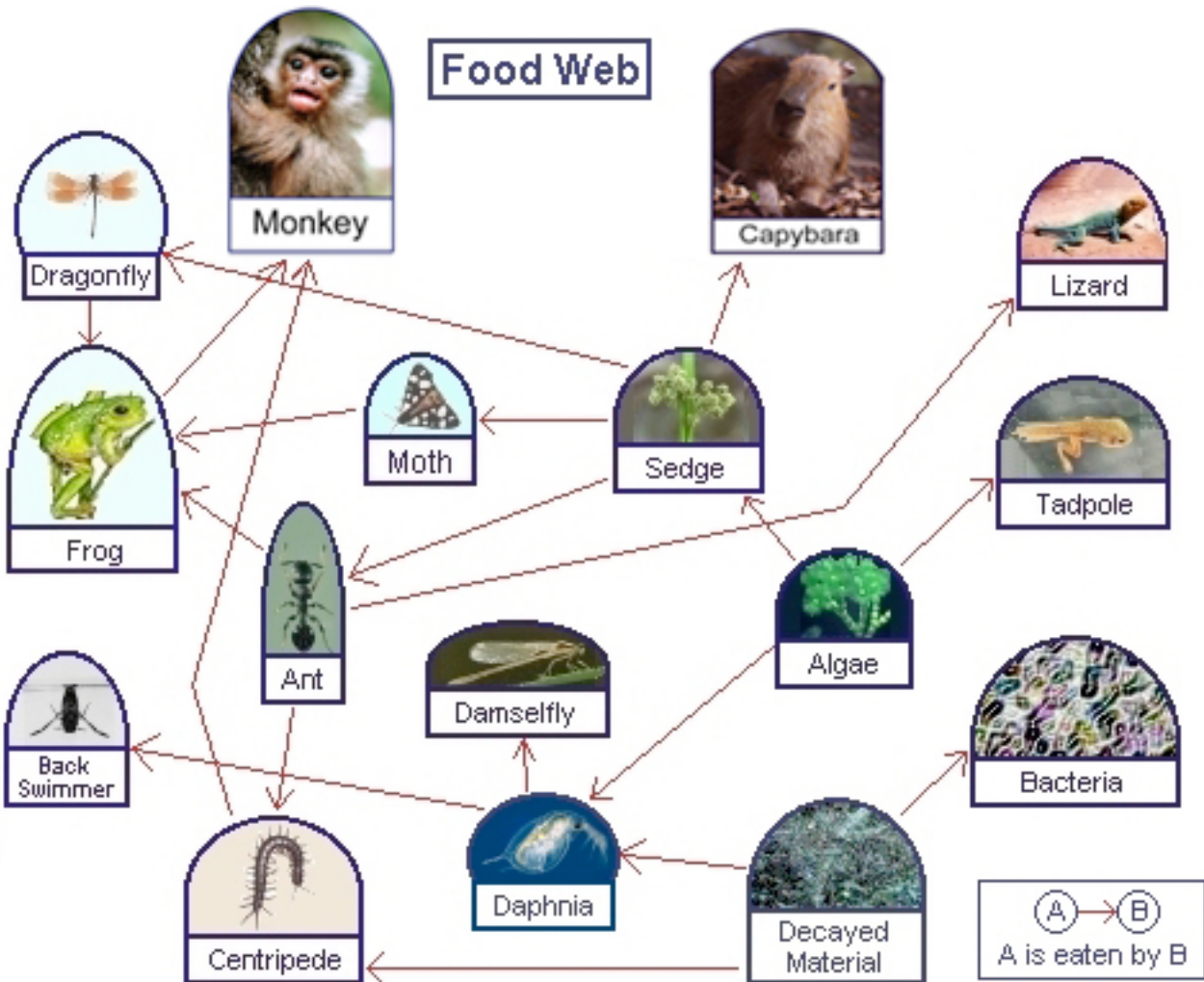
Detritivores

Scavengers which feed on dead plants and animals or their waste. They are essential for recycling of nutrients, without them, dead plant material would not be returned to the soil for new growth. Without these animals, the earth might be covered by deep layers old vegetation and lots of animal carcasses only slowly breaking down by physical and chemical processes. Detritivorous animals and fungi speed up this process. They also provide food for many predators. Detritivorous animals include millipedes, woodlice, springtails, slugs and snails.

Decomposers Fungi are the great decomposers of the world (along with some help from the bacteria). Fungi are generally characterized by their method of obtaining energy, namely absorption of nutrients from their surroundings. This sets them apart from plants, which use photosynthesis to obtain energy from the sun, and animals, which actively ingest food. The most familiar parts of fungi are spore-producing reproductive bodies such as mushrooms, toadstools, "shelves" of fungus on trees, puff balls, blue or green molds, etc. These are the only visible part of many fungi, but the main "body" of the fungus is down in the soil or rotten log (or loaf of bread!).

Food Webs

The food chain on page 34 looks very simple, but in reality it is more complex. Think about it. How many different animals eat leaves? And how many different foods does the harpy eagle eat? One doesn't find simple independent food chains in an ecosystem, but many interdependent and complex food chains that look more like a web and are therefore called food webs. A food web that shows the energy transformations in the Peruvian rainforest may look like this:

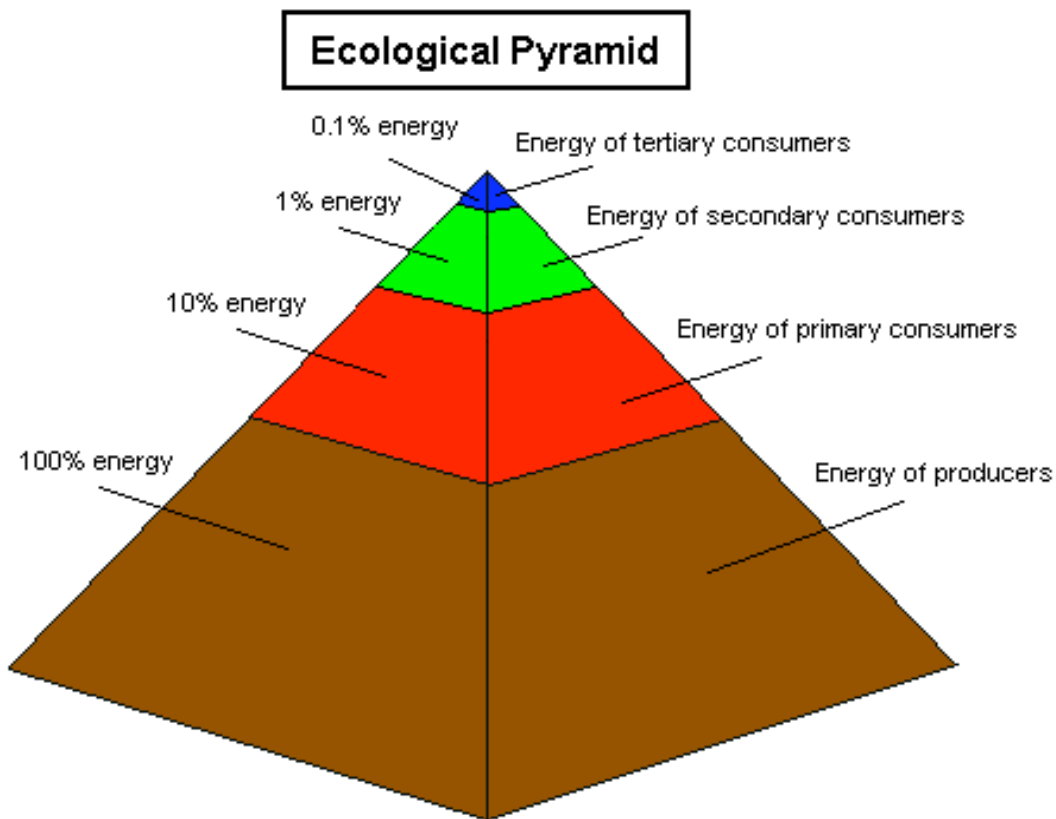


As you can see from this food webs, with all their dependencies, can be very complex, but somehow nature balances things out so that food webs last a long time. Many species share the same habitat, their populations survive for many years, and they all live well together.

The Ecological Pyramid

We described in the previous sections how energy and organic compounds are passed from one trophic level to the next. What was not mentioned is the efficiency of the transfer. In a highly efficient transfer almost all of the energy would be transferred -- 80% or more. In a low efficiency transfer very little energy would be transferred -- less than 20%. In a typical food chain, not all animals or plants are eaten by the next trophic level. In addition, there are portions or materials (such as beaks, shells, bones, etc.) that are also not eaten. That is why the transfer of matter and energy from one trophic level to the next is not an efficient one.

One way to calculate the energy transfer is by measuring or sizing the energy at one trophic level and then at the next. Calorie is a unit of measure used for energy. The energy transfer from one trophic level to the next is about 10%. For example, if there are 10,000 calories at one level, only 1,000 are transferred to the next. This 10% energy and material transfer rule can be depicted with an ecological pyramid that looks like this:



This pyramid helps one visualize the fact that in an ecological system there need to be many producing organisms at the bottom of the pyramid to be able to sustain just a couple of organisms at the top. In looking at the pyramid, can you guess how much larger the volume of each layer is as compared to the one just above it? It might not look like it, but each layer is close to 10 times larger than the layer above!

Food's Role in Survival

Now that you know about food chains and webs in the natural world, it is time to think about humans fit into the cycle.

Think about the food you ate this morning for breakfast? Where did it come from? Did it come from your refrigerator or pantry? A restaurant? Where was it before? How did it get there? What types of resources were used to deliver your food to the supermarket?

These are all very simple questions, but they have significant global impacts. The food you choose to consume has the greatest environmental impact of all your choices. The reason is that the production of food is directly related to the care and preservation of the land.

Food that is responsibly grown, in local economies (like your neighborhood, state, or region) takes far fewer resources to deliver than those from far away places.

Think about the last time you were in your supermarket. Did you see bananas? Did you see strawberries for sale, even though it wasn't summer? Have you ever seen bananas growing in your neighborhood?

Food that has to be shipped from far away requires multiple forms of transportation. Bananas may be flown from Central America to the largest city near you. Those bananas are then loaded onto trucks and driven to your supermarket, where they wait for you to buy them for later consumption. It's amazing to think of how far produce travels before it ends up on the shelf. Produce is only one example. Next time you're at the supermarket look for foods grown on each continent (excluding Antarctica, of course)

Do you think that this is a sustainable method of gathering food sources?

What might lead us toward making more sustainable food choices? As with all choices, weigh the options. Just because the option is available, does it mean that the option is justified or the correct one to make?

Once you start to trace your food sources back to their origins, you can begin to make well-informed, environmentally sustainable, culturally-sensitive food choices.

Questions for Discussion

What would happen if one trophic level were removed from a food web?

How do humans fit into the food webs? What type of consumers are humans?

What does making healthy and diverse diet choice have to do with environmental conservation?

What role do farmers have in preserving the land? Are there different types of farming that have different impacts on the land?

Is the indigenous people's way of harvesting food from the rainforest sustainable?

Where do humans fit on the Ecological Pyramid?

What role does photosynthesis play in food production?

How does food arrive at grocery stores?

Further Exploration and Sources

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<http://www.informedeating.org>

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