

ENERGY FLOW & MATERIALS CYCLE RESOURCE



Here is a more detailed explanation of the Energy Flow & Materials Cycle diagram.

The Earth's natural ecosystem has created an amazing cycle of energy/life where energy flows through the ecosystem and matter is continuously recycled. There are five key ingredients for life as we know it:

1. Continual source of energy
2. Amenable temperature for the life forms on Earth
3. Water in a liquid form
4. A sheltering and non-toxic atmosphere
5. The right assortment of matter (elements) that life forms are made

All plants and animals need energy and almost all depend on the energy coming from the Sun, but can't use it directly. It must be converted into a useable form of energy. Green plants are chemical manufacturers that provide the conduit of energy to the majority of life on Earth through photosynthesis.

The Sun generates energy in the form of heat and light (solar energy). It seems like the Sun produces a lot of energy which one might then believe there is an infinite amount to be processed through photosynthesis, but that is not the case.

- About 42% of the heat is absorbed by the earth and its oceans, helping keep the temperature not too hot or cold.
- Another 23% evaporates water, driving the water cycle and about 34% is reflected back out into space. The gases in our atmosphere also trap the heat energy that radiates off of the Earth and the oceans, as well as the reflected heat through the greenhouse effect which helps maintain an amenable temperature for life.
- Much of the light energy, especially ultraviolet light, is blocked by the sheltering ozone shield in the layer of the atmosphere called the stratosphere. This is very important, as most life on Earth could not survive the amount of ultraviolet light generated by the Sun.
- Light energy that does reach the Earth is captured by green plants in the process called photosynthesis, but only about 0.1% to 0.3% of the sunlight reaching the Earth fuels life.

“Photo” means light and “synthesis” means to make something. Green plants take in carbon dioxide (CO₂) which is made up of carbon and oxygen from the atmosphere and water (H₂O) which is made up of hydrogen and oxygen from the soil and atmosphere. Through photosynthesis, the molecules of carbon dioxide and water are broken apart. The carbon, oxygen and hydrogen elements are then recombined into a high energy organic chemical – sugar! Not all the oxygen is used and this is released by the plants into the atmosphere, and you and all the animals on Earth breathe it!

Green plants are called “producers” because they produce food in the form of sugar. Animals and plants are made up of many other elements besides carbon, oxygen and hydrogen. Some other important elements include sulphur, nitrogen, phosphorus and calcium plus many more.

The hydrogen, carbon and oxygen of the sugar molecule are held together by energy from the Sun which

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has gone through a very complex series of chemical reactions. Sugar has three functions:

1. Some of the sugar is used to make the cells which plants and animals are made out of (carbon, oxygen, hydrogen).
2. Some of the sugar is “burned” in each and every cell by combining the oxygen you breathe in with the sugar to release energy so the animal and plant can function. The waste products from this reaction include carbon dioxide, which we breathe out and water and energy. Energy not used for bodily functions, is released as heat, helping warm our bodies. This process of burning sugar is called cellular respiration. Carbon dioxide, in turn, is taken in by green plants for photosynthesis. Carbon dioxide in the atmosphere is important in that it traps heat (the greenhouse effect) and helps keep the Earth an amenable temperature.
3. Some of the sugar is stored as fat to be used later.

Animals are called “consumers” as they eat (consume) food, but cannot make it. An animal makes more of itself because it has eaten plants or animals that ate plants and uses the chemicals from them to grow. At some point, animals and plants produce waste or eventually die. The matter making up their bodies and waste is “decomposed.” Animals and plants are composed of many parts. Decomposed means to take apart.

Along each step of the way along the food chain, only about 10% of the energy consumed is incorporated into the next organism that eats the previous which is why we need a continuous supply of energy. This is because, 1) not all parts can be digested and becomes a waste product (feces and urine) and isn't available for the next animal that eats it; and 2) part of the food eaten, once converted to sugar is burned in each cell to release energy for bodily functions and then ultimately is released as heat from the body and is not available for the next animal that eats it. Now, the energy contained in the waste products and the body when the animal or plant dies, is then decomposed by microbes including bacteria and fungi. Neither of these organisms have mouths, they secrete digestive juices to liquify the waste/dead body and then absorb this for their food. Yum!

