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1.4 The Carbon Cycle

Cycling of Matter

Except for the few asteroids that arrive from space, the amount of matter on Earth is constant. Since matter is constantly being changed from one form to another, it must be recycled.

There are two categories of matter: organic and inorganic. **Organic** substances always contain atoms of carbon and hydrogen, and often contain atoms of oxygen and nitrogen. Proteins, sugars, and fats, the important chemicals that make up your body, are all organic. Matter that doesn't contain a combination of carbon and hydrogen atoms is called **inorganic** matter. For example, carbon dioxide (CO_2), water (H_2O), and ammonia (NH_3) are considered inorganic.

Matter gets recycled through eating food, which is organic matter, and through death. When an organism eats, the organic matter that was part of other living things becomes part of its body. When an organism dies, decomposers break down the organic matter into smaller inorganic molecules that are then available for other living organisms.

Photosynthesis, Cellular Respiration, and the Carbon Cycle

Carbon is a key element for living things. Each year, about 50 to 70 billion tonnes of carbon from inorganic carbon dioxide are recycled into more complex organic substances. This is done through photosynthesis.

During **photosynthesis**, plants use light energy to combine carbon dioxide and water to produce sugar (**glucose**) and oxygen.

carbon dioxide + water + light → sugar (glucose) + oxygen

Most cells use **cellular respiration**, to get energy. The process uses oxygen to break down sugars. Carbon dioxide and water are released.

sugar (glucose) + oxygen → carbon dioxide + water

Because photosynthesis uses carbon dioxide and cellular respiration produces carbon dioxide, the carbon is repeatedly cycled through both processes. This is often called the **carbon cycle**.

Inorganic Carbon Storage

While much carbon is being continuously recycled among living things in ecosystems, a tremendous amount of inorganic carbon is stored in three main storage areas: the atmosphere, the oceans, and the Earth's crust. Only about 0.03% of the total inorganic carbon is contained in the carbon dioxide that we breathe.

A very large amount of inorganic carbon is found as dissolved carbon dioxide in the oceans.

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The largest storage of inorganic carbon is in sedimentary rocks, such as limestone, that have been formed from the remains of living things. In this form, carbon can be trapped in the earth for millions of years until geological conditions bring it back to the surface. Volcanic activity can break down carbon-containing rocks, and acid rain will react with limestone to release carbon dioxide.

Organic Carbon Storage

In bogs, large amounts of organic carbon are trapped because of the very slow **decomposition** of plant material (or **peat**) lasting many years. If the peat becomes covered with many layers of sediment, the slowly decaying plant material can become compressed to form coal. Oil and gas, also fossil fuels, are formed by a similar process. In these forms, the carbon can be trapped from many millions of years.

Human Activity and the Carbon Cycle

Humans have speeded up the release of organic carbon by:

- mining
- burning fossil fuels (combustion)
- burning forests (combustion)

Humans are also increasing the amount of carbon dioxide in the atmosphere by clearing away vegetation in order to build or farm. This reduces the amount of photosynthesis, which in turn reduces the amount of carbon dioxide removed from the atmosphere. Therefore the total amount of carbon dioxide is increasing.

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Worksheet 1.4: The Carbon Cycle

1. Explain the difference between organic and inorganic matter.

2. When space probes were sent to the Moon and Mars, soil samples were collected and analyzed for organic compounds. Why would scientists want to know whether organic matter was present?

3. In your own words, explain why photosynthesis and cellular respiration are considered complementary (go well together) processes.

4. Explain the importance of decomposers in the carbon cycle.

5. Explain how the burning of fossil fuels by humans affects the carbon cycle.