

Climate Heroes Lesson Plan

The Carbon Cycle and its Role in Climate Change

Activity 1

Grades 8–10

Time required: 1 class period

Focus Questions

- What is the carbon cycle?
- How do atoms combine and recombine?

Learning Objectives

- Explain that all things are made of atoms.
- Explain that atoms can be re-arranged in whole number ratios to make different materials and that photosynthesis and cellular respiration are reverse processes.

Materials

- several different colours of construction paper
- several different colours of chalk or ribbon

Procedures

1. Use construction paper to create paper “atom” signs to be pinned to each student. You will need:

- 6 black carbon atoms
- 12 white hydrogen atoms
- 18 red oxygen atoms
- 1 big yellow energy sign
- several black $C_6H_{12}O_6$ (sugar) signs.

On the reverse side of these signs write: oil, gas, or coal. Write the name and symbol of the appropriate atom on each sign. These will be used to act out the processes of photosynthesis and cellular respiration.

2. Post the equations of these processes where the students can see them.

The equations are as follows:

- Photosynthesis: $6CO_2 + 6H_2O + \text{energy} \rightarrow C_6H_{12}O_6 + 6O_2$
Carbon dioxide plus water plus energy yields sugar and oxygen

- Respiration: $C_6H_{12}O_6 + 6O_2 \rightarrow 6CO_2 + 6H_2O + \text{energy}$
Sugar plus oxygen yields carbon dioxide plus water plus energy

3. Make a large circle on the floor with green chalk or a green piece of ribbon. The circle needs to be large enough for the student groups to step into. This will represent a plant.

4. Make a second large circle on the floor with brown chalk or with a brown piece of ribbon. The circle needs to be large enough for the student groups to step into. This will represent an animal.

5. Give each student one sign to wear. Since there are thirty-six different atoms and the energy sign, some students may have an extra atom that gets passed along during the activity to make the equations work.

6. Have students group themselves into six carbon dioxide molecules and six water molecules by holding hands or linking arms to form the chemical bonds. Show them how the carbon and oxygen have to be in the center of the group.

- Have the water molecules pretend that they are being drawn into the plant through the roots.
- Have the carbon dioxide molecules pretend that they are being drawn into the plant through the leaves.
- Once they are all in the plant, have the yellow energy person come in to break the bonds by pulling their hands apart. Make the point that it takes energy to break the bonds.
- Energy stays in the plant circle while the atoms regroup themselves into sugar and oxygen molecules, holding hands or linking arms to show that new bonds have formed.
- Have the oxygen molecules drift off into the air, as the plant does not need it.

7. Now explain that an animal, such as a human, is going to eat the plant. Have the students pretend they are eaten by stepping as a molecule (with hands still held), along with the energy, into the brown ribbon that represents an animal.

- Have the students who are the oxygen molecules pretend they are being breathed into the animal. Now have everyone regroup into carbon dioxide and water. The energy will be released as “heat” when the CO_2 and H_2O bonds form and those students who represent energy will leave the animal by stepping outside the circle.
- Tell the students that the energy is used by the animal to live and that is why the animal ate the plant. They can feel their own body heat as evidence. Ask them what happens when they are active—like when they are playing a sport. They will probably respond that they feel energized and warm/hot.
- Have them pretend that the water is released as sweat or urine, the water student molecules step out of the brown circle, and the carbon dioxide is breathed out, the carbon dioxide student molecules step out of the circle.

8. Repeat the cycle about two more times until the students can do it without help. For advanced students, you can lead to the understanding that plants both photosynthesize and respire.

9. Evaluate the students’ understanding of the activity by having them write their answers to the following questions:

- What is an atom? (An atom is the smallest particle that can exist and still have the properties of the parent material. A material made of all of one kind of atom is called an element.)
- Use the reactants in photosynthesis as an example to explain how atoms combine to make molecules. What are the elements in the molecules? How many of each atom are in each molecule? (The reactants in photosynthesis are carbon dioxide, CO_2 and water, H_2O . The carbon dioxide is made of one carbon atom between two oxygen atoms. The water is made of one oxygen atom between two hydrogen atoms)
- Use the products of photosynthesis to explain how atoms recombine to make other molecules. What happened to the reactant molecules? Where did the atoms go? How many of each atom are the new product molecules? (The reactant molecules came apart into their component atoms. Those atoms recombined to form sugar. No atoms were lost or gained in the process.)
- Is it atoms or molecules that break into pieces to form new things? (It is molecules that break apart into individual atoms.)
- Where did the plants get the carbon from? (The plants get carbon from the carbon dioxide in the air.)
- Explain how a plant or a solid, can be made from the gas, carbon dioxide. (When the atoms recombine into a different molecule the new material has different physical and chemical properties than the original molecule. So an atom of carbon in carbon dioxide has the molecular properties of a gas, but the same atom in a sugar molecule has the molecular properties of a solid.)
- What happened to the energy trapped by the plants? (The energy was stored in the plant until the plant decomposed or was eaten. Then as the respiration process began, the energy was released. This is why compost piles become warm and animals have body heat.)