

## **Teaching Activity: The Carbon Dioxide-Oxygen Cycle**

**Introduction:** Oxygen is the second most abundant gas in the Earth's atmosphere and is used directly from the atmosphere by most plants and animals. It is essential for *respiration*, the cellular process during which living things chemically combine oxygen with food to release energy. Oxygen is also necessary for the combustion of fuels such as oil, coal and wood, as well as many other chemical and biological reactions on Earth.

In comparison to oxygen, the carbon dioxide represents a very small fraction of the atmosphere. It is an important raw material used by plants in the process of *photosynthesis*, to produce food. Carbon dioxide is removed from the atmosphere by plants during this food-making process and returned to the atmosphere by the respiration of both plants and animals, as well as through the *decomposition* of dead plant and animal material.

Scientists believe that in a healthy atmosphere the amount of carbon dioxide used by plants equals the amount returned to the atmosphere by respiration, decay and other natural processes. However, human activities, such as the burning of fossil fuels and the destruction of large tracts of forests, is adding excessive amounts of  $CO_2$  to the atmosphere and possibly increasing the concentration to a dangerous level. Because of  $CO_2$ 's ability to absorb heat energy from the Earth's surface, increased levels of carbon dioxide trap could raise the heating potential of the atmosphere, causing the Earth's average global temperature to increase and causing potentially serious consequences in the Earth's ocean/ atmosphere system.

### **Objective:**

- To describe the natural cycling of oxygen and carbon dioxide in the Earth system;
- To analyze changes in the Earth's carbon cycle as a result of human activity;

**Important Terms:** Cycle, chemical reaction, carbon dioxide, oxygen, absorption, heat, decomposition, average global temperature, photosynthesis, respiration;

**Materials:** Copy of Student Activity Sheets, paper/pencil, colored pencil or markers, scissors;

### **Procedure:**

#### **Part I: The Natural $CO_2/O_2$ Cycle:**

1. Read over and discuss the **Introduction**.
2. Attached is a simply diagram of the  $CO_2/O_2$  cycle illustrates the interactions that take place between these two gases and the natural environment.
  - Make a transparency of the diagram and spend whatever time necessary to evaluate the interactions within the cycle.

- Students should fill in the missing information on the diagram by cutting out the information pieces and placing them where they belong in the diagram.
  - When they are sure they are correct, they should glue/tape them into place. They can color the diagram in they wish.
3. When students have complete work on the diagram they should complete the answer to the **Analysis** questions for **Part I**.

**PART II: The Carbon Cycle in the Age of Industrialization:**

1. Attached is a diagram of the carbon cycle since the beginning of the Industrial Revolution. It shows, in a much simplified format, the changes in the cycling of carbon within the Earth system over the past 150 years.
  - Make a transparency of this diagram and spend whatever time is necessary discussing it and the apparent changes that have taken place.
  - Students should then cut out and place the information pieces and place them in the correct location on the diagram. When they are sure they are correct, they should glue or paste them into place.
2. When students have completed work on the diagram, they should answer the **Analysis** questions for **Part II**.

# INFORMATION PIECES

## PART I:

Carbon dioxide used by plants

Carbon dioxide given off by animals

Oxygen used by animals

Oxygen given off by plants

Carbon dioxide given off by  
decaying organic matter

Oxygen from photosynthesis available  
to animals

CO<sub>2</sub> from respiration available to plants

## PART II:

In the process of photosynthesis, plants take in CO<sub>2</sub>, water and sunlight and give off O<sub>2</sub>, keeping the carbon as part of the carbohydrates they need for growth and repair:



These carbohydrates are a rich store of energy.

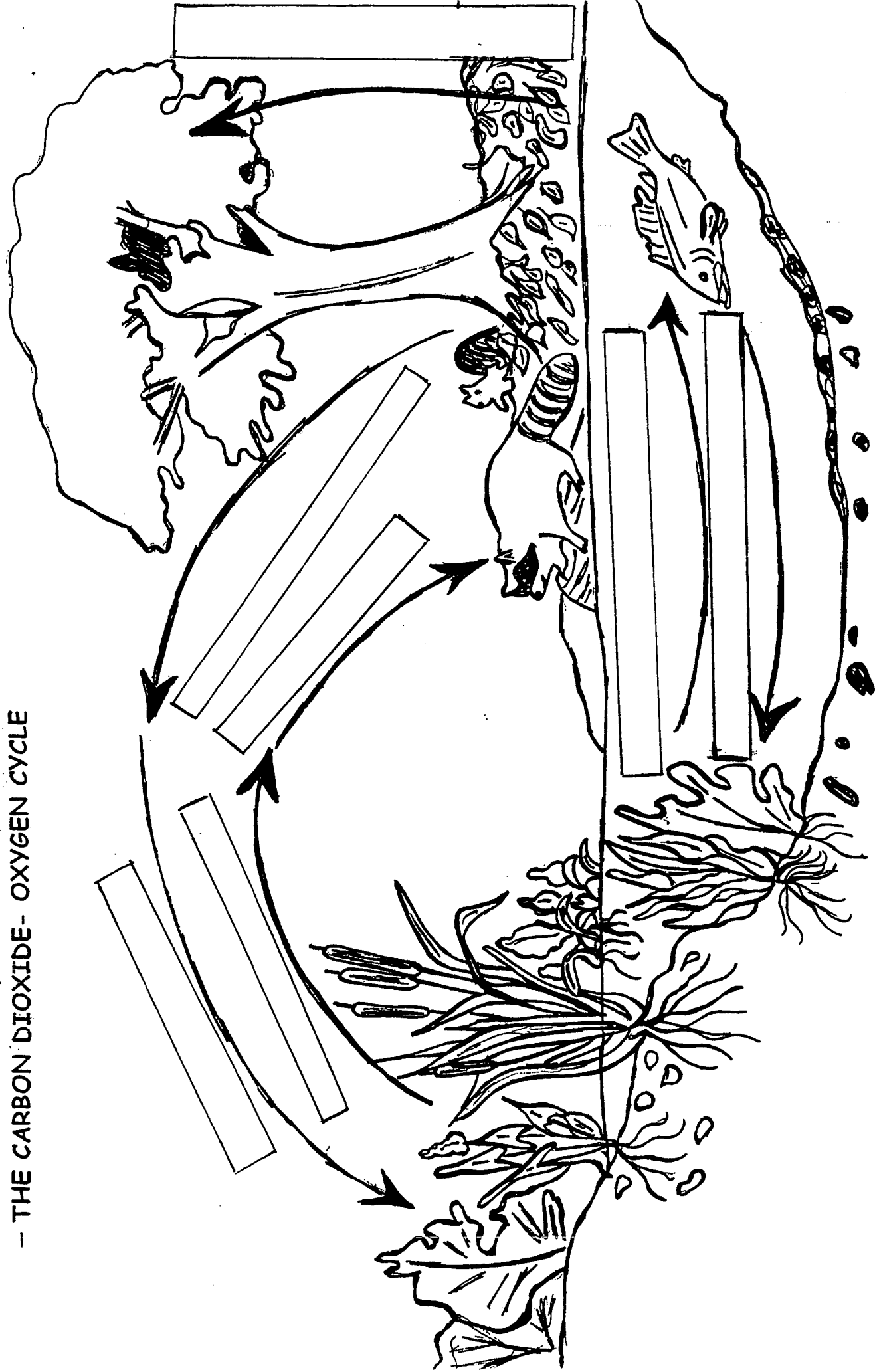
Coal and oil have been the basic fuels used by the developed nations to build their businesses and industries and a high standard of living. All of the carbon stored in them is released during burning, forming CO<sub>2</sub> with the O<sub>2</sub> in the air. Some goes back into the Earth's carbon reservoirs; the excess enters the atmosphere.

This energy is used in respiration to break down the complex carbon compounds to yield CO<sub>2</sub> and water:  $\text{C}_6\text{H}_{12}\text{O}_6 \rightarrow 6\text{CO}_2 + 6\text{H}_2\text{O} + \text{energy}$ . Plants and animals break up the food molecules and obtain the energy they need for their life processes. The carbon is stored in their tissues until they die.

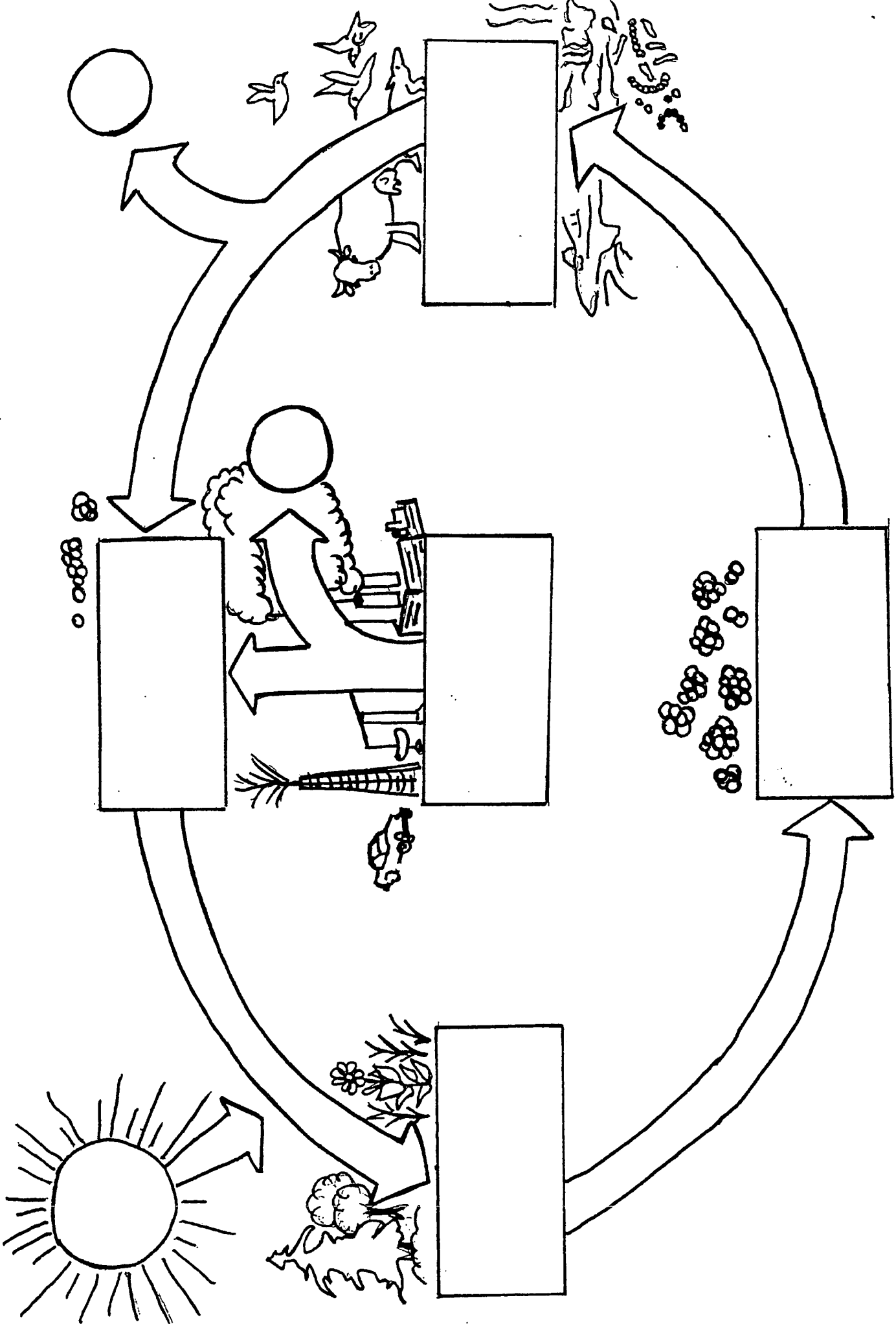
CO<sub>2</sub> is removed from the air by several natural processes. The fastest uptake is into plants and the surface layer of the ocean. As a result of human activities, the carbon cycle is no longer balanced and gases such as CO<sub>2</sub> and CH<sub>4</sub> are building up in the atmosphere.

Along with the CO<sub>2</sub>, methane, CH<sub>4</sub> is given off to the air during decomposition. Its concentration has risen as a result of human activities such as agriculture and waste disposal. CH<sub>4</sub> levels have increased by 145% over the past 150 years.

- THE CARBON DIOXIDE- OXYGEN CYCLE



# THE CARBON CYCLE IN THE AGE OF INDUSTRIALIZATION



**Student Activity Sheet #3**

**ANALYSIS AND COMPREHENSION**

**PART I**

1. What does the diagram of the  $CO_2$ - $O_2$  cycle illustrate?

---

---

2. Why could you say that this cycle is in "balance"?

---

---

3. Name 3 sources of carbon dioxide.

---

4. What are some sources of oxygen?

---

5. What role does carbon dioxide play in plant life processes?

---

---

6. What process in animal cells requires oxygen?

---

7. If all the vegetation in the pond died, what effect would it have on the animals? Why?

---

---

8. If the reverse happened, how would the aquatic plants be affected? Why?

---

---

9. Why is this natural process called a *cycle*?

---

---

10. Why is the burning of fossil fuels a concern for scientists?

---

---

Student Activity Sheet #3

11. What would be a direct effect of increases in the amounts of this gas?

---

---

---

12. What problem could this create for life on Earth? \_\_\_\_\_

---

---

**PART II:**

1. What is the source of energy behind the carbon cycle? \_\_\_\_\_

2. What is the food-producing process in plants? \_\_\_\_\_

3. Write the chemical equation for this process? \_\_\_\_\_

4. What substance is the byproduct of this process? \_\_\_\_\_

5. Why could you say that plants are a sink for carbon? \_\_\_\_\_

---

---

6. What happens to the carbon stored in the plants when they die? \_\_\_\_\_

---

---

7. Which greenhouse gas is given off during decomposition? \_\_\_\_\_

8. How have humans added excess amounts of this gas to the atmosphere?

---

---

9. What other human activity is over-loading the carbon cycle? \_\_\_\_\_

---

10. Where does the C in fossil fuels come from? \_\_\_\_\_

11. How have humans caused an imbalance in the carbon cycle? \_\_\_\_\_

---

---