



TEACHER GUIDE

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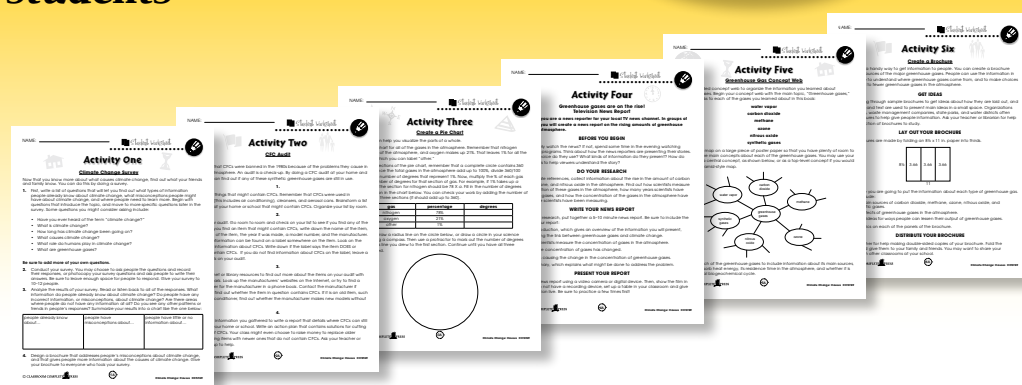
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Global Warming

Answer the questions in complete sentences.

1. Have you ever heard of the term **global warming**? What do you think it means? How does it differ from climate change?

2. Match the term on the left to its definition on the right. You may use a dictionary to help you.

1	average	a form of heat energy that can travel through empty space	A
2	escape	to take in	B
3	radiation	a measure of the middle value of a set of data	C
4	surface	a series of events that happen over and over again	D
5	absorb	a group of related things that act together to form a whole	E
6	cycle	to break away from or get free of	F
7	natural	the outer edge of a body	G
8	system	a substance that can be found on Earth	H



Greenhouse Gases: Water Vapor

There is more water vapor in the atmosphere than any of the other greenhouse gases. More **water vapor** in the atmosphere leads to warmer temperatures. This then causes more water vapor to be absorbed into the atmosphere. This process that leads to more and more change is called a **positive feedback**. As Earth warms up, the polar ice caps start to melt and shrink. The water from the ice caps evaporate into the atmosphere. This creates a lower albedo effect and leads to more warming.



STOP What happens to the size of Earth's ice caps when global temperature rises?



Water is always moving between the atmosphere and Earth's surface in a process called the **water cycle**. Water can exist on Earth in three states: solid, liquid or gas. Water is always changing from one state to another. With more water vapor in the atmosphere, more will condense into clouds. The clouds reflect the Sun's radiation from reaching Earth's surface. The greater albedo effect of the clouds could cool Earth. This kind of change that brings back balance is called a **negative feedback**.

Keep in mind that the more water vapor you have in the atmosphere, the more radiation it absorbs from Earth. This causes the atmosphere to heat up. In order for this water vapor to condense into clouds, the air needs to cool. As air cools, clouds are formed. Water falls back to the Earth as rain or snow. You can see how as a greenhouse gas, water vapor is difficult to narrow down how it affects climate change.



Greenhouse Gases: Carbon Dioxide

1. **Circle** the word **TRUE** if the statement is TRUE or **Circle** the word **FALSE** if it is FALSE.

- a) Photosynthesis takes carbon out of the atmosphere.
TRUE **FALSE**
- b) Carbohydrates are compounds made of carbon and nitrogen.
TRUE **FALSE**
- c) Decay is the breakdown of once-living things.
TRUE **FALSE**
- d) Limestone is a carbon-rich rock made of the shells of tiny ocean animals.
TRUE **FALSE**
- e) Volcanoes take carbon out of the atmosphere.
TRUE **FALSE**

2. Number the events from 1 to 5 in the order they occur in the use of fossil fuels.

- a) Over millions of years, heat and pressure change the remains into fossil fuels.
- b) Living things die and their remains become buried under ground.
- c) People pump fossil fuels from deep beneath Earth's surface.
- d) More layers of soil and rock form over the buried remains.
- e) Oil, coal, and natural gas are burned to power automobiles and factories.

3. **Circle** the processes that add carbon to the atmosphere. **Underline** the processes that take carbon out of the atmosphere.

- | | | |
|-------------------------------------|-------------------------------|------------------------------|
| photosynthesis | respiration | ocean animals forming shells |
| driving a car that runs on gasoline | decay | volcanic eruption |
| breathing | burning coal in a power plant | growth of trees |

Greenhouse Gases: Ozone

3. Answer each question with a complete sentence.

a) Explain how ozone gets into the troposphere by **NATURAL** processes.

b) Explain how burning gasoline in cars and trucks leads to the increase of ozone in the troposphere.

Research

4. Working as a class, divide a world map into regions. You may want to use continents as your regions. Break into smaller groups. Assign each group to research a region. Using the library or Internet resources, find out about areas in your region that have problems with smog. Mark these areas on the world map using push pins or sticky notes. Write a short statement about the problems that each area faces.

Take turns reading your statements until all of the areas on the map have been covered. Have a class discussion. Brainstorm ways in which people or technology can change in order to put less ozone into the atmosphere.



How does an object's color affect how much radiation the object absorbs?

You will need:

- 4 thermometers
- 4 shoe boxes (or boxes of similar size)
- White, yellow, green, and black construction paper

This activity must be done on a sunny day.

Different places on Earth reflect and absorb different amounts of the Sun's radiation. Some things, like thick clouds and ice, reflect a lot of radiation. Other things, like asphalt and soil, absorb a lot of radiation. The color of a place plays a big role in telling how much radiation the thing will absorb.

Cover four different shoe boxes with different color paper: white, yellow, green, and black. Place a thermometer inside each shoe box. Write down the temperature reading of each in the chart below. Then, place all of the shoe boxes in a sunny location for a few hours. While the sun is still on the boxes, take each thermometer out and immediately write down the new temperature reading in the chart below. Which box had the highest temperature? Which box had the lowest temperature? Based on your data, draw some conclusions. How does color affect the amount of radiation that an object absorbs?

Box Color	Starting Temperature	New Temperature
White		
Yellow		
Green		
Black		



Crossword Puzzle!

WORD LIST

albedo
atmosphere
carbon dioxide
cycle
energy
evaporate
fertilizer
gas
global warming
greenhouse
heat
hydrogen
methane
nitrogen
oxygen
ozone
synthetic

Across

- The thin layer of air that surrounds Earth.
- Temperature is a measure of this.
- _____ gases absorb radiation from Earth's surface.
- A series of events that happen over and over again.
- Radiation is a form of this.
- The rise in the average temperature at Earth's surface (two words).
- The second most common gas in the atmosphere.
- A substance that helps plants grow.

Down

- A greenhouse gas released by termites.
- Effect caused by reflection of Sun's radiation.
- A main ingredient in smog.
- One of the elements in both methane and water.
- Liquid water changes to gas.
- A substance made only by humans.
- A gas released by burning fossil fuels (two words).
- The most common gas in the atmosphere.
- State of matter that has no definite shape or volume.



Comprehension Quiz



Part A

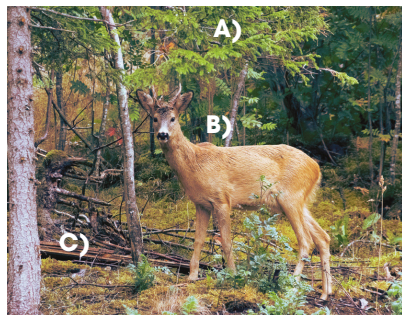
Circle the word **TRUE** if the statement is TRUE or **FALSE** if it is FALSE.

- Nitrogen and oxygen are the most common gases in the atmosphere.
TRUE **FALSE**
- In a gas, the particles of matter are close together.
TRUE **FALSE**
- Without the atmosphere, the average temperatures on Earth's surface would be much colder.
TRUE **FALSE**
- Heat energy travels from the Sun to the Earth in the form of radiation.
TRUE **FALSE**
- The kind of change that brings back balance in a system is called positive feedback.
TRUE **FALSE**
- Fossil fuels are formed from the remains of plant and animals that lived millions of years ago.
TRUE **FALSE**
- Residence time describes the amount of time it takes to complete a biogeochemical cycle.
TRUE **FALSE**
- Farms are a source of the greenhouse gas methane.
TRUE **FALSE**

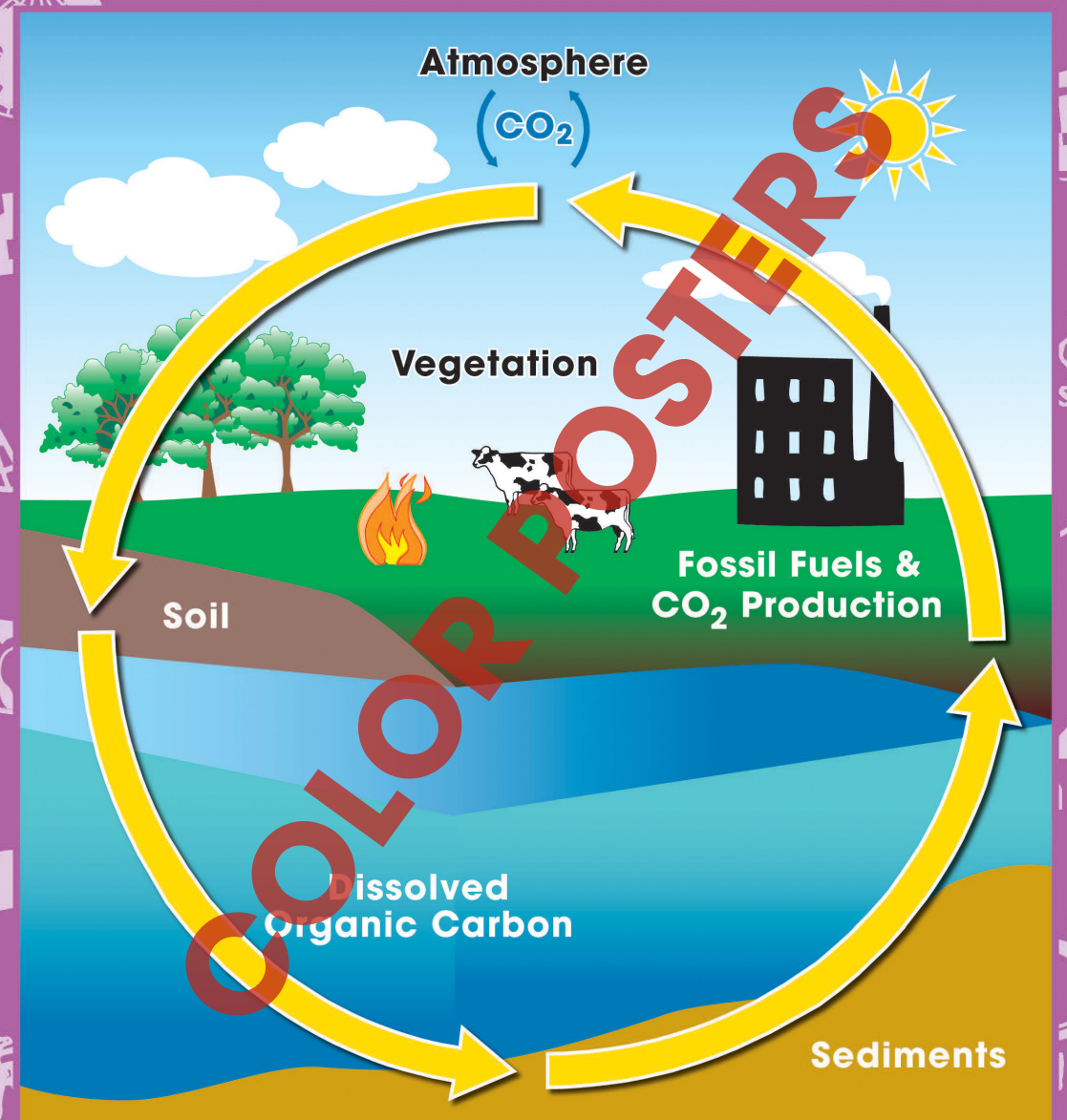
Part B

Label the diagram by doing the following:

- Label the diagram to show some of the processes in the **carbon cycle**.
1 decay _____
2 photosynthesis _____
3 respiration _____
- What is the main human source of carbon dioxide in the atmosphere?



The Carbon Cycle



NAME: _____



Greenhouse Gases: Carbon Dioxide

1. Most cars, trucks, and buses run on gasoline. Where do you think gasoline comes from? Write your ideas on the lines below.

2. Match each word to its definition. You may use a dictionary to help you.

1	released	A substance formed from two or more other substances.	A
2	compound	The act of making a substance.	B
3	food chain	The force on a material. Often due to the weight of another material pressing down on it.	C
4	pressure	Let go.	D
5	volcano	The order in which living things eat other living things.	E
6	formation	Parts of a once-living thing.	F
7	remains	A mountain through which lava erupts.	G

EASY MARKING ANSWER KEY

1. Answers will vary.

Burning coal, oil, wood, natural gas.

22

The rocks melt and erupt from volcanoes, releasing carbon dioxide back into the atmosphere.

2.

1 D

2 A

3 E

4 C

5 G

6 B

7 F

21

1.

a) TRUE

b) FALSE

c) TRUE

d) TRUE

e) FALSE

2.

a) 3

b) 1

c) 4

d) 2

e) 5

3.

Circled: respiration, driving a car, decay, volcanic eruption, breathing, burning coal in a power plant

Underlined: photosynthesis, ocean animals forming shells, growth of trees

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4.

a) The cut trees will no longer take carbon out of the atmosphere by photosynthesis. The cuttings will decay to add more carbon to the atmosphere.

b) When plants grow in the warm months, they are photosynthesizing a lot and they take carbon out of the atmosphere. When leaves fall off in the winter, plants are not photosynthesizing, so they take less carbon out of the atmosphere.

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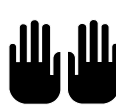


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The Carbon Cycle

