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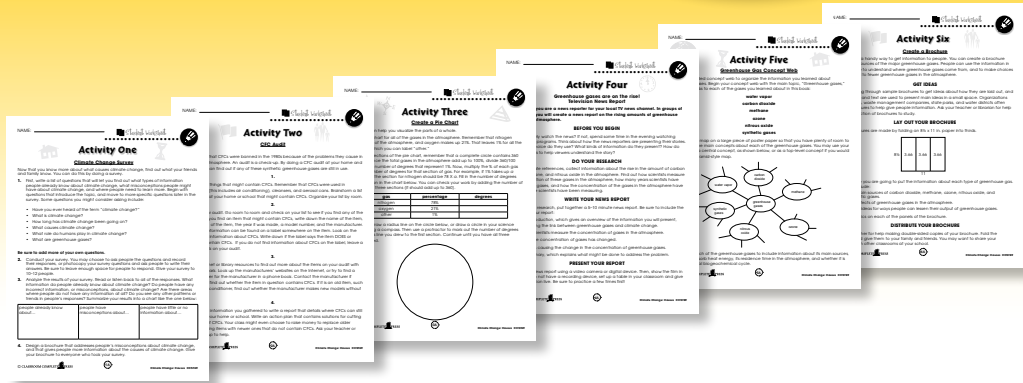
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Greenhouse Gases: Synthetic Gases

1. Use a dictionary to look up the word SYNTHETIC. Write the definition on the lines below.

The definition of **synthetic** is:

2. On the lines below, list 5 synthetic materials or products that you use in your everyday life.

3. Use the words in the box to answer each question. You may use a dictionary to help you.

refrigeration aerosol stratosphere radiation

- a) What type of heat energy do greenhouse gases absorb?
- b) What process lets foods and other items to stay cool, even in warm weather?
- c) What is another word for spray cans? Like those used for paints, hair sprays and deodorants?
- d) What layer of the atmosphere has the ozone layer?



Greenhouse Gases: Synthetic Gases

Synthetic gases are gases made by humans. They are not normally found in nature. The synthetic greenhouse gases that have the greatest effect on climate change are **chlorofluorocarbons**, or **CFCs**. CFCs were made in 1928 as a nontoxic and cheaper alternative. They were used for many things, like refrigeration, aerosol cans and cleansers.



In the 1980s, scientists discovered that, while CFCs are safe within the lower atmosphere, they were breaking down the ozone layer in the stratosphere. The ozone layer is important. It stops some harmful radiation from the Sun from reaching Earth's surface. People feared that the hole in the ozone layer would lead to a rise in skin cancers as well as environmental damage. In 1987, CFCs were banned from use.

What is known to cause the breakdown of the ozone layer in the stratosphere?



Since the 1980s, people have added very few CFCs to the atmosphere. However, CFCs have a long residence time in the atmosphere. Some can last over 500 years! So, most of the CFCs that were put into the atmosphere are still there. It will take a long time for natural processes to break them down. While they are still in the atmosphere, they absorb radiation and add to climate change.



Greenhouse Gases: Synthetic Gases

1. Put a check mark (✓) next to the answer that is most correct.

- a) Which of these substances are made only by humans and not normally found in nature?
- A ozone
 - B carbohydrates
 - C nitrous oxide
 - D chlorofluorocarbons
- b) What year were CFCs created?
- A 1800
 - B 1928
 - C 1980
 - D 1987
- c) CFCs were used for all of the following purposes EXCEPT
- A fertilizers.
 - B cleansers.
 - C refrigerators.
 - D aerosol cans.
- d) What compound in the atmosphere do CFCs break down?
- A ozone
 - B nitrogen
 - C water vapor
 - D carbon dioxide
- e) During which decade were CFCs banned from use?
- A 1920s
 - B 1940s
 - C 1960s
 - D 1980s



Greenhouse Gases: Synthetic Gases

2. Answer each question with a complete sentence.

- a) Why are CFCs still causing problems in the atmosphere even though they were banned years ago?

- b) Explain the difference between natural and synthetic greenhouse gases.

Research

3. What are the effects of synthetic greenhouse gases?

People have added many synthetic gases to the atmosphere. Use the library or Internet resources. Find out more about one of the synthetic greenhouse gases below:

- Carbon tetrafluoride (CF₄)
- Sulfur hexafluoride (SF₆)
- Hydrofluorocarbons (HFCs)
- Chlorofluorocarbons (CFCs)

Find out why the gas was created. What was it used for? Is it still in use? How does it affect the atmosphere? Design a poster presentation to share what you learned with your class.



How does carbon move from rocks into the atmosphere?

You will need:

- samples of limestone
- chalk ("dustless" chalk will not work)
- shallow tray
- vinegar
- 50 mL beaker or small glass jar
- an eyedropper

In the carbon cycle, carbon moves between solid rocks, living things, and the atmosphere. In this investigation, you will see how carbon that is in solid rocks can change to carbon dioxide gas that is released into the atmosphere.

During part of the carbon cycle, tiny animals living at the surface of the oceans take in carbon dioxide gas. Reactions inside their bodies change the carbon dioxide gas to calcium carbonate. This is a compound that makes up shells. A reaction is a process that changes one compound to another. The shells fall to the ocean floor when the animals die. Thick layers of the shells form deposits that are used to make chalk. Over millions of years, the thick layers of shells are changed by Earth processes into limestone rock. Both chalk and limestone contain solid carbon in the form of calcium carbonate. Vinegar contains a substance that reacts with carbonate to make carbon dioxide gas. Because carbon dioxide is a gas, it forms gas bubbles during the reaction.

Follow the steps below to change solid carbonate into carbon dioxide.
Safety Note: Do NOT put the vinegar into your mouth or eyes. Wash your hands after you finish the experiment.

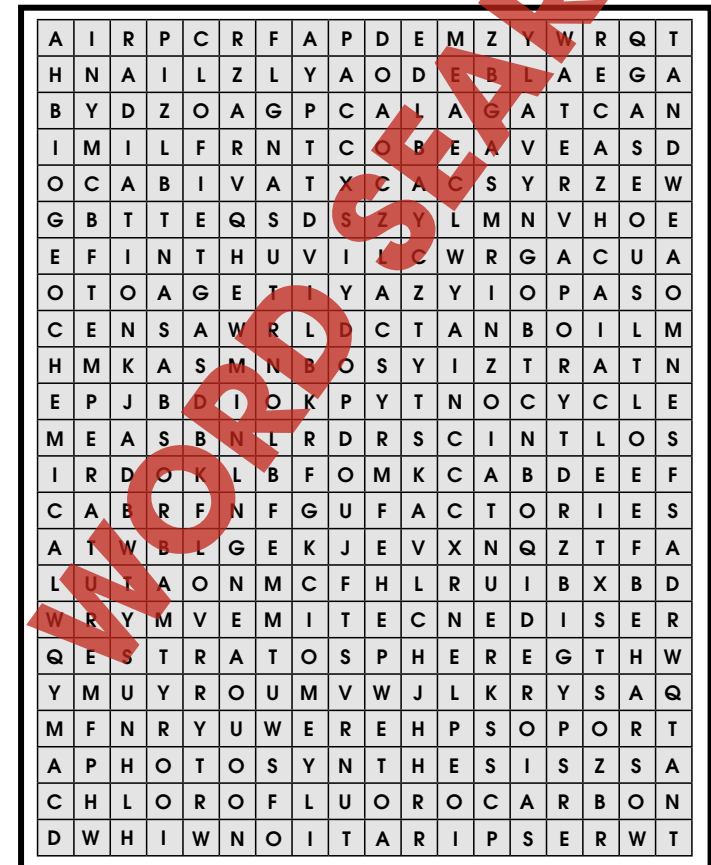
1. Place a sample of limestone and a sample of chalk into the tray.
2. Pour a small amount of vinegar into the beaker or jar.
3. Draw an eyedropper full of the vinegar.
4. Place a few drops of the vinegar onto the limestone.
5. See what happens. Write your observations in your science notebook.
6. Place a few drops of the vinegar onto the chalk.
7. See what happens. Write your observations in your science notebook.



Word Search

Find all of the words in the Word Search. Words are written horizontally, vertically, diagonally, and some are even written backwards.

- | | | | | |
|--------------------|-------------|----------------|----------------|--------------|
| absorb | coal | gaseous | plants | stratosphere |
| air | cycle | liquid | poles | sun |
| albedo | factories | matter | radiation | temperature |
| biogeochemical | feedback | nitrogen | residence time | troposphere |
| carbon | fossil fuel | oil | respiration | water vapor |
| chlorofluorocarbon | gas | photosynthesis | smog | |



Comprehension Quiz

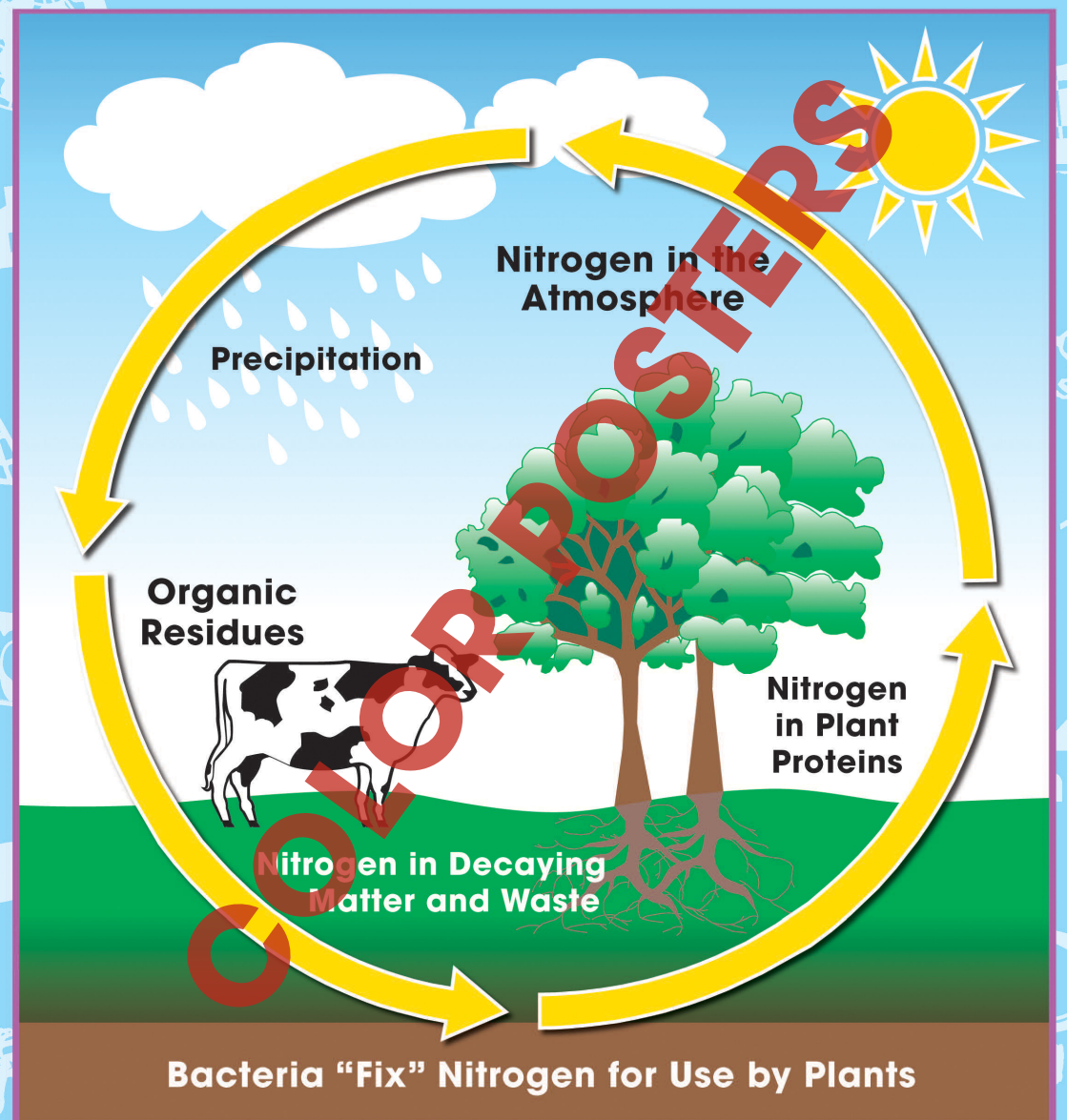
Part C

Answer the questions in complete sentences.

1. Describe the main characteristics of the **troposphere** and the **stratosphere**. 3
2. Explain how **greenhouse gases** affect the temperatures on Earth's surface. 3
3. What is the **albedo effect**? Give an example of how the albedo effect could cause a positive feedback cycle that would speed up climate change. 4
4. How does the **residence time** of a greenhouse gas relate to its role in causing climate change? 3
5. Why has the amount of carbon dioxide in the atmosphere been increasing for the past 100 years or so? 3

SUBTOTAL: /16

The Nitrogen Cycle





Greenhouse Gases: Synthetic Gases

2. Answer each question with a complete sentence.

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2.

a) Because they have a very long residence time.

b) Synthetic greenhouse gases are made only by humans; natural greenhouse gases are found in nature, but human activities add extra to the atmosphere.

Across:

- 2. atmosphere
- 5. heat
- 6. greenhouse
- 9. cycle
- 10. energy
- 11. global warming
- 13. oxygen
- 15. fertilizer

Down:

- 1. methane
- 2. albedo
- 3. ozone
- 4. hydrogen
- 7. evaporate
- 8. synthetic
- 9. carbon dioxide
- 12. nitrogen
- 14. gas



EASY MARKING ANSWER KEY



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The Nitrogen Cycle

