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Greenhouse Gases: Ozone

1. Complete each sentence with a word from the list. Use a dictionary to help you.

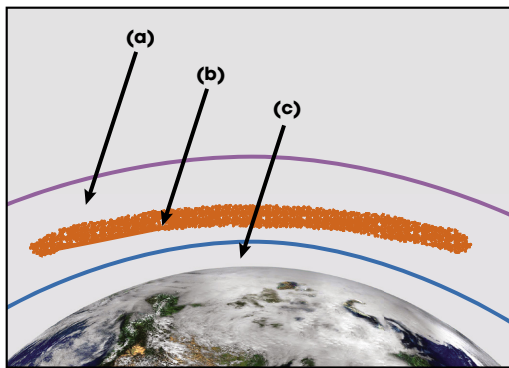
- | | | |
|--------------|----------------|-------------|
| tailpipe | power plants | smog |
| fossil fuels | residence time | ozone layer |

- _____ is about how long materials spend in a part of Earth, like the atmosphere.
- Greenhouse gases are released when _____ are burned in cars, power plants, and factories.
- _____ is a mixture of smoke and fog that forms in areas with a lot of air pollution.
- The _____ stops some harmful radiation from the Sun from reaching Earth's surface.
- When gasoline is burned in cars, some materials are let out of the _____.
- Some kinds of _____ use energy from burning fossil fuels to make electricity.

2. Label the diagram below using the words in the list.

- | | | |
|-------------|-------------|--------------|
| ozone layer | troposphere | stratosphere |
|-------------|-------------|--------------|

- _____
- _____
- _____



Greenhouse Gases: Ozone

Ozone can be found in two places in the atmosphere. In the stratosphere, radiation from the Sun turns oxygen into ozone. This makes the ozone layer. This layer protects living things from harmful radiation from the Sun. A tiny bit of the ozone from the ozone layer mixes into the lower atmosphere, in the troposphere. So, the troposphere has a tiny amount of ozone naturally. However, human activities have caused more ozone to form in the troposphere. Ozone in the troposphere acts as a greenhouse gas. It traps radiation and leads to warming.



Name the two places in the atmosphere in which ozone can be found.



When gasoline is burned in cars and other automobiles, carbon and nitrogen compounds come out of the tailpipe and into the atmosphere. Sunlight breaks apart these carbon and nitrogen compounds to make ozone. The same thing happens to smoke from factories and power plants that burn fossil fuels. Ozone is one of the main compounds in smog.

The amount of ozone in the troposphere has more than doubled since humans have been building factories and cars. This increase is so much and so harmful due to its location that it plays an important role in climate change. However, ozone has a short residence time in the atmosphere. If people release less ozone into the lower atmosphere, than the amount of ozone left should lower quickly.



Greenhouse Gases: Ozone

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

- Ozone can be found in only one place in the atmosphere.
TRUE FALSE
- A tiny amount of ozone from the stratosphere naturally sinks to the troposphere.
TRUE FALSE
- Ozone is one of the main compounds in smog.
TRUE FALSE
- Humans have increased the amount of ozone in the troposphere by driving cars and running power plants to make electricity.
TRUE FALSE
- Ozone has a long residence time in the atmosphere.
TRUE FALSE

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

- Which compounds from tailpipes break down in sunlight to make ozone in the troposphere?
 - A carbon and water
 - B hydrogen and water
 - C carbon and nitrogen
 - D hydrogen and nitrogen
- Which human activities have led to the increase of ozone in the troposphere?
 - A cutting forests
 - B fertilizing farms
 - C draining wetlands
 - D burning fossil fuels
- How much has the amount of ozone in the troposphere increased due to human activities?
 - A By about half.
 - B More than doubled.
 - C Tripled.
 - D Very little.



Greenhouse Gases: Ozone

3. Answer each question with a complete sentence.

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

- 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.



Create a model of the carbon cycle

Working with a small group, create a model that shows all of the processes of the carbon cycle.

- First, use the library or Internet resources. Learn more about the details of your biogeochemical cycle. As you research information, ask questions like:
 - In what parts of Earth can carbon be found?
 - What form does carbon take in each part of the carbon cycle?
 - How do natural processes move carbon from one part of the nitrogen cycle to another?
 - How do human activities move carbon from one part of the carbon cycle to another?
 - What is the residence time of carbon in each part of the cycle?
- Then, decide how you want to model your cycle. Be creative! You could choose a diorama. Or, a model with moving parts. Or even a song, dance or play. Before creating your model, make a plan. In your plan, be sure your model has information about:
 - All of the parts of the carbon cycle.
 - The form carbon takes in all of the different parts of the cycle.
 - The way that carbon moves from one part of the cycle to another.
 - The amount of time different parts of the cycle take to complete.
 - How human activities play a role in the carbon cycle.
- Make your model. If you are making a physical model, get all of your materials together. This can include clay, glue, tape, construction paper, scissors, etc. If you are doing a performance, write down all of the parts. Practice many times with your group.
- Present your model to the class. If you have a physical model, show it to the class. Be sure to explain what each part represents. If you are doing a performance, give a short introduction explaining how you will show the parts of the carbon cycle. Leave time in your presentation to answer questions from the class.



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

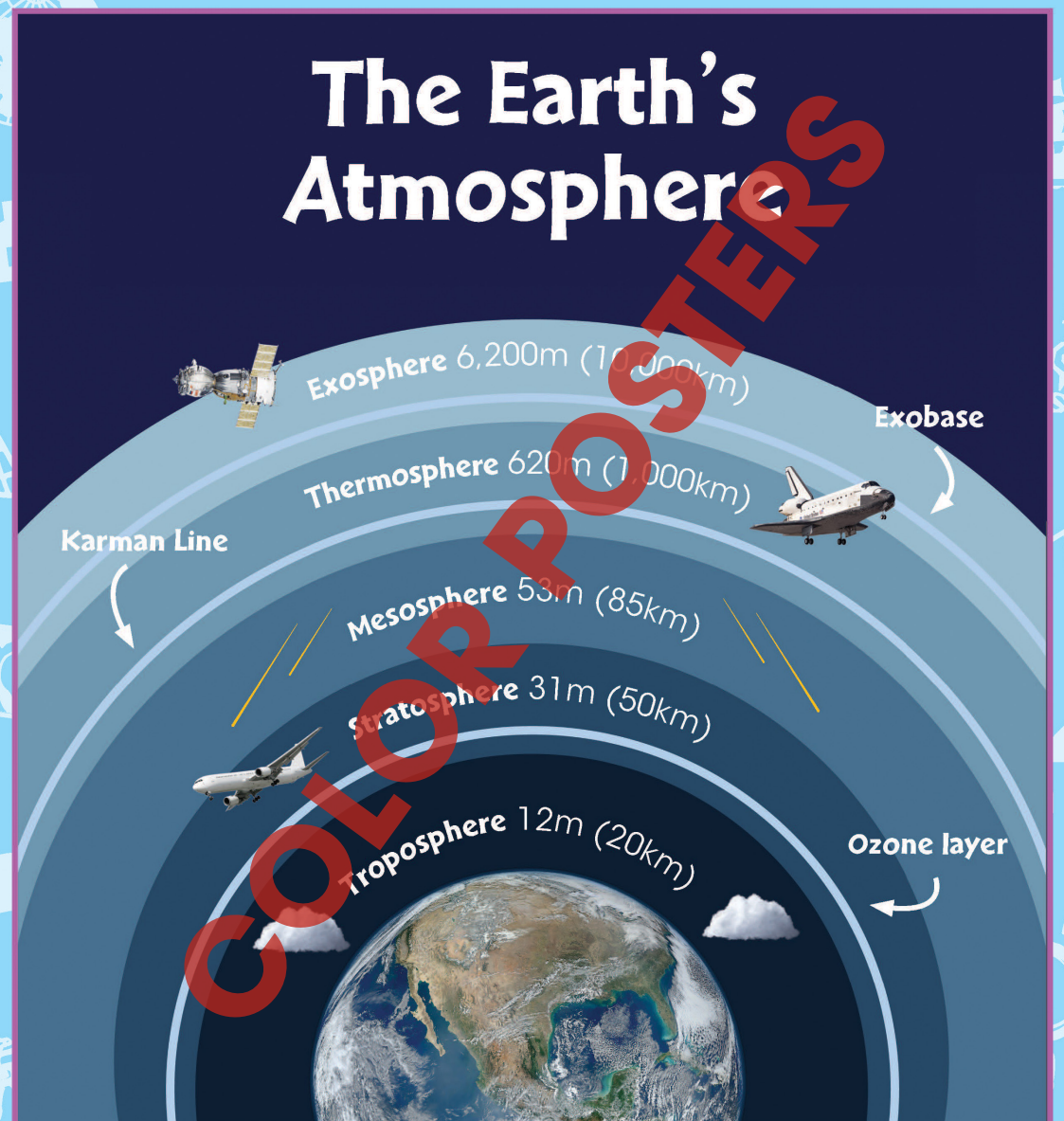
Part C

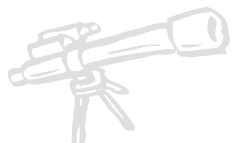
Answer the questions in complete sentences.

- Describe the main characteristics of the **troposphere** and the **stratosphere**. 3
- Explain how **greenhouse gases** affect the temperatures on Earth's surface. 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
- How does the **residence time** of a greenhouse gas relate to its role in causing climate change? 3
- Why has the amount of carbon dioxide in the atmosphere been increasing for the past 100 years or so? 3

SUBTOTAL: /16

Layers of the Atmosphere





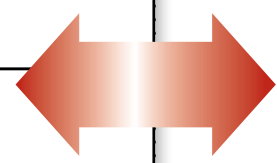
Greenhouse Gases: Ozone



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

EASY MARKING

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.

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3.

a) A tiny amount of ozone falls into the troposphere from the stratosphere.

b) Cars release carbon and nitrogen compounds that react to form ozone in the sunlight.

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

10

15





Greenhouse Gases: Ozone

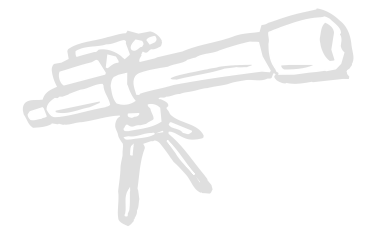
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Layers of the Atmosphere

The Earth's Atmosphere

