ScienceNews

Activity Guide for Students: Unbalancing the Carbon Cycle

Directions:

Carbon storage
For the first part of this activity, read the *Science News* article "Here's where Earth stores its carbon" and answer the questions that follow.

1. Based on the *Science News* article "Here's where Earth stores its carbon," where is the majority of carbon on Earth stored? How much is stored there?

2. How does the amount of carbon stored underneath the surface compare to that above the surface? Round to the correct number of significant figures.

3. Above the surface, where is most of the carbon stored? Where is the least amount of carbon stored?

4. What percentage of above-surface carbon is found in the atmosphere?

5. How does carbon naturally enter the atmosphere?

6. What is the largest contributor to the amount of carbon in the atmosphere *today*? How much carbon does this contributor add to the atmosphere yearly?

Carbon cycle
After discussing the carbon cycle as a class, answer the questions that follow.

7. Give an example of how carbon shows up in the biosphere, the geosphere, the hydrosphere and the atmosphere?

8. Carbon is the basis for life on Earth — people are 18 percent carbon and plants are 45 percent carbon, for example. The element is considered key to Earth's habitability. What are three examples that show how important carbon is for life on Earth?

9. How can carbon in the geosphere enter the biosphere? And how does carbon move from the biosphere back into the geosphere?

10. The carbon cycle shows how carbon moves through all four spheres of Earth. Sketch some of the interactions that connect the movement of carbon through the spheres. Describe and/or label the interactions.

11. What does it mean when we say that the carbon cycle is a closed cycle?

Humans and the carbon cycle

Consider the effects that human-released carbon dioxide is having on the planet by answering the questions that follow.

12. If the carbon cycle is closed, where is the additional carbon dioxide that is entering the atmosphere coming from?

13. How have human activities increased the amount of carbon dioxide in the atmosphere?

14. If carbon is vital for life, why is increasing the amount of carbon dioxide in the atmosphere problematic?

15. Describe three potential outcomes of increased carbon dioxide in the atmosphere.

Data analysis and graphing

The table below shows the amount of carbon dioxide in the atmosphere from 1750 (about 10 years before the start of the Industrial Revolution) to 2019. It also shows the temperature anomalies for each of those years. After answering questions 16 through 18 as a class, graph the data and answer the remaining questions.

Atmospheric CO_2 and Temperature Over Time
Sources: www.co2levels.org and www.temperaturerecord.org

Year	Atmospheric CO_2 level (ppm)	Temperature anomaly (degrees C)
1750	277	-0.3
1760	277.6	-0.16
1770	278.6	-0.31
1780	280.1	-0.31
1790	281.6	-0.3
1800	282.9	-0.28
1810	283.8	-0.26
1820	284.2	-0.49
1830	284.4	-0.28
1840	283.4	-0.35
1850	284.7	-0.31
1860	286.2	-0.11
1870	287.5	-0.06
1880	290.7	-0.21
1890	294.2	-0.25
1900	295.8	-0.13
1910	299.7	-0.39
1920	303	-0.31
1930	307.2	-0.22
1940	310.4	0.12
1950	310.7	-0.09
1960	319.4	-0.05
1970	325.7	-0.03
1980	337.8	0.22
1990	356.7	0.39
2000	372	0.4
2010	391.2	0.69
2019	414.2	0.92

16. A temperature anomaly is the difference between the current recorded temperature and a long-term average temperature, known as a baseline temperature. If the recorded temperature in a room is 25° C but the baseline temperature for that room is 20° C, what is the temperature anomaly in that room?

17. What does a positive temperature anomaly indicate? What does a negative temperature anomaly indicate?

18. What does a temperature anomaly of zero indicate?

19. What trend do you notice about the numbers in the atmospheric carbon dioxide column of the table? What does this trend indicate?

20. Graph the data presented in the table. Graph the atmospheric carbon dioxide levels on one graph and the temperature anomalies on another. Refer to your teacher's instructions for where to create your graphs.

21. Describe your observations of your graphs.

22. Does the line for the temperature anomalies cross the *x*-axis? What does this indicate?

23. If the trend keeps going in the same pattern, what might atmospheric CO_2 levels look like in 10 years? 50 years?

24. If the trend keeps going in the same pattern, what might the temperature anomalies look like in 10 years? 50 years?

25. Discuss some impacts on Earth's spheres that may occur based on your understanding of the carbon cycle and on the carbon dioxide trend you observe in your graph.

26. What can people do to limit the amount of CO_2 released into the atmosphere?

27. Some estimates suggest that reducing carbon dioxide entering the atmosphere will not be enough to curb the effects of global warming — people will also have to remove some of the carbon dioxide they have already pumped into the atmosphere. Based on your understanding of the carbon cycle, what possible approaches could remove carbon dioxide from the atmosphere?

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