

Computers: Biogeochemical Cycles

Water, Carbon, Nitrogen, Phosphorus, & Sulfur



Water Cycle

Precipitation, evaporation, and condensation are all terms that you recognize, but what do they mean? They are all part of the water cycle, which is a complex process that not only gives us water to drink and food to eat, but also helps our plants grow. Only about 3% of the Earth's water is fresh, and 1% of that water can be used for many human purposes. Why can't we use the other 2% of the fresh water found on the Earth? What about the other 97% of the water found in the world? To find these answers and to discover more, come along for an interactive journey through the water cycle!

Website: http://www.epa.gov/ogwdw/kids/flash/flash_watercycle.html (choose auto, or start with Rain)

1. Another name for rain, snow, sleet, and hail is _____. This occurs when there is so much _____ in the _____ that it cannot hold onto it anymore.
2. Name some locations where water is stored on earth.
3. _____ is when water vapor comes from _____, _____, and land.
4. Which temperature causes water vapor to turn back into clouds?
5. What is the name for the process that forms clouds?

Website: http://oceanservice.noaa.gov/education/pd/oceans_weather_climate/media/watercycle.swf

6. How much of the Earth's water exists in each of the following locations?

Oceans	Atmosphere	Underground Aquifers	Rivers	Lakes	Soil	Glaciers/ Ice Caps

7. Click on "Person" and record two interesting facts about how individual people use water.
 - a. _____
 - b. _____
8. Click on "Agriculture" and record two interesting facts about agricultural uses of water.
 - a. _____
 - b. _____

Carbon Cycle

Carbon is an element that is found in all organisms, fossil fuels, soil, the ocean, and the atmosphere. We take part in the carbon cycle by breathing CO₂ into the air; autotrophs participate by removing atmospheric CO₂ for use in building leaves, stems and other organs through the process of photosynthesis. As we burn more and more fossil fuels such as oil and coal, we release large amounts of carbon dioxide into the atmosphere more than can be removed by oceans and photosynthetic organisms. Within the atmosphere, this extra CO₂ traps heat. As more CO₂ accumulates, the Earth becomes warmer through a process known as the greenhouse effect.

Website: http://www.windows.ucar.edu/tour/link=/earth/Water/co2_cycle.html

9. In what form is carbon in the atmosphere?
10. How does carbon move from the atmosphere to plants and then from plants to animals?
11. How does carbon move from plants and animals to the ground?
12. How does carbon move from living things to the atmosphere? What is the process called?



13. How much carbon is released each year from burning fossil fuels? Where does the carbon go?
14. Carbon dioxide is a greenhouse gas. Describe why greenhouse gases (*in moderation*) are important to the survival of life on earth.
15. Click on the link [warmer](#). How much warmer is the planet today than it was 100 years ago?
16. List the effects of global warming. Then navigate back to the page on the carbon cycle.
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(RETURN to MAIN Carbon Cycle Page)

17. Besides coal and oil (fossil fuels) what type of rocks store a great deal of carbon?

Nitrogen Cycle

The nitrogen cycle is one of the most important nutrient cycles found in terrestrial ecosystems. Nitrogen is used by living organisms to produce a number of complex organic molecules like amino acids, proteins, and nucleic acids. The majority of nitrogen is found in the atmosphere, where it exists as a gas (mainly N₂). Other major reserves of nitrogen include organic matter in soil and the oceans. Despite its large quantity in the atmosphere, nitrogen is often the most limiting nutrient for plant growth. This problem occurs because most plants can only take up nitrogen in two solid forms: the ammonium ion (NH₄⁺) and the nitrate ion (NO₃⁻). Specialized bacteria “fix” nitrogen, converting it to a form that can be used by organisms. By fixing nitrogen, these bacteria are a critical link between atmospheric nitrogen and life on Earth.

Website: http://www.pbslearningmedia.org/asset/lsp07_int_nitrogen/

Opening Screen

18. Nitrogen is essential to life. Where in all living things (including humans) is nitrogen found?

Begin the activity, and then hover over “Nitrogen in the Atmosphere.”

19. Nitrogen makes up about what percent of the atmosphere? _____
20. Nitrogen exists in what form in the atmosphere?

Read through “Nitrogen Fixation” and “Ammonification.”

21. What is the role of nitrogen-fixing bacteria in the nitrogen cycle?

Read over both “Nitrifications.”

22. Ammonia can form _____, which can then be converted into _____. Both can be taken in by _____.

Read over “Denitrification.”

23. _____ bacteria can convert _____ back into _____, which goes into the _____.

Read “Ammonification.”

24. Ammonification is when decomposers do what?

Finally, read “Assimilation” and hover over the chipmunk.

25. What is the only way in which humans and other animals can obtain nitrogen?



Website: <https://gulfhypoxia.net/about-hypoxia/> **Note - play animation for a visual

26. Describe what is causing the hypoxia (aka. Dead Zone in the Gulf of Mexico) and how Nitrogen is involved.

Phosphorus Cycle

Phosphorus is an important chemical for plants and animals. It is part of DNA, certain fats in cell membranes, bones, teeth, and the shells of some animals. Phosphorus circulates through water, the Earth's crust, and living organisms. It is not in the atmosphere and is most likely to enter food chains following the slow weathering of rock deposits. Some of the released phosphates become dissolved in soil water, which is then taken up by plant roots. Phosphorus is therefore the main limiting factor for plant growth in most soils and aquatic ecosystems. Animals obtain phosphorus by eating plants and/or herbivores. Dead organisms and animal wastes return phosphorus to the soil, to streams, and eventually to ocean floors as rock deposits.

Website: <http://www.wwnorton.com/college/biology/discoverbio3/core/content/ch24/animations.asp>

Click on “Phosphorus Cycle”

Click on “step through”

27. Identify if the phosphorus cycle has a gaseous component.

28. List 3 ways humans have impacted the phosphorus cycle.

29. Explain the connection between phosphorus, fertilizers, and algae blooms

Click on “Intro”

Click on “Quiz”

30. Which type of global cycle characterizes the movements of phosphorous?

31. What is the main reservoir of phosphorous on Earth?

Website: <http://enviroliteracy.org/article.php/480.html>

7. How is phosphorus important to living things?

8. The phosphorus cycle differs from the other cycles in that it does not have a _____.

9. The largest reservoir of phosphorus is _____.
10. Describe the sequence of how phosphorus goes from the soil to a carnivore.
11. Using evidence from the article, explain why phosphorus can be considered a pollutant.



Sulfur Cycle

Sulfur (S), the tenth most abundant element in the universe, is a brittle, yellow, tasteless, and odorless non-metallic element. It comprises many vitamins, proteins, and hormones that play critical roles in both climate and in the health of various ecosystems. The majority of the Earth's sulfur is stored underground in rocks and minerals, including as sulfate salts buried deep within ocean sediments.

Website: <http://www.wnnorton.com/college/biology/discoverbio3/core/content/ch24/animations.asp> (same as above)

Click on "Sulfur Cycle"

32. How does Sulfur enter the atmosphere?
33. What occurs when too much sulfur dioxide enters the atmosphere?
34. How does Sulfur Dioxide harm the environment?

Click on "Intro"

Click on "Quiz"

35. Which type of global cycle characterizes the movements of Sulfur?
36. What is the main source of Sulfur in Acid Rain?

Human-Induced Changes on BioGeoChemical Cycles

Human activities have greatly increased carbon dioxide levels in the atmosphere and nitrogen levels in the biosphere. Altered biogeochemical cycles combined with climate change increase the vulnerability of biodiversity, food security, human health, and water quality to a changing climate. Explore interactions between climate change and biogeochemical cycles. Try to focus most on the Carbon & Nitrogen Cycles.

Website: <http://nca2014.globalchange.gov/report/sectors/biogeochemical-cycles> (Scroll down through...)

37. Key Message #1:

a. Example:

38. Key Message #2:

a. Example:

39. Key Message #3:

a. Example: