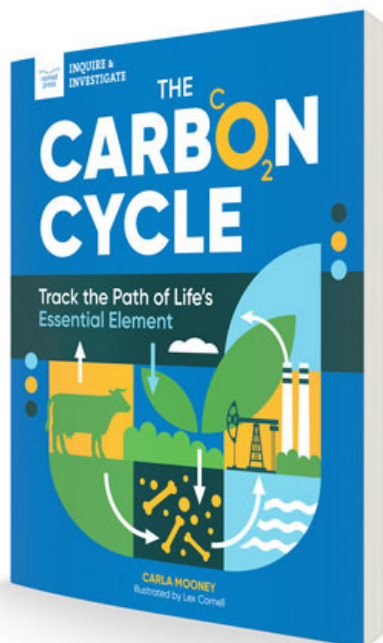


Nomad Press

CLASSROOM GUIDE



What element is found in all known forms of life? Carbon!

Scientists call carbon the chemical backbone of life on Earth. That's because without carbon, there'd be no humans, animals, plants, microbes, or any other kind of life. In *The Carbon Cycle: Track the Path of Life's Essential Element*, young scientists explore how the first life forms that evolved on our planet consumed carbon and now, 4 billion years later, carbon is still the building block of all known forms of life.

Learn all about the carbon cycle and the human influence on that cycle through a compelling narrative, links to online resources, essential questions, text-to-world observations, hands-on STEM activities, and graphic-novel-style illustrations and photographs.

Learn more at nomadpress.net/nomadpress-books/carbon-cycle

Softcover: 9781647411558, \$19.95
Hardcover: 9781647411527, \$24.95
eBook: all formats available, \$12.99
Specs: 8 x 10, 128 pages, color interior

Reading Level: Ages 12–15
Interest Level: Grades 7–9
Focus: Earth Sciences
GRL: Y Lexile: TBD



BE CARBON AWARE! Here are a few examples of activities that add to your carbon footprint. - Driving a gasoline-powered car - Taking long showers with hot water - Eating meat (especially beef) - Using a lot of electricity from coal or gas power plants - Buying new goods that use energy to be produced and shipped TEXT TO WORLD Do you live near a volcano? A forest? A field? What roles do these places play in the carbon cycle? YOUR CARBON FOOTPRINT Everyone has a carbon footprint. A carbon footprint is the total amount of CO₂ and other greenhouse gases that are released into the air because of our activities. These gases come primarily from burning fossil fuels such as coal, oil, and natural gas. 	CO₂ is a greenhouse gas that traps heat in the atmosphere. The more CO₂ in the atmosphere, the warmer the planet becomes. This leads to global warming and climate change, which can cause rising sea levels, more extreme weather, ocean acidification, and other environmental concerns. Since the Industrial Revolution during the 1800s, humans have added billions of tons of CO₂ to the air by burning fossil fuels. This has increased the concentration of CO₂ in the atmosphere beyond natural levels. Another human impact on the carbon cycle comes from deforestation. Trees are a carbon sink and absorb CO₂ from the atmosphere. When we cut down forests, we reduce the earth's ability to remove CO₂ from the air. Farming and changes in land use also release carbon that was once stored in soil and plants. We'll look at examples in future chapters. Every time you drive a gas-powered car, use electricity, eat food, or buy clothes, you leave behind a "footprint" of CO₂. The more energy or resources you use, the bigger your footprint. Why does your carbon footprint matter? Human activities that release carbon into the atmosphere affect the carbon cycle and Earth's climate. By understanding your carbon footprint, you can find ways to reduce your impact on Earth and the carbon cycle. WHY THE CARBON CYCLE MATTERS Understanding carbon and the carbon cycle is important because it helps us be aware of how Earth works and how human activity affects the planet. The amount of carbon in the atmosphere affects the earth's temperature and climate. If we continue to add too much CO₂ to the air, we risk changing the climate in ways that are harmful to people, animals, and ecosystems. But there is hope! Scientists are working on ways to reduce carbon emissions, such as using renewable energy sources including wind and solar, protecting forests, and developing new technologies to remove carbon from the air. By understanding carbon and learning how it works, we can make choices that help people and the earth thrive for generations. KEY QUESTIONS • Why do we need some carbon in the atmosphere but not too much? • How are humans affecting the carbon cycle?	VOCAB LAB Write down what you think each word means. What root words can you find to help you? What does the context of the word tell you? - carbon sink - climate - element - fossil fuel - hydrosphere Compare your definitions with those of your friends or classmates. Did you all come up with the same meanings? Turn to the text and glossary for help.
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ESSENTIAL QUESTIONS

BEFORE READING:

Establish Background Knowledge

- What do you already know about carbon and the carbon cycle?
- What do you know about climate change?
- How does the earth's atmosphere make life on this planet possible?

Skill Introduction

- What do you do when you come to a word or phrase you do not know?
- How do illustrations and photographs help someone learn?
- How do hands-on activities help people learn?

CCSS.ELA-Literacy.L.6.4a Use context (e.g., the overall meaning of a sentence or paragraph; a word's position or function in a sentence) as a clue to the meaning of a word or phrase.

CCSS.ELA-Literacy.RST.6-8.9 Compare and contrast the information gained from experiments, simulations, video, or multimedia sources with that gained from reading a text on the same topic.

CCSS.ELA-Literacy.SL.6.2 Interpret information presented in diverse media and formats (e.g., visually, quantitatively, orally) and explain how it contributes to a topic, text, or issue under study.

DURING READING:

Check for Understanding

- What are the steps in the scientific method? How are they similar and different from those in the engineering design process?
- What does a city feel like compared to a place with lots of grass and trees?
- What are some of the effects of climate change where you live?

CCSS.ELA-Literacy.RST.6-8.2 Determine the central ideas or conclusions of a text; provide an accurate summary of the text distinct from prior knowledge or opinions.

CCSS.ELA-Literacy.RST.6-8.4 Determine the meaning of symbols, key terms, and other domain-specific words and phrases as they are used in a specific scientific or technical context relevant to grades 6–8 texts and topics.

AFTER READING:

Summary and Expansion

- What are the three different steps in the carbon cycle? In what ways do these steps overlap?
- What is a carbon source? What is a carbon sink? How do these balance each other?
- What can happen when sources and sinks fall out of balance?
- What is the difference between the fast carbon cycle and the slow carbon cycle?
- How did the Industrial Revolution change the carbon cycle?
- What role do volcanoes play in the carbon cycle?
- How does our energy use affect how much carbon gets released from rocks?
- How is the carbon cycle similar to the water cycle? How is it different?
- What is rock weathering and how does it help with climate change?
- What role does carbon capture technology play in the fight against climate change?
- Why are coral reefs sometimes called the “rainforests of the sea?”
- Why is the biosphere a crucial part of the carbon cycle?
- Why is soil considered to be living?
- What do we lose when rainforests are destroyed?
- What do humans need to do to curb the growing climate crisis? Why is it hard to get humans to change their behaviors?

CCSS.ELA-Literacy.RST.6-8.8 Compare and contrast the information gained from experiments, simulations, video, or multimedia sources with that gained from reading a text on the same topic.

CCSS.ELA-Literacy.RST.6-8.8 Integrate quantitative or technical information expressed in words in a text with a version of that information expressed visually (e.g., in a flowchart, diagram, model, graph, or table).

CCSS.ELA-Literacy.WHST.6-8.4 Produce clear and coherent writing in which the development, organization, and style are appropriate to task, purpose, and audience.

Inquire & Investigate



Ideas for Supplies

- › safety goggles
- › heat-resistant surface or tray
- › small, paraffin wax candle (tea light works best)
- › a small, clear cup
- › water
- › bromothymol blue (BTB)
- › 1 wide-mouth glass jar, large enough to cover the candle and the small cup

Use your knowledge of fossil fuels to create a marketing campaign for renewable energy. What might you say to convince people to consider using different types of energy?

INVESTIGATE MORE

CO₂ FROM COMBUSTION

Burning fossil fuels releases massive amounts of CO₂ into the atmosphere. In this activity, you'll watch the release of CO₂ when you burn a paraffin wax candle. Paraffin wax is made from petroleum (crude oil), a fossil fuel.

Have an adult help whenever you work with fire.

Put on the safety goggles. Place the candle on a heat-resistant surface or tray.

Fill the small cup about three-quarters full of water and add a few drops of BTB. Place the cup near the candle.

Carefully light the candle. Let it burn for a minute or two before carefully placing the glass jar upside down over the cup and candle to trap the air and gases released from the burning candle.

Observe the candle and the cup. What is happening in the jar?

- Why does the flame go out when the jar is placed over the candle?
- What does the BTB solution look like?
- What does this mean?
- How does this activity demonstrate that burning fossil fuels releases CO₂ into the atmosphere?

Check out more titles and other great activities at nomadpress.net.

Inquire & Investigate



Ideas for Supplies

- › large balloon
- › empty clear plastic soda bottle, with cap
- › warm water
- › sugar
- › teaspoon
- › package of dry yeast
- › science notebook

Change the temperature of the water or change the organic material. For example, instead of using a sugar solution, try sprinkling yeast on small pieces of banana, apple, or bread in the bottle. What happens? What differences, if any, do you observe?

INVESTIGATE MORE

DECOMPOSERS AT WORK

Yeast is a single-celled fungus. Like other decomposers, yeast feeds on organic material (sugar). The decomposition process produces CO_2 . In this activity, you'll see a decomposer (yeast) at work!

Stretch the balloon a few times. You want to ensure it inflates easily during this activity.

Fill the soda bottle with warm water. It should be about half full.

Add 2 teaspoon of sugar to the warm water. Stir the sugar and water until the sugar dissolves.

Add a teaspoonful of yeast to the liquid. Seal the bottle with its cap and shake it to thoroughly mix in the yeast.

Remove the cap from the bottle. Place the balloon over the mouth of the bottle. Check to make sure the balloon is securely attached to the bottle.

Observe the bottle and the balloon. Record your observations. What happens? Explain your results.

Check out more titles and other great activities at nomadpress.net.

THE ROLE OF PLANTS IN THE CARBON CYCLE

Plants play a crucial role in the carbon cycle by absorbing CO_2 from the air during photosynthesis and releasing oxygen. This helps reduce atmospheric CO_2 to keep the carbon cycle in balance. In this activity, you'll investigate how plants help regulate atmospheric CO_2 .

Fill each jar with 8 ounces of water. Add six drops of BTB to each and stir. What color is the solution? BTB changes color in response to CO_2 levels. When CO_2 levels are low, BTB is blue. BTB turns green at moderate CO_2 levels and turns yellow at high levels.

Using a straw, blow into each jar. Keep blowing until the water turns a yellowish color. What does that mean?

Place a sprig of elodea or other water plant in one of the jars. Cover both jars with lids and put them in direct sunlight for one hour.

After an hour, observe the two jars. What happened to the water in each? Record your observations.

Explain what you observed. How does this demonstrate the role of plants in the carbon cycle?



Inquire & Investigate

Ideas for Supplies

- › 2 small clear jars with lids
- › measuring cup
- › water
- › bromothymol blue (BTB) or another CO_2 indicator
- › light source (lamp or sunlight)
- › sprigs of elodea (or another water plant, commonly found in aquarium supply stores)
- › straw
- › science notebook

Let the jars sit overnight. What changes, if any, do you observe? What do you think happened?

INVESTIGATE MORE

Check out more titles and other great activities at nomadpress.net.

Inquire & Investigate



Ideas for Supplies

- › safety goggles
- › 2 clear cups or glass containers with covers
- › water
- › bromothymol blue (BTB), available online or at a drugstore
- › white vinegar
- › straw
- › white paper

Repeat this activity with two cups, one with warm water and one with cold water. Blow air through a straw into each and cover the cups. Compare the two cups. What differences, if any, do you observe? What happened?

INVESTIGATE MORE

MODEL OCEAN ACIDIFICATION

Oceans absorb a large amount of CO_2 from the atmosphere. When CO_2 dissolves in seawater, it forms carbonic acid, which lowers the pH of the water and makes it more acidic. This acidification can harm marine life, including coral reefs and shellfish. In this activity, you'll explore how CO_2 can make water more acidic.

Put on the safety goggles.

Fill both cups with the same amount of water.

Add a few drops of BTB to each cup to create a solution. What color is the liquid in the cups? What does that indicate?

In the first cup, add a small amount of vinegar to the solution. What change, if any, do you observe? Why did this occur?

In the second cup, blow air through a straw into the air above the solution for several minutes.

Quickly place the cover on top of the cup to trap the air.

To see the changes more easily, hold a piece of white paper behind the cup.

- What changes, if any, do you observe?
- What do you think is happening?
- How does this model explain what happens during ocean acidification?

Check out more titles and other great activities at nomadpress.net.

SAMPLE GLOSSARY

absorb: to soak up a liquid or take in energy, heat, light, or sound.

acidic: describes a substance having a pH below 7 that is sour or corrosive. Vinegar and lemon juice are acidic.

acidification: in the ocean, the condition of increased carbon dioxide and lowered pH.

adapt: to make a change to survive in new or different conditions.

agriculture: the practice of farming, including growing crops and raising animals to provide food and other products.

agroforestry: the intentional integration of trees and shrubs into crop and animal farming systems to create environmental, economic, and social benefits.

algae: a simple organism found in water that is like a plant but without roots, stems, or leaves.

atmosphere: the mixture of gases surrounding a planet.

atom: the smallest particle of matter.

atomic mass: the amount of physical matter in an atom.

atomic number: the number of protons in an atom's nucleus.

autotrophic: describes organisms that create their own food with light or chemical energy instead of consuming other organisms.

bacteria: tiny organisms found in animals, plants, soil, and water.

basalt: a black, shiny igneous rock.

basic: describes a substance with a pH above 7 that has a bitter taste and that often feels slippery. Soap is usually a base, as are baking soda and ammonia.

bicarbonate ion: an ion formed when carbonic acid breaks apart.

biodiversity: the variety of life on Earth.

bioenergy: energy from biomass.

biological carbon pump: the process during which marine life transfers carbon to the deep ocean.

biology: the science of life and living things.

biomass: plant material and animal waste that can be used as fuel or as an energy source.

biome: a natural area with a distinct climate and plants and animals adapted for life there. Deserts and rainforests are examples of biomes.

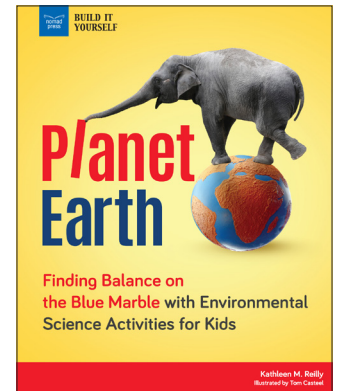
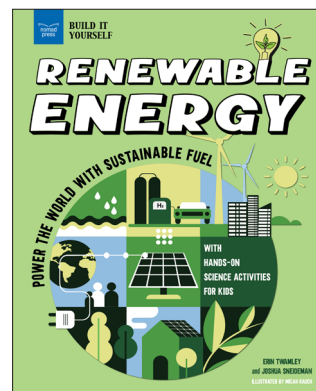
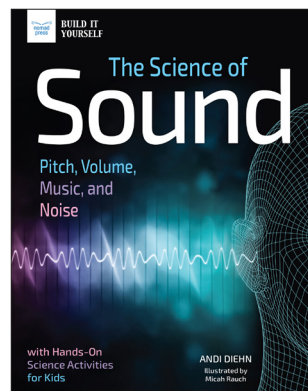
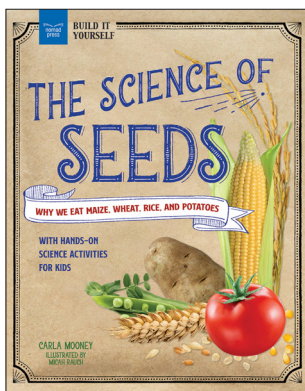
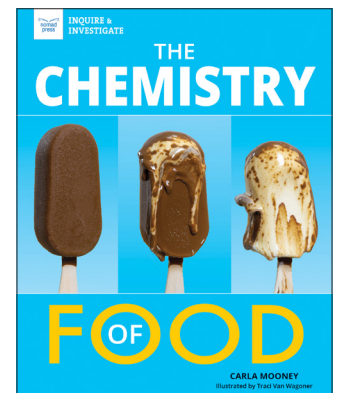
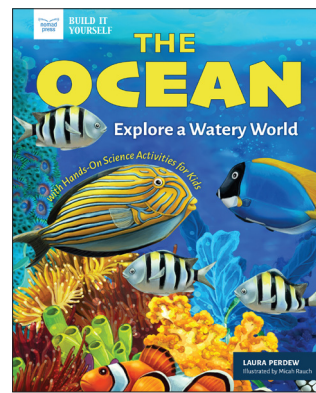
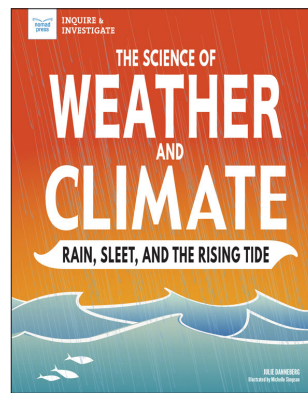
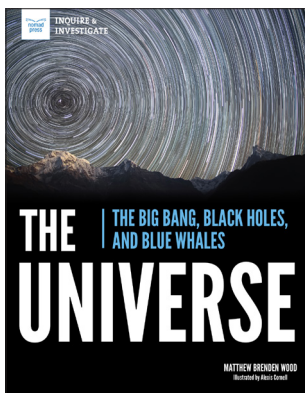
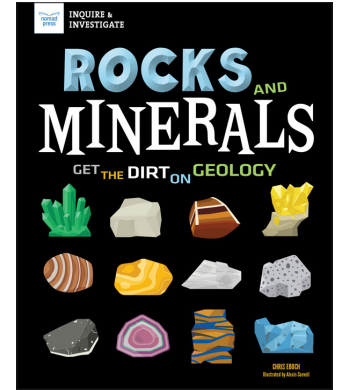
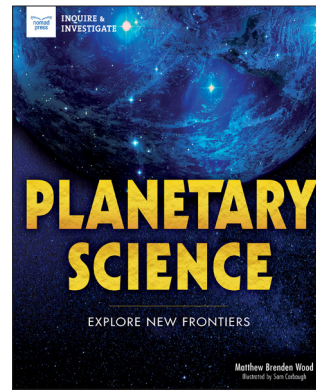
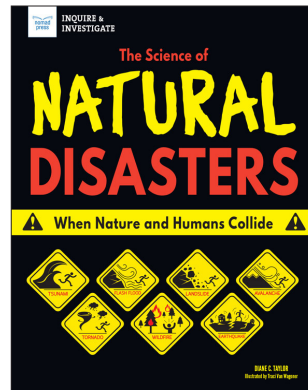
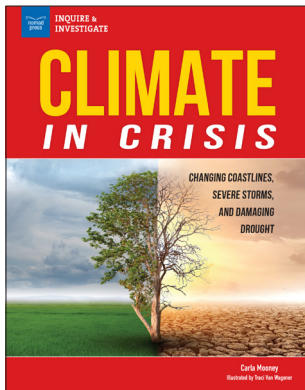
biosphere: the part of Earth's crust, waters, and atmosphere that supports life.

blue carbon: the carbon removed from the atmosphere and stored in coastal and marine ecosystems such as mangroves and salt marshes.

bond: a force that holds together the atoms or groups of atoms in a molecule or crystal.

boreal forest: a forest of coniferous trees found in the cold temperatures of the Northern Hemisphere.

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