

RESOURCE LIBRARY | ACTIVITY : 1 HR 40 MINS

Matter and Energy Cycles: Research

Students work in teams to research one of the three main matter and energy cycles: the water cycle, the rock cycle, and photosynthesis and respiration. This research will deepen their understanding of the sub-cycles that support the global carbon cycle.

GRADES

6, 7, 8

SUBJECTS

Earth Science

CONTENTS

1 Image, 3 Links, 1 Video, 1 PDF, 10 Resources

OVERVIEW

Students work in teams to research one of the three main matter and energy cycles: the water cycle, the rock cycle, and photosynthesis and respiration. This research will deepen their understanding of the sub-cycles that support the global carbon cycle.

For the complete activity with media resources, visit:

<http://www.nationalgeographic.org/activity/matter-and-energy-cycles-research/>

In collaboration with



DIRECTIONS

This activity is part of the Carbon Trackers unit

1. Help students draw the comparison between the work they have done and will continue to do throughout this unit and the work that scientists do: make observations and ask questions.

- Read aloud or have students partner up to read the *Explorer Profile: Mark E. Olson, Plant Biologist*. Then prompt students' thinking by asking: *How was Mark Olson inspired to look at the ways plants do photosynthesis? How do scientists come up with questions to explore?*
- Follow up by showing students *The Real Process of Science* interactive chart and focusing on the "Exploration and Discovery" circle. Draw their attention to the step involving "making observations" and "asking questions" that generally leads into the "gathering data" part of "testing ideas."
- Point out that in the *Tracking Down the Carbon* activity, students made observations about the objects they sorted, which led them to generate initial ideas and note areas they want to investigate further. Explain that this is similar to what Mark E. Olson and other scientists do as they make observations and explore; questions that arise as you move through a process of research and observation are iterative.

2. Revisit the class-generated model of the carbon cycle, created in the *Tracking Down the Carbon* activity. Focus on the parts of the cycle on which students indicated a need for more information. Tell students that this activity will focus on gathering that information.

- First, review the *Know & Need to Know* chart from the *Putting the "Fossil" in Fossil Fuels* activity and remind students what they identified in the "Need to Know" column.
- Focus attention on areas that correspond to the rock cycle, water cycle, and photosynthesis and respiration cycle. Tell the class that they will split into three teams to dive into each cycle, enabling them to add more detail to the larger carbon cycle model.
- Emphasize that this activity will help students work towards answering the unit driving question (*Where does the energy in fossil fuels come from and where does it go*) and the lesson driving question (*Are fossil fuels important to Earth's matter and energy cycles?*).
 - You may also want to clearly state for students the connection between these sub-cycles and the carbon cycle: that most fossil fuel material was originally created via photosynthesis, that photosynthesizing organisms need water, and that to become fossilized this material needs to be preserved for a long time (millions of years) in rocks.

3. Break students into three teams to begin research on either the rock cycle, water cycle, or photosynthesis and respiration cycle.

- How you divide your students will depend on how large the class is. One suggestion is to break the class into six teams with roughly three students in each team if possible, with two teams focusing on the same cycle, but working separately and then coming together to compare/share their work at the end.
- Distribute the *Researching Earth's Cycles* handout to every student. This handout includes suggested articles, infographics, and videos to help them learn more about their assigned cycle. Explain that while students can help each other gather information, each student needs to complete their own document to keep and study/work from later. Review the questions on the document with the class to make sure students know what to look for in the videos and readings.
- This is an activity where you can strategically assign groups to accommodate multiple students' needs.
 - In a group of advanced readers or independent learners, it may be useful to assign one article or video to each team member. Each person can take notes on their assigned article or video, and then share the information with their group in a Jigsaw style, helping other team members complete the document.
 - Other students may benefit from taking turns reading each article aloud as a group, highlighting or underlining important points as they go.
- Remind the class of the following to help make their research successful:
 - All group members will participate equally in information gathering and information sharing.
 - Each person is responsible to ask for ideas and information from quieter group members.
 - Any individual group member, if randomly called upon at the end of the activity, should be able to summarize the ideas from all of the sources on the document.
 - Check your group for understanding by asking them specific questions about what they learned and explained. If they cannot answer them, try to explain the ideas in a new way.
- Remind them that they only need to complete the part of *Researching Earth's Cycles* that is relevant to their team's cycle right now. They will fill in the remainder in another activity.

Modification

Step 2: If students will not have easy access to one-to-one computers, you can choose to print the articles and show the videos in a class setting.

Tip

Step 2: The research materials for the water cycle are fewer and contain a video, making that cycle well-suited to students who may struggle with reading. The other two cycles have similar amounts of reading and complexity, but both are more challenging than the water cycle.

Informal Assessment

You can collect the *Researching Earth's Cycles* document from students to assess their understanding of the readings and give feedback where needed. After reviewing the documents, remember to redistribute them prior to the next activity, *Matter and Energy Cycles: Modeling*, during which students will begin to share their knowledge with other groups.

OBJECTIVES

Subjects & Disciplines

Earth Science

Learning Objectives

Students will:

- Model and describe the detailed parts and processes of either the water cycle, the rock cycle, or photosynthesis and respiration.
- Collaborate to read and synthesize across multiple scientific texts in order to describe patterns about the natural world.

Teaching Approach

- Project-based learning

Teaching Methods

- Jigsaw
- Multimedia instruction
- Research

Skills Summary

This activity targets the following skills:

- 21st Century Student Outcomes
 - Information, Media, and Technology Skills
 - Information Literacy
 - Information, Communications, and Technology Literacy
 - Media Literacy
 - Learning and Innovation Skills
 - Communication and Collaboration
 - Life and Career Skills
 - Flexibility and Adaptability
 - Initiative and Self-Direction
 - Leadership and Responsibility
 - Productivity and Accountability
 - Social and Cross-Cultural Skills
- 21st Century Themes
 - Environmental Literacy
 - Global Awareness
- Science and Engineering Practices
 - Obtaining, evaluating, and communicating information

National Standards, Principles, and Practices

COMMON CORE STATE STANDARDS FOR ENGLISH LANGUAGE ARTS
& LITERACY

- **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.SL.7.2:**

Analyze the main ideas and supporting details presented in diverse media and formats (e.g., visually, quantitatively, orally) and explain how the ideas clarify a topic, text, or issue under study.

- **CCSS.ELA-LITERACY.WHST.6-8.8:**

Gather relevant information from multiple print and digital sources, using search terms effectively; assess the credibility and accuracy of each source; and quote or paraphrase the data and conclusions of others while avoiding plagiarism and following a standard format for citation.

- **CCSS.ELA-LITERACY.WHST.6-8.9:**

Draw evidence from informational texts to support analysis, reflection, and research.

NEXT GENERATION SCIENCE STANDARDS

- **Crosscutting Concept 4:**

Systems and system models

- **Crosscutting Concept 5:**

Energy and matter: Flows, cycles, and conservation

- **ESS2.A: Earth Materials and Systems:**

All Earth processes are the result of energy flowing and matter cycling within and among the planet's systems. This energy is derived from the sun and Earth's hot interior. The energy that flows and matter that cycles produce chemical and physical changes in Earth's materials and living organisms. The planet's systems interact over scales that range from microscopic to global in size, and they operate over fractions of a second to billions of years. These interactions have shaped Earth's history and will determine its future.

- **ESS2.C: The Roles of Water in Earth's Surface Processes:**

Water continually cycles among land, ocean, and atmosphere via transpiration, evaporation, condensation and crystallization, and precipitation, as well as downhill flows on land. (MS-ESS2-4)

- **LS1.C: Organization for Matter and Energy Flow in Organisms:**

Plants, algae (including phytoplankton), and many microorganisms use the energy from light to make sugars (food) from carbon dioxide from the atmosphere and water through the process of photosynthesis, which also releases oxygen. These sugars can be used immediately or stored for growth or later use. (MS-LS1-6)

- **MS-ESS2-1:**

Develop a model to describe the cycling of Earth's materials and the flow of energy that drives this process.

- **MS. Matter and Energy in Organisms and Ecosystems:**

MS-LS2-3. Develop a model to describe the cycling of matter and flow of energy among living and nonliving parts of an ecosystem

- **PS3.D Energy in Chemical Processes and Everyday Life:**

The chemical reaction by which plants produce complex food molecules (sugars) requires an energy input (i.e., from sunlight) to occur. In this reaction, carbon dioxide and water combine to form carbon-based organic molecules and release oxygen. (secondary to MS-LS1-6) Cellular respiration in plants and animals involve chemical reactions with oxygen that release stored energy. In these processes, complex molecules containing carbon react with oxygen to produce carbon dioxide and other materials. (secondary to MS-LS1-7)

- **Science and Engineering Practice 2:**

Developing and using models

Preparation

What You'll Need

REQUIRED TECHNOLOGY

- Internet Access: Required
- Tech Setup: 1 computer per learner, Speakers

PHYSICAL SPACE

- Classroom
- Computer lab

GROUPING

- Jigsaw grouping
- Small-group learning
- Small-group work

RESOURCES PROVIDED: UNDEFINED

- Definitions in the Field: Photosynthesis

RESOURCES PROVIDED: HANDOUTS & WORKSHEETS

- [Researching Earth's Cycles](#)

RESOURCES PROVIDED: REFERENCE

- Photosynthesis
- The Rock Cycle
- Metamorphic Rocks
- Sedimentary Rocks
- Igneous Rocks
- Water Cycle
- Cellular Respiration

RESOURCES PROVIDED: MAPS

- The Rock Cycle

RESOURCES PROVIDED: INTERACTIVES

- PBS: Illuminating Photosynthesis
- Understanding Science: The Real Process of Science

RESOURCES PROVIDED: IMAGES

- Photosynthesis
- Cellular Respiration
- [Water Cycle](#)
- USGS: The Water Cycle for Schools and Students: Advanced Students

BACKGROUND & VOCABULARY

Background Information

The global carbon cycle is the way that carbon moves through various reservoirs on Earth. There is a slower part of the carbon cycle and a faster part of the carbon cycle. Understanding how carbon moves in these two cycles requires knowledge of other sub-cycles and processes, namely photosynthesis and respiration, the rock cycle, and the water cycle.

The slow carbon cycle moves carbon through the lithosphere, atmosphere, and hydrosphere over 100- to 200-million-year timescales, primarily through the processes of the rock cycle. The fast carbon cycle moves carbon from the atmosphere into the biosphere via photosynthesis in plants and phytoplankton. It can then move back into the atmosphere if the plant matter is burned, the plants die and decay via bacterial processes, the plants are eaten by animals or people and carbon is released into the atmosphere as a product of digestion, or it is exhaled through the process of respiration.

Prior Knowledge

["Students need to understand that matter and energy move through and within various major Earth reservoirs (or "spheres") in various important cycles to keep things in balance."]

Recommended Prior Activities

- [Putting the "Fossil" in Fossil Fuels](#)
- [Researching Fossil Fuels](#)
- [Tracking Down the Carbon](#)

Vocabulary

Term	Part of Speech	Definition
condensation	noun	process by which water vapor becomes liquid.
energy	noun	capacity to do work.
erosion	noun	act in which earth is worn away, often by water, wind, or ice.
evaporation	noun	process by which liquid water becomes water vapor.
hydrologic cycle	noun	system of recycling liquid, gas, and solid water throughout a planet. Also called the water cycle.
photosynthesis	noun	process by which plants turn water, sunlight, and carbon dioxide into water, oxygen, and simple sugars.
precipitation	noun	all forms in which water falls to Earth from the atmosphere.
respiration	noun	breathing.
rock cycle	noun	processes that explain the relationship between the three rock types: igneous, sedimentary, and metamorphic. Any rock type can become any other.
sedimentation	noun	process of accumulating small solid deposits.

Term	Part of Speech	Definition
sublimation	<i>noun</i>	the process by which snow or ice becomes water vapor without first melting and passing through the liquid phase.
weathering	<i>noun</i>	the breaking down or dissolving of the Earth's surface rocks and minerals.

For Further Exploration

Articles & Profiles

- [Science Learning Lab: The Rock Cycle](#)



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