Renewable Resources Lesson 2: "The Make"
Educator's Resource Guide

Objective:
In the Make, students will:

1. Construct a scientific explanation based on evidence for how the uneven distributions of Earth's mineral, energy, and groundwater resources are the result of past and current geoscience processes. (MS-ESS3-1)
2. Explain how these resources are limited and typically non-renewable, and how their distributions are significantly changing as a result of removal by humans. (MS-ESS3-1)
3. Demonstrate how human activity draws on natural resources and has both short and long-term consequences, positive as well as negative, for the health of people and the natural environment. (MS-ESS3-1)

Time Required: 120 minutes

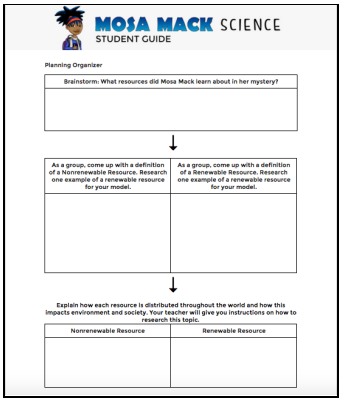
Materials Required	Safety Considerations	Science & Engineering Practices
• Computers for research • White Paper • Colored pencils/markers • Blank paper	None	• Developing and Using Models • Constructing Explanations or Arguments From Evidence

Inquiry Scale:
Level 1: (most teacher-driven) (*recommended for grades 4-5)*
Teacher leads the entire Make process as a class-wide project, occasionally breaking kids into small groups for brainstorming, but coming back together as a class to collect and finalize ideas for annotated diagrams.
Level 2: (*recommended for grades 5-6)*
Teacher leads a brainstorm session as a class-wide discussion, collecting examples of renewable and nonrenewable resources from the episode. Teacher leads a class-wide discussion about each resource, explaining how each resource is distributed throughout the world and how this impacts the environment and society. Groups are then each assigned two resources to make their annotated diagrams.
Level 3: (*recommended for grades 5-7)*
Teacher leads a brainstorm session as a class-wide discussion, collecting examples of renewable and nonrenewable resources from the episode. Students are then free to decide on the resources of their choice in groups and construct their annotated diagrams independently.

Level 4: (most student-driven)(*recommended for grades 7-8)*
Learners independently complete all aspects of the Make process, including brainstorming examples of resources, choosing and researching their resources, and creating their own annotated diagrams.

Agenda:

I. Show PowerPoint to introduce the Make Activity (10-15 minutes)
The PowerPoint will review essential concepts learned in "The Solve" and provide context for their upcoming "Make" challenge.


MOSA MACK SCIENCE
STUDENT GUIDE

Planning Organizer

Brainstorm: What resources did Mosa Mack learn about in her mystery?

As a group, come up with a definition of a Nonrenewable Resource. Research one example of a renewable resource for your model.

As a group, come up with a definition of a Renewable Resource. Research one example of a renewable resource for your model.

Explain how each resource is distributed throughout the world and how this impacts environment and society. Your teacher will give you instructions on how to research this topic.

Nonrenewable Resource	Renewable Resource

II. Make Activity (120 minutes)
As guided by the student organizer, students will:

1. Brainstorm the difference between renewable and nonrenewable resources.
2. In groups of two, research one nonrenewable and one renewable resource.
    - Cut out and use the first column of Appendix A to assign groups their resources randomly (i.e. put the pieces of paper in a hat).
    - Based on your preference, computer access, rented library books, or resource packets available for student research. Encourage students to use keyword internet searches, like, "why is resource important to society" or "resource fact sheet."
    - Make sure students document the resources they use for their research.
3. Students will complete their research cards on assigned resources to explain:
    - Why is this resource considered nonrenewable or renewable.
    - Where is it found in the world and how it's related to the geological process that forms it.
    - Summarize the positive and negative impacts of using this resource on society and the environment.
    - Summarize the importance of this resource to society.
4. Students will compare and contrast the resource cycles.
5. Using the criteria provided in the Student Guide, students will create a visual presentation.
6. As a class, students will present their research and illustrate the distribution of their resources on the large world map provided.
    - Students must take notes on their classmates' presentations.
    - Be sure to assign each student a unique color to represent their resource.

III. Exit Ticket (10 minutes)

Students complete the exit ticket that summarizes their understanding of the Make and connects students to the upcoming Engineering challenge.

Note: In collaborative classrooms, this serves as the individual accountability in a group project.

Exit Ticket Answer Key

1. How is a nonrenewable resource different from a renewable resource?

A renewable resource can be generated again and again from natural sources whereas a nonrenewable resource is finite and due to modern overuse, will not be available in the future.

2. Why does it matter if resources are overused?

If resources are overused today, they will not be available for future generations to use.

3. Why does it matter if resources are unevenly distributed throughout the world?

On the one hand, certain regions thus have more access to certain resources than others. These regions are also, however, subject to more environmental degradation than others.

4. Which type of resource do you suggest is better for humans to use? Why?

Renewable resources are better for human use because they can be generated again and again.

5. Brainstorm what you could do to help reduce overuse of limited resources.

Answers will vary, but students can respond about personal efforts they could make to reduce use of nonrenewable resources or make suggestions for possible alternative energy sources.

Make Assessment: Project Grade and Rubric Score Sheet - Renewable Resources

Project Submitted by _____

Renewable Resources Make Checklist: Content Concepts and Practices

Your Challenge: Compare a nonrenewable resource with a renewable resource and explain how each resource is distributed throughout the world

Project Completeness:

- ❏ Completes research questions for each chosen resource.
- ❏ Compares the difference between nonrenewable and renewable resource cycles
- ❏ Diagram design is well-organized, neat, and in color with relevant annotations

DCI Standards Checklist:

- ❏ Includes one example of a nonrenewable resource
  - ❏ Accurately describes a nonrenewable resource as a resource that cannot be replaced in a reasonable amount of time
  - ❏ Explains how this resource is distributed throughout the world and how this impacts society and the environment
  - ❏ Accurately depicts in a visual diagram how this resource cycles through the environment
- ❏ Includes one example of a renewable resource
  - ❏ Accurately describes a renewable resource as a resource that can be replaced in a reasonable amount of time
  - ❏ Explains how this resource is distributed throughout the world and how this impacts society and the environment
- ❏ Depicts in a visual diagram how this resource cycles through the environment

Science & Engineering Practices Rubric:

	Emerging (1)	Developing (2)	Proficient (3)	Advanced (4)
Developing and Using Models	Drawings, diagrams, or visual models include major misconceptions or have missing parts. Explanation of the model is minimal or not present.	Drawings, diagrams, or visual models include minor misconceptions or have missing parts. Explanation of the model is minimal.	Drawings, diagrams, or visual models are complete, but contain a minor misconception. Explanation of the model is complete but lacking complexity.	Drawings, diagrams, or visual models have no misconceptions and contain all details. Explanation of the model is complete and complex.
Constructing Explanations or Arguments From Evidence	Constructs an explanation with no clear sources of evidence.	Uses scientific principles and/or data from at least one source to construct or evaluate an explanation, but explanation contains minor misconceptions.	Uses accurate but incomplete scientific principles and/or data from multiple sources to construct or evaluate an explanation.	Uses accurate and complete scientific principles and/or data from multiple sources to construct or evaluate an explanation.

Teacher Comments:	
Final Score:	Final Grade:

Appendix A: Examples of resources for student research

Resource	Notable Facts to Guide Student Research
Sunlight	Renewable, photovoltaic cells in solar panels cause a reaction between photons and electrons on an atomic scale. When specific wavelengths of sunlight collide with electrons in the photovoltaic cells, the electrons get catapulted loose. Then, the electrons are captured and channeled into electricity.
Wind Energy	Renewable wind energy has been in use since 2000 B.C. and was first developed in Persia and China. Ancient sailors found distant lands by making use of wind energy in their sails. Today the most popular use of wind energy is converting it to electrical energy.
Wave/Water Energy	Renewable, tide/wave turbines are more expensive to build and maintain than wind turbines, but produce more energy. Tidal/wave turbines have a smaller environmental impact than dams, which can destroy entire ecosystems to create a lake or disrupt waterlife migration.
Geothermal Energy	Renewable, about 10 feet below the surface of the Earth, the ground is a consistent temperature between 50 and 60° F throughout the year. By moving water through the Earth it can be heated in the winter or cooled in the summer. Alternately, power plants take advantage of extremely hot water that is between one and two miles deep in the Earth to generate electricity. These plants can cause earthquakes.
Fresh Water	Renewable, only 30% of freshwater is in/on the ground. Most of it is trapped in glaciers. About 6,800 gallons of water is required to grow a family of four food for one day. Americans use 5.7 billion gallons per day flushing our toilets. It takes 132 gallons of

	water to make one 2-liter bottle of soda, and about 500 gallons to grow, dye and process the cotton, to make a single pair of Levi's stonewashed jeans.
Agricultural Crops	Renewable crops are about more than just food. Biomass such as sugars and oils from agricultural crops can be used to make fuel for vehicles. Toyota Raum (sold in Japan), contains plastic made from sweet potatoes and other plants. DuPont's Sorona, a family of polymers made from corn, can be used in fabrics and plastics.
Arable Soil	Renewable soils capable of producing agricultural crops are the basis for food, feed, fuel, and fiber production. Soils are used for competing uses, like growing crops for an increasing world population, forestry, pasture/rangeland and urbanization. Soil can be depleted to the point it is no longer able to grow anything from intense use or pollution.
Forest Products	Renewable, the global demand for wood has increased every year since 1950 and continues. Trees remove CO_2 from the atmosphere by storing carbon in leaves, branches, and trunk. Young, healthy, growing trees sequester carbon at a higher rate than older trees. Willow bark is still used in modern pharmaceuticals to create aspirin. Gum is made from the sap of the sapodilla tree. Latex rubber also comes from the sap of a tree..
Petroleum/Crude Oil	Nonrenewable, is a carbon-based energy source formed from past fossilized life, our ancestors, millions of years ago. It is the liquid form of fossil fuels. It is found in the ground surrounded by non-porous rocks, like the filling of a pie surrounded by its crust.

Natural Gas	Nonrenewable, is the "cleanest" fossil fuel. When burned, it only releases carbon dioxide and water vapor. Coal and petroleum also release gases and particulate matter harmful to the air and water.
Coal	Nonrenewable, people generate more electricity from coal than any other fossil fuel. Coal is the most abundant fossil fuel and exists in most areas of the world. In addition to energy, coal is necessary to produce iron and steel.
Uranium	Nonrenewable, uranium-235, is the only naturally occurring isotope capable of sustaining a nuclear fission reaction. (An isotope is a version of the element with a differing number of neutrons in its nucleus.) Only 0.7% of all uranium is uranium-235.
Copper	Nonrenewable, the Statue of Liberty is made of copper. Copper is naturally antimicrobial. Copper is 100% recyclable and nearly 80% of the copper that has been produced is still in use today. Does recyclability make a resource renewable?
Iron	Nonrenewable, in elemental form, iron is quite soft, so other elements are added through smelting to produce steel, which is 1,000 times harder than pure iron. Iron is also necessary for all living organisms.
Aluminum	Nonrenewable, it is the most abundant naturally occurring metal on Earth.Aluminium is potentially fully recyclable which requires only five percent of the energy that extracting it from ore requires.
Zinc	Nonrenewable, it is used in the production of brass with copper, and other alloys. Zinc Oxide is the sunscreen that turns your nose white.

Appendix B: Renewable and Nonrenewable Resource Information and Distribution Sources

Use the following websites, as well as searching for information using online search engines. Also, reach out to local experts, universities, or non-profits for resources for student research.

- US Energy Information Administration (renewable resources): https://www.eia.gov/energyexplained/renewable-sources/
- US Energy Information Administration (energy sources): https://www.eia.gov/energyexplained/what-is-energy/sources-of-energy.php
- USGS: https://www.usgs.gov/science/mission-areas/energy-and-minerals?qt-mission_areas_l2_landing_page_ta=0#qt-mission_areas_l2_landing_page_ta
- US Office of Energy Efficiency and Renewable Energy: https://www.energy.gov/eere/education/education-homepage
- National Geographic: https://www.nationalgeographic.org/
- PBS: https://www.pbs.org/wgbh/nova/labs/lab/energy/1/1/
- Energy Kids: https://www.eia.gov/kids/
- NSF: https://www.nsf.gov/
- Union of Concerned Scientists: https://www.ucsusa.org/
- US Energy Information Administration: https://www.eia.gov/energyexplained/index.php
- Us of Energy: http://usofenergy.com/
- Live Science: https://www.livescience.com/
- Soft Schools: http://www.softschools.com/facts/periodic_table/
- Study.com: https://study.com/academy/lesson/nonrenewable-resources-definition-examples.html
- Conserve Energy Future: https://www.conserve-energy-future.com/
- Creately: https://creately.com/diagram/example/honm1oi7/Non-renewable%20vs%20Renewable%20Resource
- Greentumble: https://greentumble.com/10-examples-of-renewable-and-non-renewable-resources/
- Woodland Hills School District: http://www.whsd.net/userfiles/1524/Classes/7398/Renewable%20and%20Nonrenewable%20Resources%20Notes.pdf
- Sample Map Websites:
    - https://www.nrcs.usda.gov/wps/portal/nrcs/detail/soils/use/?cid=nrcs142p2_054013
    - https://www.wri.org/resources
    - https://resourcegovernance.org/analysis-tools/publications/natural-resource-revenue-sharing
    - https://micras.org/maps_resources.php
    - http://guides.lib.berkeley.edu/VegMaps
    - https://www.gao.gov/key_issues/managing_natural_resources/issue_summary