NAVIGATING® NUCLEAR
Energizing Our World

Classroom Activity

Topic
Exploring Energy

OBJECTIVES

Students will:

- Understand the fundamental characteristics of fossil fuels, wind energy, and nuclear energy.
- Compare and contrast each energy type through the lens of several focus areas.
- Synthesize what they have learned and select the most viable power solution(s).

Overview

In this follow up to the Amazing Atoms activity, students will be challenged to investigate different energy sources as they seek to find an electricity solution for a remote location. The class will first be introduced to fossil fuels, wind power, and nuclear power through images, a video, and a simulation. They will then work in pairs to analyze the potential of each energy type, as they focus on factors ranging from environmental impact to accessibility. They will ultimately share their analyses as they collaborate to determine the best remote power solution(s).

Grade Band

Elementary, primarily grades 3–5

Note: To help younger students prepare for this activity and become familiar with different power sources, consider completing one or more of the following:

- Read-alouds, with books such as:
  - *The Boy Who Harnessed the Wind* by William Kamkwamba
  - *Energy (DK Eyewitness Books Series)* by Dan Green
  - *How Does My Home Work?* by Chris Butterworth
- Hands-on activities (to complete with an adult):
  - Build a Pizza Box Solar Oven
  - Create a Pinwheel
  - Construct a Wind Turbine

Instructional Delivery Method

This activity is presented as an in-classroom experience, but it can also be easily completed at home. Feel free to make modifications based on your teaching environment. For example:

- All partner activities may also be completed independently or in virtual breakout rooms.
- The small-group discussions can be facilitated virtually or performed in writing using a collaborative document.
- The cumulative discussion can be conducted virtually, or students can respond to the questions independently.

Timing

60 minutes

NGSS Standards

Next Generation Science Standards	ITEEA Standards for Technological Literacy	English Language Arts Standards
Energy: • 4-ESS3-1. Obtain and combine information to describe that energy and fuels are derived from natural resources and their uses affect the environment. **Engineering Design:** • 3-5-ETS1-1. Define a simple design problem reflecting a need or a want that includes specified criteria for success and constraints on materials, time, or cost. • 3-5-ETS1-2. Generate and compare multiple possible solutions to a problem based on how well each is likely to meet the criteria and constraints of the problem.	Standard 4: Students will develop an understanding of the cultural, social, economic and political effects of technology. In order to recognize the changes in society caused by the use of technology, students in Grades 3-5 should learn that: • B. When using technology, results can be good or bad.	**Reading:** • CCSS.ELA-LITERACY.CCRA.R.1: Read closely to determine what the text says explicitly and to make logical inferences from it; cite specific textual evidence when writing or speaking to support conclusions drawn from the text. **Speaking and Listening:** • CCSS.ELA-LITERACY.CCRA.SL.4: Present information, findings, and supporting evidence such that listeners can follow the line of reasoning and the organization, development, and style are appropriate to task, purpose, and audience.

Materials & Equipment

- A device with the ability to project video, for the teacher
- **Image 1: Fossil Fuels**, one copy to share, project, and/or display
- **Image 2: Wind Energy**, one copy to share, project, and/or display
- Video 1: Wind Turbine, to project

- **Image 3: Uranium atom**, one copy to share, project, and/or display
- Dominos, or other similarly-sized manipulatives, about 20 per group of three or four students
- **Energy Topics handout**, one topic slip per student
- **Compare and Contrast handout**, one per student

Activity

1. Flip the light switch off and on, and ask students to turn to a partner and discuss: What makes our lights turn on? Lead students to: electricity!
2. Then challenge students a little further and ask: "What *is* electricity?". After hearing students' thoughts, explain that electricity is a special type of energy produced by moving electrons.

   Ask students to wiggle their bodies and explain that just like it takes energy to wiggle their bodies, it takes another kind of energy to create electricity!
3. Move on and ask: "Where does this special electricity energy come from? How is it created?". Explain that there are three main ways that America gets electricity.
   - Hold up a copy of **Image 1: Fossil Fuels** and explain that fossil fuels are one way that America gets electricity. Coal, petroleum, and natural gas are different kinds of fossil fuels. Machines, like the ones in the image, dig up fossil fuel from deep in the Earth. They are called fossil fuels because they're actually made from the fossils of animals and plants that lived long, long ago! Once the fossil fuels are dug up, they're brought to a power plant (a factory that creates electricity) where they are burned. When fossil fuels are burned, they can create electricity!
   - Then hold up a copy of **Image 2: Wind Energy**, and show a segment of Video 1: "Wind Turbine" on mute. As students watch, explain that we can also get energy for electricity from the sun, water, and even wind! In this video, wind is making the turbine spin. As it spins, the wind turbine can create electricity!
   - Lastly, show students a copy of **Image 3: Uranium Atom**. Remind students that this is an atom, which they learned about during the Amazing Atoms activity. This particular atom is a uranium atom. Explain that uranium atoms can also create electricity! Let's see how this works…
4. Give small groups of students about 20 dominos.* Then ask: "How could you set up these dominos so that, if you knocked over just one, the others would fall over as quickly as possible?" Give students a few minutes to experiment with different setups, and then invite students to share which configuration worked best.

   *For at-home instruction, students may complete this activity with anything that they have multiple copies of: blocks, books, Legos, etc. They can create a video of their chain reaction in which they explain why they chose their particular set-up.
5. Explain that students just created a **chain reaction**. During a chain reaction, one event causes the next event to happen, which causes the next event to happen, which causes the next event to happen, etc. The chain reaction that knocked over the dominos the most quickly likely had one domino tip over and hit two dominos, which hit four dominos, and so on!
6. Then bring students' attention back to **Image 3**. Explain that uranium atoms give off the special energy needed to create electricity when they are split in half. A power plant begins a chain reaction by hitting a uranium atom with a neutron. This causes the uranium atom to split in half. When a uranium atom is split in half, it releases more neutrons.

These neutrons hit other uranium atoms, which causes them to split in half, release more neutrons, and continue the chain reaction. Each time a uranium atom splits in half, they can create electricity!

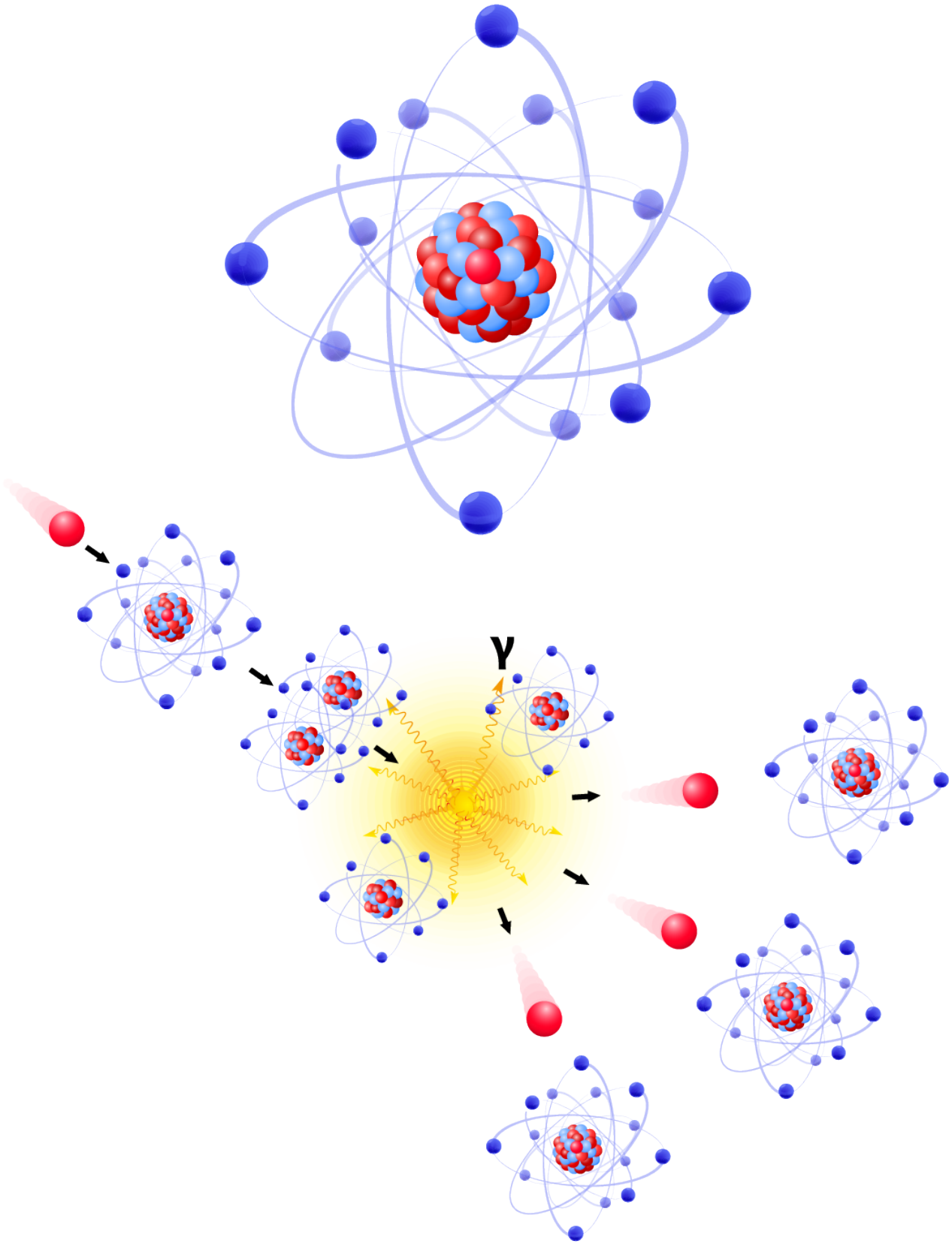
Note: For a simpler explanation, you can also explain: Uranium atoms give off the special energy needed to create electricity when they are split in half. When one uranium atom is split in half at a power plant, it begins a chain reaction. This chain reaction causes more and more atoms to split in half, too. As they do, they can create electricity!

7. Write the words "nuclear power" on the board and explain that this is a common name for electricity generated using uranium as a fuel. Ask students if they recognize anything in these words that seems similar to what they learned during the Amazing Atoms activity. If needed, point out that *nuclear* is similar to *nucleus*. Electricity that we get from uranium is called nuclear power because it comes from energy stored in the nucleus of atoms!
8. Explain that students will now pretend that they are electricity experts—or energy engineers—and their state needs their help! Ask them to pretend that there is a remote part of their state that is very far from the nearest city or town. Right now, nobody lives there because there is no electricity. However, their state would like to start building homes there. But they first need to decide the best way to give it electricity. It will be up to the class to decide whether this area should be powered with fossil fuels, wind power, or nuclear power!
9. Divide the class into pairs and distribute an Energy Topic slip to each student. (Students within a pair should receive the same Energy Topic slip.) Try to distribute the topics as evenly as possible.
10. Explain that each pair will read information about one energy topic. They will then work together to answer the question on their slip, and they will later share what they learned with others. Each student must record their own answer. Give each group 10-15 minutes to read, discuss, and answer the question.

    Note: For younger students, you may complete all topics together as a class. Before you begin reading, create a three-column t-chart with "Fossil Fuels," "Wind Power," and "Nuclear Power" as headers. You can then keep track of pros and cons of each energy type together as you read.
11. When partners have finished answering their questions, guide students in forming new groups around the classroom of at least four students so that at least one representative from each Energy Topic is included in every group.
12. Then distribute one **Compare and Contrast handout** to each student. Explain that each student should describe their Energy Topic and explain the answer they recorded. As students share, the rest of the group should take notes on their **Compare and Contrast handout**. If needed, explain how to use the handout to take notes, and then encourage groups to begin. Give groups about 10-15 minutes to share their answers, beginning with Topic 1.
13. When there are about 10 minutes left in class, regain students' attention and ask: "Based on what you shared and learned, what is the best way to give electricity to this part of our state?" Encourage groups to think especially about what type of power would be the most reliable *and* what type of power would be "cleaner" or best for the environment.*

    Give groups a few minutes to refer to their **Compare and Contrast handout** and discuss their answer.

    **Note:* You may also give groups the option to select two power sources to be used together. If so, challenge students to explain why these two power sources should be paired.
14. Then select one student from each group to share the energy source that they selected and the top two reasons why they selected this type of power. Keep a tally as students share, so you can determine the winner.
15. Wrap up by announcing the energy decision and review the main reasons behind this selection. Remember to thank the electricity experts and/or energy engineers for their hard work during their investigation of this electricity challenge!


γ

Topic 1: Pollution & Environment

Fossil Fuels: When fossil fuels are burned, they emit greenhouse gases and other toxic pollutants. Greenhouse gases make Earth get hotter. This is called global warming, and it has many negative effects. It causes bad storms, melts ice in our oceans, hurts plants and animals, and more. However, new and safer types of fuel are being invented, as well as technologies that use less fuel!

Nuclear Power: Nuclear power plants create used fuel which is radioactive. This radioactivity can be harmful to living things if it is not handled correctly. However, nuclear power plants safely take care of used fuel, and it does not hurt people or the environment.

Wind Power: Wind turbines do not create air pollution. However, they do need to be spread out on a lot of land. This can take land away from the habitats (or homes) of plants and animals. Sometimes, they can also injure birds and animals.

Based on this information, which power source(s) seems like the best choice? Why?

_____

_____

_____

Topic 2: Can we count on them to work and create electricity?

Fossil Fuels: Fossil fuel power plants only work about half the time! When they don't work, they don't create electricity. People need to do a lot of work to make sure these power plants run smoothly.

Nuclear Power: Nuclear power plants work almost 100 percent of the time. This means they can almost always create electricity! They need much less human help than fossil fuel power plants.

Wind Power: Wind turbines run only about one-third of the time, because they need the right amount of wind to work! They work less often than power plants *and* less often than nuclear power plants.

Based on this information, which power source(s) seems like the best choice? Why?

_____

_____

_____

Topic 3: Can we keep using them?

Fossil Fuels: There are a lot of fossil fuels inside Earth and it can be easy to get them! But when you use fossil fuels once, you cannot use them again. New fossil fuels are not created quickly. There are fewer fossil fuels in the Earth today than there used to be. If we keep using fossil fuels like we are now, they will run out.

Nuclear Power: Like all elements, there is only a certain amount of uranium on Earth. We hope to use research and technology to make uranium in fuel recyclable. This will make it possible for uranium to be used over and over again. If we recycle uranium, it could give us limitless energy!

Wind Power: As long as there is wind, we can create energy from it. The world will not run out of wind. However, some areas are much more windy than others!

Based on this information, which power source(s) seems like the best choice? Why?

_____

_____

_____

Topic 4: Can it be used easily in remote and faraway areas?

Fossil Fuels: Fuel would need to be brought to remote areas. Coal needs to be transported by train or truck, which can be expensive. This could also add to air pollution. Gas and oil would need to be brough to the area through a long pipe, called a pipeline. Though pipelines can carry lots of fuel, there is a risk that they can leak.

Nuclear Power: Mini-nuclear power plants called microreactors are the newest nuclear power invention! A microreactor is small enough to fit in a large truck. It can be driven to a remote area and quickly used for power.

Wind Energy: Wind turbines work best far from cities, where they can receive lots of wind and are not blocked by buildings. They can be built on farms or ranches. They work well in areas with constant wind, such as near the ocean, in fields, or on top of hills.

Based on this information, which power source(s) seems like the best choice? Why?

_____

_____

_____

COMPARE AND CONTRAST HANDOUT

STUDENT HANDOUT

Fossil Fuels		Wind Energy		Nuclear Energy	
Pros (+)	Cons (-)	Pros (+)	Cons (-)	Pros (+)	Cons (-)