

Grade 4 Science

Unit 5: Using Natural Resources for Energy

17 lessons and a unit quiz. Use this pack with the **Using Natural Resources for Energy Student Reader** (print it, or download it once from the course) to teach the whole unit without the internet.

What is in this pack

- A lesson plan for each chapter: the Big Question, words to know, which pages to read, questions to talk over and the activity pages.
- The unit quiz, ready to print.
- Answers for the teacher at the back: every discussion question and the quiz key.

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Lesson schedule

Two or three lessons a week, about 30 minutes each. Tick each one off as you go.

	Lesson	Reader pages	Activity pages
☐	Lesson 1: Introduction to Cost-Benefit Analysis	—	AP 1.1, AP 1.2, AP 1.3
☐	Lesson 2: Renewable and Nonrenewable Resources	PDF pages 7-14	AP 2.1
☐	Lesson 3: Cost-Benefit Analysis Outline	—	AP 3.1, AP 3.2
☐	Lesson 4: Types of Fossil Fuels	PDF pages 15-18	AP 4.1, AP 4.2
☐	Lesson 5: Using Fossil Fuels	PDF pages 19-26	AP 5.1, AP 5.2
☐	Lesson 6: Researching Fossil Fuels	—	AP 6.1
☐	Lesson 7: Nuclear Energy	PDF pages 27-30	AP 7.1
☐	Lesson 8: Researching Nuclear Power	—	AP 8.1
☐	Lesson 9: Wind Energy	PDF pages 31-36	AP 9.1
☐	Lesson 10: Researching Use of Wind Turbines	—	AP 10.1
☐	Lesson 11: Hydroelectric Energy	PDF pages 37-42	AP 11.1
☐	Lesson 12: Researching Use of Hydroelectric Power	—	AP 12.1
☐	Lesson 13: Solar Energy	PDF pages 43-48	AP 13.1
☐	Lesson 14: Researching Use of Solar Energy	—	AP 14.1
☐	Lesson 15: Geothermal Energy	PDF pages 49-52	AP 15.1
☐	Lesson 16: Researching Use of Geothermal Energy	—	AP 16.1
☐	Lesson 17: Energy Resource Innovations	PDF pages 53-58	AP 17.1
☐	Unit review and assessment	—	AP UC.1, AP UC.2, AP UC.3
☐	Words quiz	—	—

Page numbers are the PDF page numbers of the Student Reader file, so they match what your PDF reader shows.

Lesson 1: Introduction to Cost-Benefit Analysis

THE BIG QUESTION

What is a cost-benefit analysis? Problem-Based Learning Project: Investigate the costs and benefits of different types of energy resources, including renewable and nonrenewable, and propose the types best suited to implement locally.

Words to know

- **analysis** — thorough study of the details of something complex
- **benefit** — something that produces a helpful outcome
- **cost-benefit analysis** — a study of the costs and benefits associated with an action
- **fact** — a piece of information that is indisputably true
Student Reader page numbers
onal vocabulary terms related and that are often used within ge numbers listed.
Vocabulary words
- **opinion** — a belief, impression, or judgment that is not an undisputed fact
- **pros and cons** — the benefits and costs of any factor being evaluated
- **values** — beliefs about worth or importance

Teacher's lesson plan

Follow the Teacher Guide, PDF pages 27–32: the steps, materials and timing for this lesson.

Talk it over

1. sticky notes (2 per student) What Is a Cost-Benefit Analysis?
2. Why would a longer lunch period be good?
3. Why would a longer lunch period be bad?
4. A cost-benefit analysis looks at any possible alternatives to a solution. SUPPORT—Ask: Why is it important to look at the alternatives to a solution?

Answers are at the back of this pack.

Check for understanding

- Answer the Big Question in a sentence or two: What is a cost-benefit analysis?
Problem-Based Learning Project: Investigate the costs and benefits of different types of energy resources, including renewable and nonrenewable, and propose the types best suited to implement locally.
- Use one of today's words in a sentence of your own.

Activity pages

- Activity Page 1.1: Project Evaluation Guide — Teacher Guide PDF page 137

- Activity Page 1.2: What Is a Cost-Benefit Analysis? — Teacher Guide PDF page 138
- Activity Page 1.3: Energy Research Take-Home Letter — Teacher Guide PDF page 139

Lesson 2: Renewable and Nonrenewable Resources

THE BIG QUESTION

What is the difference between renewable and nonrenewable resources? Problem-Based Learning Project: Learn more about renewable and nonrenewable resources, as well as their costs and benefits to society and the environment, in anticipation of the unit capstone project.

Words to know

- **nonrenewable resource** — a resource that cannot be restored as quickly as it is used
- **renewable resource** — a resource that can be restored more quickly than it is used up
- **fossil fuel** — a fuel formed from the fossilized remains of organisms
- **electricity** — a form of energy resulting from the flow of charged particles
- **biosphere** — the Earth system that encompasses all living things
- **radioactivity** — the property of elements that spontaneously emit energetic particles
- **sustainable** — describing the practice of using resources in ways that do not permanently deplete them or cause untenable damage

Teacher's lesson plan

Follow the Teacher Guide, PDF pages 34–41: the steps, materials and timing for this lesson.

Read

Read Student Reader, Chapter 1: “Renewable and Nonrenewable Resources”: PDF pages 7–14. Look at the pictures and maps together.

Talk it over

1. why the resources are harmful CHALLENGE—Draw student attention to the illustrations on pages 5 and 7. Ask: What kind of negative effects do you think oil spills from extracting petroleum and pollution from burning coal can have?
2. What are examples of renewable energy sources?
3. What is the percentage of renewable energy that people use?
4. What is the most widely used type of energy by humans?
5. What are the benefits of using renewable energy?
6. What are some downsides of using renewable energy sources?

7. Where do fossil fuels come from?
8. Are fossil fuels renewable or nonrenewable?
9. How do humans use fossil fuels?
10. What happens if we run out of fossil fuels?
11. How are fossil fuels bad for the environment?
12. What are some examples of fossil fuels that you read about?
13. What does this game show you about how renewable energy is used?
14. What did you learn about using your energy?
15. What happened if you used up all of your energy during one of the rounds?
16. Why is it important to know where to find renewable and nonrenewable resources in daily life?
17. Do you think there are ways that the local community can use more renewable resources and fewer nonrenewable resources?

Answers are at the back of this pack.

Check for understanding

- Answer the Big Question in a sentence or two: What is the difference between renewable and nonrenewable resources? Problem-Based Learning Project: Learn more about renewable and nonrenewable resources, as well as their costs and benefits to society and the environment, in anticipation of the unit capstone project.
- Use one of today's words in a sentence of your own.

Activity pages

- Activity Page 2.1: Check — Teacher Guide PDF page 140

Lesson 3: Cost-Benefit Analysis Outline

THE BIG QUESTION

What might a cost-benefit analysis of natural resource use look like? Problem-Based Learning Project: As part of learning how to perform a cost-benefit analysis, students explore how to arrive at a consensus and what it means for sources of research to be reliable.

Words to know

- **authority** — an individual recognized as an expert
- **consensus** — general agreement
- **cost-benefit analysis** — a study of the costs and benefits associated with an action
- **reliable** — suitable to be depended upon

Teacher's lesson plan

Follow the Teacher Guide, PDF pages 42–46: the steps, materials and timing for this lesson.

Check for understanding

- Answer the Big Question in a sentence or two: What might a cost-benefit analysis of natural resource use look like? Problem-Based Learning Project: As part of learning how to perform a cost-benefit analysis, students explore how to arrive at a consensus and what it means for sources of research to be reliable.
- Use one of today's words in a sentence of your own.

Activity pages

- Activity Page 3.1: Costs and Benefits Practice Sheet — Teacher Guide PDF page 141
- Activity Page 3.2: Check — Teacher Guide PDF page 142

Lesson 4: Types of Fossil Fuels

THE BIG QUESTION

What are fossil fuels? Problem-Based Learning Project: Investigate different types of fossil fuels to learn more about their costs and benefits.

Words to know

- **nonrenewable resource** — a resource that cannot be restored as quickly as it is used
- **fossil fuel** — a fuel formed from the fossilized remains of organisms
- **decompose** — to separate into more basic parts; to rot
- **natural gas** — combustible mixtures of gases from fossil fuel formation

Teacher's lesson plan

Follow the Teacher Guide, PDF pages 49–54: the steps, materials and timing for this lesson.

Read

Read Student Reader, Chapter 2: “Types of Fossil Fuels”: PDF pages 15–18. Look at the pictures and maps together.

Talk it over

1. What are renewable resources?
2. What are nonrenewable resources?
3. What are examples of renewable resources?
4. What are examples of nonrenewable resources?
5. What does it mean if a resource is in abundance?
6. What are the three main types of fossil fuels?
7. What do these types of fossil fuels have in common?
8. How do these types of fossil fuels differ?
9. How are fossil fuels used in everyday life?
10. What are some activities that you participate in that use fossil fuels?
11. Do you see fossil fuels being used in the local community?
12. Which kind of fossil fuel formation did you portray in your picture?

Answers are at the back of this pack.

Check for understanding

- Answer the Big Question in a sentence or two: What are fossil fuels? Problem-Based Learning Project: Investigate different types of fossil fuels to learn more about their

costs and benefits.

- Use one of today's words in a sentence of your own.

Activity pages

- Activity Page 4.1: Formation of Fossil Fuels — Teacher Guide PDF page 143
- Activity Page 4.2: Fossil Fuel Diagram — Teacher Guide PDF page 144

Lesson 5: Using Fossil Fuels

THE BIG QUESTION

What are some costs and benefits of using fossil fuels?

Problem-Based Learning Project: Investigate how fossil fuels are used to learn more about their costs and benefits.

Words to know

- **greenhouse gas** — a gas that traps heat in Earth’s atmosphere
- **industrial** — related to manufacturing activity
- **petrochemical** — a chemical material derived from petroleum

Teacher’s lesson plan

Follow the Teacher Guide, PDF pages 55–63: the steps, materials and timing for this lesson.

Read

Read Student Reader, Chapter 3: “Using Fossil Fuels”: PDF pages 19–26. Look at the pictures and maps together.

Talk it over

1. What are the three main types of fossil fuels?
2. Where are fossil fuels found?
3. Are fossil fuels renewable or nonrenewable sources of energy?
4. What are some examples of ways that people use fossil fuels?
5. Is transporting oil a cost or a benefit or both? Why?
6. Have you ever had to make a decision and you didn’t know whether an answer was right or wrong?
7. What were you trying to decide?
8. Did you make a list of the things that were good about the decision and the things that were bad about the decision?
9. What are the costs and benefits associated with how the fossil fuels are extracted?
10. What are the costs and benefits associated with how the fossil fuels are transported?
11. What are the costs and benefits associated with burning the fossil fuels?
12. Where does coal come from?
13. In what form is coal found?
14. What do people do with coal in its original form?
15. What kind of impact do you think this event had on the environment?

16. Do you think disasters like these should stop people from drilling for oil? Why or why not?
17. Which liquids need more processing for them to be useful?
18. What does cracking do?
19. What is reforming?
20. What role do molecules play in oil refinement?

Answers are at the back of this pack.

Check for understanding

- Answer the Big Question in a sentence or two: What are some costs and benefits of using fossil fuels? Problem-Based Learning Project: Investigate how fossil fuels are used to learn more about their costs and benefits.
- Use one of today's words in a sentence of your own.

Activity pages

- Activity Page 5.1: Fossil Fuels Costs and Benefits — Teacher Guide PDF page 145
- Activity Page 5.2: Electricity Diagram — Teacher Guide PDF page 146

Lesson 6: Researching Fossil Fuels

THE BIG QUESTION

Where can I find reliable information about costs and benefits of using fossil fuels? Problem-Based Learning Project: Investigate different types of fossil fuels to learn more about their costs and benefits.

Words to know

- **fossil fuel** — a fuel formed from the fossilized remains of organisms
- **greenhouse gas** — a gas that traps heat in Earth’s atmosphere
- **cost-benefit analysis** — a study of the costs and benefits associated with an action
- **emission** — something sent forth or released
- **flare** — a sudden outburst
- **fracking** — a process of using fluids to fracture rock to create access to petroleum resources
- **strip mining** — removing resources by digging to expose them at Earth’s surface level

Teacher’s lesson plan

Follow the Teacher Guide, PDF pages 64–68: the steps, materials and timing for this lesson.

Talk it over

1. What are the three main fossil fuels?
2. How are fossil fuels, which contain chemical energy, converted to forms of energy that humans want?
3. What are other uses for fossil fuels?
4. What are some short-term benefits of burning coal?
5. What are some long-term benefits of using coal?
6. What are some short- and long-term costs of using coal?

Answers are at the back of this pack.

Check for understanding

- Answer the Big Question in a sentence or two: Where can I find reliable information about costs and benefits of using fossil fuels? Problem-Based Learning Project: Investigate different types of fossil fuels to learn more about their costs and benefits.
- Use one of today’s words in a sentence of your own.

Activity pages

- Activity Page 6.1: Costs and Benefits of Fossil Fuels — Teacher Guide PDF page 147

Lesson 7: Nuclear Energy

THE BIG QUESTION

What is nuclear power? Problem-Based Learning Project: Investigate nuclear power to learn more about its costs and benefits in anticipation of the unit capstone project.

Words to know

- **nuclear energy** — energy produced by the splitting of atoms, tiny particles of matter
- **atom** — the smallest particle of a specific element
- **enriched** — describing a material that has been fortified in some way to make it more useful

Teacher's lesson plan

Follow the Teacher Guide, PDF pages 69–73: the steps, materials and timing for this lesson.

Read

Read Student Reader, Chapter 4: “Nuclear Energy”: PDF pages 27–30. Look at the pictures and maps together.

Talk it over

1. In what forms does energy leave the power plant?
2. Does any matter leave the power plant as a result of the chain reaction?
3. If Earth has a lot of uranium that has not yet been mined or enriched, why isn't nuclear power considered renewable?
4. How does the radioactivity of nuclear waste factor into nuclear power being called nonrenewable?
5. What are two of the main benefits of using nuclear power to generate electricity?
6. What are two of the main costs of nuclear power?

Answers are at the back of this pack.

Check for understanding

- Answer the Big Question in a sentence or two: What is nuclear power? Problem-Based Learning Project: Investigate nuclear power to learn more about its costs and benefits in anticipation of the unit capstone project.
- Use one of today's words in a sentence of your own.

Activity pages

- Activity Page 7.1: Check — Teacher Guide PDF page 148

Lesson 8: Researching Nuclear Power

THE BIG QUESTION

Where can I find reliable information about costs and benefits of using nuclear power? Problem-Based Learning Project: Investigate nuclear power to learn more about its costs and benefits.

Words to know

- **cost-benefit analysis** — a study of the costs and benefits associated with an action
- **fission** — the splitting of atomic nuclei, resulting in the release of a great deal of energy

Teacher's lesson plan

Follow the Teacher Guide, PDF pages 74–78: the steps, materials and timing for this lesson.

Talk it over

1. What is the actual fuel for nuclear power?
2. How is the energy released by a nuclear reaction converted into electricity?
3. How is nuclear power good for the environment?
4. What are the environmental costs of nuclear power?
5. How does nuclear power compare to fossil fuels in terms of usefulness in transportation and everyday activities?
6. How do the environmental benefits of nuclear power relate to the environmental costs of fossil fuels?
7. What is one way in which the waste produced by nuclear power is more of a problem than the waste or by-products of fossil fuel use?

Answers are at the back of this pack.

Check for understanding

- Answer the Big Question in a sentence or two: Where can I find reliable information about costs and benefits of using nuclear power? Problem-Based Learning Project: Investigate nuclear power to learn more about its costs and benefits.
- Use one of today's words in a sentence of your own.

Activity pages

- Activity Page 8.1: Nuclear Power Costs and Benefits — Teacher Guide PDF page 149

Lesson 9: Wind Energy

THE BIG QUESTION

How do people use wind as a source of energy?

Problem-Based Learning Project: Investigate wind energy to learn more about its costs and benefits.

Words to know

- **renewable resource** — a resource that can be restored more quickly than it is used up
- **wind farm** — many wind turbines installed together in an area to generate electricity for a community
- **power grid** — the network of electricity generation and transfer in a region
- **viable** — capable of functioning successfully

Teacher's lesson plan

Follow the Teacher Guide, PDF pages 81–85: the steps, materials and timing for this lesson.

Read

Read Student Reader, Chapter 5: “Wind Energy”: PDF pages 31–36. Look at the pictures and maps together.

Talk it over

1. Why do you think a small island would be a good place for using wind energy?
2. Why might renewable energy resources such as wind and solar be especially useful in this kind of place?
3. Why does the story on the page specify that wind power is good for the afternoon? Why not all the time?
4. What kinds of constraints might be placed on a turbine's design by the environment?
5. What kinds of constraints or criteria might people place on a wind farm that's being planned?
6. What are the benefits of using wind power?
7. What are the costs of using wind power?

Answers are at the back of this pack.

Check for understanding

- Answer the Big Question in a sentence or two: How do people use wind as a source of energy? Problem-Based Learning Project: Investigate wind energy to learn more about its costs and benefits.
- Use one of today's words in a sentence of your own.

Activity pages

- Activity Page 9.1: Check — Teacher Guide PDF page 150

Lesson 10: Researching Use of Wind Turbines

THE BIG QUESTION

Where can I find reliable information about costs and benefits of wind as a source of energy? Problem-Based Learning Project: Investigate wind turbines to learn more about wind energy's costs and benefits.

Words to know

- **renewable resource** — a resource that can be restored more quickly than it is used up
- **wind farm** — many wind turbines installed together in an area to generate electricity for a community

Teacher's lesson plan

Follow the Teacher Guide, PDF pages 86–90: the steps, materials and timing for this lesson.

Talk it over

1. What kinds of environments are good for harnessing wind energy?
2. What is the name of the machine that converts wind energy into electricity?
3. What is the difference between a windmill and a wind turbine?
4. How is wind power good for the environment?
5. What are the environmental costs of wind power?
6. Can wind power be used in the transportation industry?
7. How do the environmental benefits of wind power compare to the environmental costs of fossil fuels?
8. How is wind power used in this area? If it isn't used, why not?

Answers are at the back of this pack.

Check for understanding

- Answer the Big Question in a sentence or two: Where can I find reliable information about costs and benefits of wind as a source of energy? Problem-Based Learning Project: Investigate wind turbines to learn more about wind energy's costs and benefits.
- Use one of today's words in a sentence of your own.

Activity pages

- Activity Page 10.1: Wind Power Costs and Benefits — Teacher Guide PDF page 151

Lesson 11: Hydroelectric Energy

THE BIG QUESTION

How do people use moving water as a source of energy?
Problem-Based Learning Project: Investigate how and why people use moving water as a source of energy.

Words to know

- **hydroelectric power** — electricity generated by the energy in moving water, usually through a dam
- **cost-effective** — describing the balance of factors when benefits outweigh costs

Teacher's lesson plan

Follow the Teacher Guide, PDF pages 91–96: the steps, materials and timing for this lesson.

Read

Read Student Reader, Chapter 6: “Hydroelectric Energy”: PDF pages 37–42. Look at the pictures and maps together.

Talk it over

1. What takes more time and money to set up—a small gas-powered generator or a hydroelectric turbine?
2. Why might a renewable energy solution such as a hydroelectric dam be cost effective in the long run compared to the gas-powered generator?

Answers are at the back of this pack.

Check for understanding

- Answer the Big Question in a sentence or two: How do people use moving water as a source of energy? Problem-Based Learning Project: Investigate how and why people use moving water as a source of energy.
- Use one of today's words in a sentence of your own.

Activity pages

- Activity Page 11.1: Check — Teacher Guide PDF page 152

Lesson 12: Researching Use of Hydroelectric Power

THE BIG QUESTION

Where can I find reliable information about the costs and benefits of using moving water as a source of energy?

Problem-Based Learning Project: Continue investigating how and why people use moving water as a source of energy.

Words to know

- **renewable resource** — a resource that can be restored more quickly than it is used up
- **hydroelectric power** — electricity generated by the energy in moving water, usually through a dam

Teacher's lesson plan

Follow the Teacher Guide, PDF pages 97–101: the steps, materials and timing for this lesson.

Talk it over

1. What do you need for hydroelectric energy to be a large-scale provider of electricity?
2. What is the name of the machine that converts the energy of motion in moving water into electricity?
3. What is the difference between a water mill and a hydroelectric turbine?
4. How do you think the scale of a hydroelectric power project affects how cost effective it is?
5. What are the environmental costs of hydroelectric power facilities that use dams?
6. What are the environmental costs of hydroelectric power facilities that do not use dams but instead have turbines or wheels installed in naturally flowing bodies of water?
7. How do the environmental benefits of hydroelectric power compare to the environmental costs of fossil fuels?
8. How is hydroelectric power used in this area? If it isn't used, why not?

Answers are at the back of this pack.

Check for understanding

- Answer the Big Question in a sentence or two: Where can I find reliable information about the costs and benefits of using moving water as a source of energy?
Problem-Based Learning Project: Continue investigating how and why people use moving water as a source of energy.

- Use one of today's words in a sentence of your own.

Activity pages

- Activity Page 12.1: Hydroelectric Power Costs and Benefits — Teacher Guide PDF page 153

Lesson 13: Solar Energy

THE BIG QUESTION

How do people use sunlight as a source of energy?

Problem-Based Learning Project: Investigate how and why people use sunlight as a source of energy.

Words to know

- **solar cell** — a device that converts sunlight to electricity
- **solar power** — the use of sunlight to meet energy needs
- **efficiency** — the degree of producing desired results
- **electron** — a negatively charged atomic particle
- **photon** — a quantity of electromagnetic energy, modeled as a particle

Teacher's lesson plan

Follow the Teacher Guide, PDF pages 102–106: the steps, materials and timing for this lesson.

Read

Read Student Reader, Chapter 7: “Solar Energy”: PDF pages 43–48. Look at the pictures and maps together.

Talk it over

1. What are some other things that can be heated or powered by passive solar power?
2. What are some other solar-powered devices?
3. How is wind related to solar energy?
4. How is thermal energy related to solar energy?
5. How are fossil fuels related to solar energy?
6. What is the most basic problem with relying on solar energy to provide all your energy needs?
7. What other geographical factors affect how much sunlight strikes a given area?
8. What other factors limit the exposure of Earth's surface to sunlight?
9. What kinds of terrain do you think are good for placing a large number of solar panels?

Answers are at the back of this pack.

Check for understanding

- Answer the Big Question in a sentence or two: How do people use sunlight as a source of energy? Problem-Based Learning Project: Investigate how and why people use sunlight as a source of energy.

- Use one of today's words in a sentence of your own.

Activity pages

- Activity Page 13.1: Check — Teacher Guide PDF page 154

Lesson 14: Researching Use of Solar Energy

THE BIG QUESTION

Where can I find reliable information about costs and benefits of using sunlight as a source of energy?

Problem-Based Learning Project: Continue investigating how and why people use sunlight as a source of energy.

Words to know

- **renewable resource** — a resource that can be restored more quickly than it is used up
- **solar cell** — a device that converts sunlight to electricity

Teacher's lesson plan

Follow the Teacher Guide, PDF pages 107–111: the steps, materials and timing for this lesson.

Talk it over

1. What are three different ways of using solar energy?
2. What is the major drawback of solar power in some locations?
3. What is one problem with photovoltaic technology that has prevented solar power from being a bigger producer of electricity?
4. What are the costs and benefits of a large-scale solar power facility such as a concentrated solar thermal plant or a huge solar array farm in the desert?
5. What can be done to make more use of solar energy in areas that have short days in the winter?
6. How do the environmental benefits of solar power compare to the environmental costs of fossil fuels?
7. How is solar power used in this area? If it isn't used, why not?
8. What are some secondary benefits of using solar arrays?

Answers are at the back of this pack.

Check for understanding

- Answer the Big Question in a sentence or two: Where can I find reliable information about costs and benefits of using sunlight as a source of energy? Problem-Based Learning Project: Continue investigating how and why people use sunlight as a source of energy.
- Use one of today's words in a sentence of your own.

Activity pages

- Activity Page 14.1: Solar Power Costs and Benefits — Teacher Guide PDF page 155

Lesson 15: Geothermal Energy

THE BIG QUESTION

What is geothermal energy, and how do people use it?
Problem-Based Learning Project: Investigate how and why people use geothermal energy.

Words to know

- **renewable resource** — a resource that can be restored more quickly than it is used up
- **geothermal energy** — energy produced by heat that is transferred from Earth’s interior

Teacher’s lesson plan

Follow the Teacher Guide, PDF pages 112–116: the steps, materials and timing for this lesson.

Read

Read Student Reader, Chapter 8: “Geothermal Energy”: PDF pages 49–52. Look at the pictures and maps together.

Talk it over

1. What is the overall share of the United States’ electricity generation by nonrenewable energy resources?
2. Where does geothermal energy rank among the renewables in terms of its share of electricity generation?
3. How much more is natural gas used to make electricity than geothermal energy in the U.S.?

Answers are at the back of this pack.

Check for understanding

- Answer the Big Question in a sentence or two: What is geothermal energy, and how do people use it? Problem-Based Learning Project: Investigate how and why people use geothermal energy.
- Use one of today’s words in a sentence of your own.

Activity pages

- Activity Page 15.1: Check — Teacher Guide PDF page 156

Lesson 16: Researching Use of Geothermal Energy

THE BIG QUESTION

Where can I find reliable information about costs and benefits of using geothermal energy? Problem-Based Learning Project: Research the costs and benefits of geothermal energy.

Words to know

- **renewable resource** — a resource that can be restored more quickly than it is used up
- **geothermal energy** — energy produced by heat that is transferred from Earth's interior
- **geyser** — a geothermal spring that intermittently erupts water and steam

Teacher's lesson plan

Follow the Teacher Guide, PDF pages 117–120: the steps, materials and timing for this lesson.

Talk it over

1. What do engineers need to look for and tap into to generate electricity from geothermal energy?
2. How is geothermal energy used in a similar way to other energy resources?
3. What is the advantage of using a geothermal reservoir that consists of steam that can be used directly in a turbine?
4. What is the advantage of recycling wastewater in an abandoned oil field to generate electricity?
5. How do the environmental benefits of geothermal energy compare to the environmental costs of fossil fuels?
6. Is geothermal energy used very widely in your area? If not, why?

Answers are at the back of this pack.

Check for understanding

- Answer the Big Question in a sentence or two: Where can I find reliable information about costs and benefits of using geothermal energy? Problem-Based Learning Project: Research the costs and benefits of geothermal energy.
- Use one of today's words in a sentence of your own.

Activity pages

- Activity Page 16.1: Geothermal Energy Costs and Benefits — Teacher Guide PDF page 157

Lesson 17: Energy Resource Innovations

THE BIG QUESTION

What other energy resources are being developed?
Problem-Based Learning Project: Research the costs and benefits of new developments in energy resources.

Words to know

- **biofuel** — a combustible (burnable) fuel made from the remains of recently living organisms
- **hybrid** — a combination of two types; a vehicle that uses two different sources of fuel
- **fuel cell** — a device in which a chemical reaction takes place to produce electricity, similar to a battery
- **ferment** — to go through a chemical change breaking down an energy-rich compound
- **permafrost** — a permanently frozen layer of Earth
- **regenerative braking** — technology that generates electricity from energy transferred when brakes slow down a moving vehicle

Teacher's lesson plan

Follow the Teacher Guide, PDF pages 121–126: the steps, materials and timing for this lesson.

Read

Read Student Reader, Chapter 9: “Energy Resource Innovations”: PDF pages 53–58. Look at the pictures and maps together.

Talk it over

1. Are there any fossil fuels that have not yet been utilized as major sources of energy for human activities?
2. What are some examples of humans using their bodies to generate electricity?
3. Why is methane a problem when it enters the atmosphere?
4. Gasoline is burned in a car engine. Biofuel is burned in another car engine. Which one is “cleaner” in terms of the effects on the atmosphere?
5. Corn plants (not corn) and sugarcane can be processed into biofuels, but what is the potential problem with turning this into a large-scale industry?
6. How does a non-plug-in hybrid get energy?
7. How does a plug-in hybrid work?
8. Which of the vehicles described on the page releases the fewest emissions?

9. Even if electric vehicles are using energy that comes from fossil fuels being burned at a power plant somewhere miles away, what is the environmental benefit of using electric motors instead of gas-burning engines?
10. Imagine walking on a sidewalk that “gives” a little bit under your feet. Do you think this is worthwhile if it produces some electricity?
11. Can you think of some ways that the technology of the sidewalk could be applied to other human activities so that they are less physically difficult?
12. Is this hydroelectric power, such as that generated by a dam?
13. Harnessing wave energy is a bit like harnessing wind energy in terms of where you would need to set up the equipment. Why?

Answers are at the back of this pack.

Check for understanding

- Answer the Big Question in a sentence or two: What other energy resources are being developed? Problem-Based Learning Project: Research the costs and benefits of new developments in energy resources.
- Use one of today’s words in a sentence of your own.

Activity pages

- Activity Page 17.1: Check — Teacher Guide PDF page 158

UNIT REVIEW

Unit review and assessment

- Activity page answer key (for the teacher): Teacher Guide PDF pages 162–167
- Activity Page UC.1 — Teacher Guide PDF page 159
- Activity Page UC.2 — Teacher Guide PDF page 160
- Activity Page UC.3 — Teacher Guide PDF page 161

WORDS QUIZ

Using Natural Resources for Energy

Name: _____ Date: _____

Circle the letter of the best answer.

- 1.** Which word means “a resource that cannot be restored as quickly as it is used”?
 - a) nonrenewable resource
 - b) solar power
 - c) greenhouse gas
 - d) cost-effective
- 2.** Which word means “a gas that traps heat in Earth’s atmosphere”?
 - a) greenhouse gas
 - b) fossil fuel
 - c) biofuel
 - d) electricity
- 3.** Which word means “energy produced by the splitting of atoms, tiny particles of matter”?
 - a) nuclear energy
 - b) hybrid
 - c) solar power
 - d) biofuel
- 4.** Which word means “a device that converts sunlight to electricity”?
 - a) solar cell
 - b) nonrenewable resource
 - c) renewable resource
 - d) solar power
- 5.** Which word means “a form of energy resulting from the flow of charged particles”?
 - a) cost-effective
 - b) fuel cell
 - c) hydroelectric power
 - d) electricity
- 6.** Which word means “a resource that can be restored more quickly than it is used up”?
 - a) fossil fuel
 - b) solar cell
 - c) solar power
 - d) renewable resource

- 7.** Which word means “many wind turbines installed together in an area to generate electricity for a community”?
- a) geothermal energy
 - b) solar cell
 - c) cost-effective
 - d) wind farm
- 8.** Which word means “a device in which a chemical reaction takes place to produce electricity, similar to a battery”?
- a) nuclear energy
 - b) geothermal energy
 - c) wind farm
 - d) fuel cell
- 9.** Which word means “describing the balance of factors when benefits outweigh costs”?
- a) renewable resource
 - b) fossil fuel
 - c) cost-effective
 - d) nonrenewable resource
- 10.** Which word means “energy produced by heat that is transferred from Earth’s interior”?
- a) wind farm
 - b) nuclear energy
 - c) geothermal energy
 - d) hydroelectric power
- 11.** Which word means “electricity generated by the energy in moving water, usually through a dam”?
- a) electricity
 - b) hydroelectric power
 - c) solar power
 - d) solar cell
- 12.** Which word means “a fuel formed from the fossilized remains of organisms”?
- a) nonrenewable resource
 - b) cost-effective
 - c) fossil fuel
 - d) solar cell

Answers

Lesson 1: Introduction to Cost-Benefit Analysis

1. **sticky notes (2 per student) What Is a Cost-Benefit Analysis?**
AP 1.2
2. **Why would a longer lunch period be good?**
Gives students more time to eat and burn off their energy
3. **Why would a longer lunch period be bad?**
Cuts into learning time
4. **A cost-benefit analysis looks at any possible alternatives to a solution.**
SUPPORT—Ask: Why is it important to look at the alternatives to a solution?
So you can see if there are better solutions that weren't thought of yet

Lesson 2: Renewable and Nonrenewable Resources

1. **why the resources are harmful CHALLENGE—Draw student attention to the illustrations on pages 5 and 7. Ask: What kind of negative effects do you think oil spills from extracting petroleum and pollution from burning coal can have?**
They can harm animals that live in the sea; they can pollute seawater.
2. **What are examples of renewable energy sources?**
Wind, solar, geothermal
3. **What is the percentage of renewable energy that people use?**
Ten percent
4. **What is the most widely used type of energy by humans?**
Fossil fuels
5. **What are the benefits of using renewable energy?**
No emissions, better for climate, can decrease pollution, better for health and environment, reliable and will not run out
6. **What are some downsides of using renewable energy sources?**
More difficult to generate as much power; disruption of ecosystems and habitats; intermittent availability of energy
7. **Where do fossil fuels come from?**
Inside Earth's crust
8. **Are fossil fuels renewable or nonrenewable?**
Nonrenewable
9. **How do humans use fossil fuels?**
Powering their homes, heating, transportation
10. **What happens if we run out of fossil fuels?**
It will take a long time for fossil fuels to replenish themselves since they are not renewable.

11. **How are fossil fuels bad for the environment?**
They cause pollution and emit greenhouse gases.
12. **What are some examples of fossil fuels that you read about?**
Coal, petroleum, natural gas
13. **What does this game show you about how renewable energy is used?**
It can be replenished; we keep getting more energy to use.
14. **What did you learn about using your energy?**
The more energy we had left over, the more energy was replenished; the more energy we used, the less energy was replenished.
15. **What happened if you used up all of your energy during one of the rounds?**
We didn't get any more energy.
16. **Why is it important to know where to find renewable and nonrenewable resources in daily life?**
So we know how much of them we are using
17. **Do you think there are ways that the local community can use more renewable resources and fewer nonrenewable resources?**
Yes

Lesson 4: Types of Fossil Fuels

1. **What are renewable resources?**
Resources that can be replenished and that do not run out
2. **What are nonrenewable resources?**
Resources that cannot always be replenished because they run out
3. **What are examples of renewable resources?**
Sunlight, wind, water, geothermal heat
4. **What are examples of nonrenewable resources?**
Natural gas, coal, nuclear power
5. **What does it mean if a resource is in abundance?**
There is a lot of it.
6. **What are the three main types of fossil fuels?**
Petroleum, coal, and natural gas
7. **What do these types of fossil fuels have in common?**
They are found in Earth; they are nonrenewable resources; they are all used for energy.
8. **How do these types of fossil fuels differ?**
They are formed in different ways.
9. **How are fossil fuels used in everyday life?**
Transportation, industry, plastic products, makeup, medicine
10. **What are some activities that you participate in that use fossil fuels?**
Driving to school or riding the bus; using electricity; playing with toys that were made using fossil fuels

11. **Do you see fossil fuels being used in the local community?**

Yes

12. **Which kind of fossil fuel formation did you portray in your picture?**

Can you describe how that fossil fuel is formed?

Lesson 5: Using Fossil Fuels

1. **What are the three main types of fossil fuels?**

Petroleum/oil, natural gas, coal

2. **Where are fossil fuels found?**

Inside Earth

3. **Are fossil fuels renewable or nonrenewable sources of energy?**

Nonrenewable

4. **What are some examples of ways that people use fossil fuels?**

Transportation, electricity, heating/cooling, making things

5. **52 Is transporting oil a cost or a benefit or both? Why?**

It is both. Transporting oil is very expensive, and it can result in dangerous spills. Those are costs. However, it also gets it to where people can use it to meet their energy needs. That is a benefit.

6. **Have you ever had to make a decision and you didn't know whether an answer was right or wrong?**

Most students will likely answer yes.

7. **What were you trying to decide?**

Encourage volunteers to give details.

8. **Did you make a list of the things that were good about the decision and the things that were bad about the decision?**

Most students will likely reply that they did not; encourage them to think about doing this in the future.

9. **What are the costs and benefits associated with how the fossil fuels are extracted?**

Example benefit: They create jobs. Example risk: Some of them can leak out and pollute the ground.

10. **What are the costs and benefits associated with how the fossil fuels are transported?**

Example benefit: They create jobs. Example risk: Some of them can leak out and pollute the area around them.

11. **What are the costs and benefits associated with burning the fossil fuels?**

Example benefit: They create energy that can fuel things. Example risk: They can pollute the air, water, and ground.

12. **Where does coal come from?**

Earth; mines

13. **In what form is coal found?**
Solid
14. **What do people do with coal in its original form?**
Burn it for heat
15. **What kind of impact do you think this event had on the environment?**
It had a negative impact on the environment because so much oil was spilled; it harmed ocean organisms; it polluted the ocean.
16. **Do you think disasters like these should stop people from drilling for oil? Why or why not?**
Accept all thoughtful answers.
17. **Which liquids need more processing for them to be useful?**
Heavier liquids
18. **What does cracking do?**
It turns heavy oil into lighter fluids.
19. **What is reforming?**
A process that increases the amount of gasoline produced from crude oil
20. **What role do molecules play in oil refinement?**
The molecules are being changed so the oil can be used for different things.

Lesson 6: Researching Fossil Fuels

1. **What are the three main fossil fuels?**
Natural gas, petroleum, coal
2. **How are fossil fuels, which contain chemical energy, converted to forms of energy that humans want?**
They are burned.
3. **What are other uses for fossil fuels?**
Plastics and other products can be made from petroleum.
4. **What are some short-term benefits of burning coal?**
Provides heat, which can be used directly or be used to power a generator to provide electricity
5. **What are some long-term benefits of using coal?**
Abundant resource, inexpensive, found in many locations around the world, easy to transport
6. **What are some short- and long-term costs of using coal?**
Short term: poor air quality; long term: too much carbon in the atmosphere/global warming, mercury in water and wildlife, other coal-related pollution and environmental problems

Lesson 7: Nuclear Energy

1. **In what forms does energy leave the power plant?**
Heat and electricity

2. **Does any matter leave the power plant as a result of the chain reaction?**
No, it shouldn't. If an accident occurs, then it might. Otherwise, matter should be recycled within the plant until the control rods are spent.
3. **If Earth has a lot of uranium that has not yet been mined or enriched, why isn't nuclear power considered renewable?**
The amounts of those materials are limited, and it's very expensive to mine and enrich them.
4. **How does the radioactivity of nuclear waste factor into nuclear power being called nonrenewable?**
The waste needs to be handled very carefully, stored in secure locations, and then left alone for a very long time.
5. **What are two of the main benefits of using nuclear power to generate electricity?**
Get lots of energy from a small amount of matter, no greenhouse gas emissions
6. **What are two of the main costs of nuclear power?**
Dangerous materials both during and after their use, limited amount of expensive material

Lesson 8: Researching Nuclear Power

1. **What is the actual fuel for nuclear power?**
An enriched unstable material such as uranium-235
2. **How is the energy released by a nuclear reaction converted into electricity?**
Heat produced by the reaction boils water, which becomes steam, which passes through a turbine, which is connected to a generator.
3. **How is nuclear power good for the environment?**
It doesn't produce carbon emissions.
4. **What are the environmental costs of nuclear power?**
Accidents can release harmful radiation; explosions can destroy large areas of Earth's surface.
5. **How does nuclear power compare to fossil fuels in terms of usefulness in transportation and everyday activities?**
It is much less practical because nuclear reactors are large, expensive, heavily regulated, and dangerous. You cannot have a nuclear reactor in a car or in a backyard power generator.
6. **How do the environmental benefits of nuclear power relate to the environmental costs of fossil fuels?**
Nuclear power does not have the carbon emissions that fossil fuel power has.
7. **What is one way in which the waste produced by nuclear power is more of a problem than the waste or by-products of fossil fuel use?**
Nuclear waste remains radioactive and dangerous for a very long time, requiring secure storage. Fossil fuel by-products are less hazardous, and some can even be useful for other purposes.

Lesson 9: Wind Energy

1. **Why do you think a small island would be a good place for using wind energy?**

Plenty of wind off the water

2. **Why might renewable energy resources such as wind and solar be especially useful in this kind of place?**

Limited and expensive access to fossil fuels, environmental risks of relying on fossil fuels

3. **Why does the story on the page specify that wind power is good for the afternoon? Why not all the time?**

Wind isn't always available or strong enough to turn the turbines.

4. **What kinds of constraints might be placed on a turbine's design by the environment?**

How much wind it needs to handle, waves or other forces that may strike the tower, temperature changes, storms

5. **What kinds of constraints or criteria might people place on a wind farm that's being planned?**

They might not want to see it or hear the turbines or worry about crashing boats into them. They might also want a plan in place to repair a turbine in the event that one breaks down or falls.

6. **What are the benefits of using wind power?**

Renewable energy source, no pollution

7. **What are the costs of using wind power?**

Wind farms can take up a lot of space and make it off-limits for other activities, and wind isn't always abundant or strong enough to generate much power.

Lesson 10: Researching Use of Wind Turbines

1. **What kinds of environments are good for harnessing wind energy?**

Relatively open areas with steady breezes, such as coastal areas or plains

2. **What is the name of the machine that converts wind energy into electricity?**

A turbine with a generator

3. **What is the difference between a windmill and a wind turbine?**

A windmill does not convert mechanical energy into electricity. A turbine does.

4. **How is wind power good for the environment?**

It doesn't produce carbon emissions. It doesn't use fossil fuels.

5. **What are the environmental costs of wind power?**

It can harm wildlife, especially birds; construction of towers can damage and alter natural habitats.

6. **Can wind power be used in the transportation industry?**

Only if it is used to charge batteries or provide electricity to vehicles powered by electrified tracks or wires

7. **How do the environmental benefits of wind power compare to the environmental costs of fossil fuels?**

Wind power does not have the carbon emissions that fossil fuel power has.

8. **How is wind power used in this area? If it isn't used, why not?**

Answers will vary but should reflect whether and how wind power is being used in the area.

Lesson 11: Hydroelectric Energy

1. **What takes more time and money to set up—a small gas-powered generator or a hydroelectric turbine?**

Hydroelectric turbine

2. **Why might a renewable energy solution such as a hydroelectric dam be cost effective in the long run compared to the gas-powered generator?**

Hydropower is renewable. It doesn't require a fuel. As long as there is flowing water and the components of the system work, the energy basically has an ongoing and renewable source.

Lesson 12: Researching Use of Hydroelectric Power

1. **What do you need for hydroelectric energy to be a large-scale provider of electricity?**

Large volume of moving water or a reservoir that can be drained

2. **What is the name of the machine that converts the energy of motion in moving water into electricity?**

A turbine with a generator

3. **What is the difference between a water mill and a hydroelectric turbine?**

A water mill does not convert mechanical energy into electricity; it just uses the mechanical energy to move machinery. A turbine does convert mechanical energy into electricity.

4. **How do you think the scale of a hydroelectric power project affects how cost effective it is?**

Larger projects are less likely to pay off in the short term but more likely to pay off in the long run.

5. **What are the environmental costs of hydroelectric power facilities that use dams?**

The dams block fish migrations, flood upriver areas, and reduce flow and volume downriver.

6. **What are the environmental costs of hydroelectric power facilities that do not use dams but instead have turbines or wheels installed in naturally flowing bodies of water?**

Their costs are much lower. They do not alter the flow of the water as much, nor do they interfere with wildlife as much as dams.

7. **How do the environmental benefits of hydroelectric power compare to the environmental costs of fossil fuels?**

Hydroelectric power does not have the carbon emissions that fossil fuel power releases, but it does affect natural habitats, including the rivers that are often dammed to generate hydroelectric power.

8. **How is hydroelectric power used in this area? If it isn't used, why not?**

Answers will vary.

Lesson 13: Solar Energy

1. **What are some other things that can be heated or powered by passive solar power?**

Water heaters, some homes and businesses, etc.

2. **What are some other solar-powered devices?**

Cell phone chargers, flashlights, reading lamps, walkway lights, stop signs, wireless speakers, etc.

3. **How is wind related to solar energy?**

Wind is a result of solar energy causing uneven heating of different areas of Earth's surface.

4. **How is thermal energy related to solar energy?**

Thermal energy, which is heat present in the atmosphere, geosphere, and hydrosphere, is largely a product of solar energy that has been absorbed and then moved through different substances, including air and water.

5. **How are fossil fuels related to solar energy?**

The fossil fuels we rely so much on are forms of chemical energy that organisms made from sunlight long ago.

6. **What is the most basic problem with relying on solar energy to provide all your energy needs?**

The sun goes down at night. For about half the time, there is no sunlight available at all.

7. **What other geographical factors affect how much sunlight strikes a given area?**

Latitude. Areas near the equator get more direct sunlight, and it is more consistent throughout the year. Areas near the poles can go months with little sunlight and months almost without night. Sunlight is very variable/extreme near the poles.

8. **What other factors limit the exposure of Earth's surface to sunlight?**

Cloud cover, trees, mountains, buildings

9. **What kinds of terrain do you think are good for placing a large number of solar panels?**

Relatively flat areas of land that aren't covered with trees

Lesson 14: Researching Use of Solar Energy

1. **What are three different ways of using solar energy?**

Passive solar to heat a home, photovoltaic panels to make electricity, and

concentrated solar thermal to power a turbine and generator

2. **What is the major drawback of solar power in some locations?**

Not many hours of sunlight, cloudy weather

3. **What is one problem with photovoltaic technology that has prevented solar power from being a bigger producer of electricity?**

It's not very efficient.

4. **What are the costs and benefits of a large-scale solar power facility such as a concentrated solar thermal plant or a huge solar array farm in the desert?**

Big projects cost a lot of money up front but are more likely to pay off in the long run, and they can service more people/homes, too.

5. **What can be done to make more use of solar energy in areas that have short days in the winter?**

Batteries could store power generated during the daylight hours. Solar thermal can run into the night using residual heat.

6. **How do the environmental benefits of solar power compare to the environmental costs of fossil fuels?**

Both nuclear and nonrenewables have some environmental costs related to the mining and manufacture of materials, but solar has very few negative environmental impacts.

7. **How is solar power used in this area? If it isn't used, why not?**

Answers will vary.

8. **What are some secondary benefits of using solar arrays?**

They can shade parking lots and rooftops, making them cooler.

Lesson 15: Geothermal Energy

1. **What is the overall share of the United States' electricity generation by nonrenewable energy resources?**

Eighty-three percent

2. **Where does geothermal energy rank among the renewables in terms of its share of electricity generation?**

Last

3. **How much more is natural gas used to make electricity than geothermal energy in the U.S.?**

Eighty times more

Lesson 16: Researching Use of Geothermal Energy

1. **What do engineers need to look for and tap into to generate electricity from geothermal energy?**

A source of heat in rock and soil not too far below Earth's surface

2. **How is geothermal energy used in a similar way to other energy resources?**

Heat is used to make steam that spins a turbine that powers a generator.

3. **What is the advantage of using a geothermal reservoir that consists of steam that can be used directly in a turbine?**
It's the most direct way to use the energy to make electricity. There's no need for heat-exchanging pipes or fluids.
4. **What is the advantage of recycling wastewater in an abandoned oil field to generate electricity?**
It makes use of something that is already there, including the wastewater.
5. **How do the environmental benefits of geothermal energy compare to the environmental costs of fossil fuels?**
Carbon emissions are a major environmental cost of fossil fuel use. Lack of carbon emissions is a major benefit of geothermal energy use.
6. **Is geothermal energy used very widely in your area? If not, why?**
Answers will vary. States with volcanic activity or plate boundaries are more likely to have large-scale geothermal energy use.

Lesson 17: Energy Resource Innovations

1. **Are there any fossil fuels that have not yet been utilized as major sources of energy for human activities?**
Answers will vary. Some students may have heard about methane hydrates, though this is unlikely. Others may discuss biofuels, but these are not fossil fuels.
2. **What are some examples of humans using their bodies to generate electricity?**
Students may mention exercise bikes whose electronics are powered by the moving pedals or wind-up toys and rechargeable devices that can be wound by hand.
3. **Why is methane a problem when it enters the atmosphere?**
It is a powerful greenhouse gas, meaning it traps heat against Earth's surface.
4. **Gasoline is burned in a car engine. Biofuel is burned in another car engine. Which one is "cleaner" in terms of the effects on the atmosphere?**
They are the same—the fuels are burned, emitting carbon.
5. **Corn plants (not corn) and sugarcane can be processed into biofuels, but what is the potential problem with turning this into a large-scale industry?**
It requires a lot of farmland. If a natural habitat such as a rain forest is cut down to make farmland for the biofuel industry, then the overall effect on the environment is negative.
6. **How does a non-plug-in hybrid get energy?**
Burning gasoline for a gas engine, and capturing energy through the brakes to power an electric motor and charge a battery
7. **How does a plug-in hybrid work?**
It works the same as a hybrid except that the battery is charged by plugging into an electrical outlet instead of or in addition to using regenerative braking.
8. **Which of the vehicles described on the page releases the fewest emissions?**
The plug-in electric

9. **Even if electric vehicles are using energy that comes from fossil fuels being burned at a power plant somewhere miles away, what is the environmental benefit of using electric motors instead of gas-burning engines?**

There is less pollution right there where the car is being used. This can mean cleaner air where people and vehicles are, such as congested roadways and cities.

10. **Imagine walking on a sidewalk that “gives” a little bit under your feet. Do you think this is worthwhile if it produces some electricity?**

Answers will vary. Some people will find it awkward or even dangerous to walk on such a surface.

11. **Can you think of some ways that the technology of the sidewalk could be applied to other human activities so that they are less physically difficult?**

Answers will vary but are likely to center on exercise equipment. As long as people’s motions feel natural and they get a good workout, they will probably feel good about generating electricity.

12. **Is this hydroelectric power, such as that generated by a dam?**

Yes and no. The force of gravity is not the driver here. Wave action is, so it is not the same as what occurs in a hydroelectric dam.

13. **Harnessing wave energy is a bit like harnessing wind energy in terms of where you would need to set up the equipment. Why?**

You would want to harness it in areas with plenty of the energy resources [lots of waves or wind] but not too much, because too much could damage or destroy the technology that is needed to convert the energy of motion into electrical energy.

Unit quiz key

1. a 2. a 3. a 4. a 5. d 6. d 7. d 8. d 9. c 10. c 11. b 12. c