

Grade 4 Science

Unit 1: Energy Transfer and Transformation

13 lessons and a unit quiz. Use this pack with the **Energy Transfer and Transformation 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: Energy Causes Change	PDF pages 7-12	AP 1.1
☐	Lesson 2: Forms of Energy	—	AP 2.1, AP 2.2
☐	Lesson 3: Moving Objects Have Energy	PDF pages 13-18	AP 3.1
☐	Lesson 4: Investigating Energy and Speed	—	AP 4.1, AP 4.2
☐	Lesson 5: Energy and Speed Are Related	PDF pages 19-22	—
☐	Lesson 6: Sound Transfers Energy	—	AP 6.1
☐	Lesson 7: Energy Transfer	PDF pages 23-30	AP 7.1
☐	Lesson 8: Investigating Energy Transfer	—	AP 8.1
☐	Lesson 9: Evidence of Energy Transfer	—	AP 9.1, AP 9.2
☐	Lesson 10: Collisions Transfer Energy	PDF pages 31-36	AP 10.1
☐	Lesson 12: How Can Energy Transformations Solve Problems?	PDF pages 37-42	AP 12.1
☐	Lesson 13: Designing Devices to Transform Energy	—	AP 13.1, AP 13.2, AP 13.3, AP 13.4, AP 13.5, AP 13.6
☐	Lesson 14: Solving Problems and Designing Solutions: Thomas A. Edison	PDF pages 43-48	—
☐	Unit review and assessment	—	AP UR.1
☐	Words quiz	—	—

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

Lesson 1: Energy Causes Change

THE BIG QUESTION

Where can we observe evidence of energy causing change?

Words to know

- **energy** — the ability to cause change
- **motion** — the process of an object changing position
- **energy transfer** — movement of energy from one object to another or from one place to another
- **sound** — a form of energy that comes from a vibrating object
- **electrical energy** — the flow of electrons from one location to another
- **evidence** — anything that helps prove or disprove an idea
- **forms of energy** — the different forms energy can be found in, such as light or heat
- **heat** — a form of energy caused by the movement of atoms or molecules
- **light** — a form of energy caused by the movement of photons, which are little packets of energy
- **position** — the place an object occupies
- **transform** — to change the appearance or form of something; see also energy transformation

Teacher's lesson plan

Follow the Teacher Guide, PDF pages 24–28: the steps, materials and timing for this lesson.

Read

Read Student Reader, Chapter 1: “Energy Causes Change”: PDF pages 7–12. Look at the pictures and maps together.

Talk it over

1. How does the pencil change?
2. How does the pencil sharpener change?
3. What makes the changes happen?
4. How does the rocket change?
5. How does the area around the rocket change?
6. How are the examples similar?

Answers are at the back of this pack.

Check for understanding

- Answer the Big Question in a sentence or two: Where can we observe evidence of energy causing change?
- Use one of today's words in a sentence of your own.

Activity pages

- Activity Page 1.1: Energy Scavenger Hunt — Teacher Guide PDF page 107

Lesson 2: Forms of Energy

THE BIG QUESTION

What are some forms of energy?

Words to know

- **cause and effect** — is a relationship in which one thing makes another thing happen change. v. to become different
- **energy** — the ability to cause change
- **sound** — a form of energy that comes from a vibrating object
- **electricity** — a form of energy caused by the movement of electrons
- **forms of energy** — the different forms energy can be found in, such as light or heat
- **heat** — a form of energy caused by the movement of atoms or molecules
- **light** — a form of energy caused by the movement of photons, which are little packets of energy
- **model** — a helpful tool for representing an idea or explaining a process or relationship

Teacher's lesson plan

Follow the Teacher Guide, PDF pages 29–33: the steps, materials and timing for this lesson.

Talk it over

1. to describe what they observed in terms of cause and effect. What is the cause?
2. to describe what they observe. (The wax melts and drips, and then it solidifies again on the paper.) What is the cause?

Answers are at the back of this pack.

Check for understanding

- Answer the Big Question in a sentence or two: What are some forms of energy?
- Use one of today's words in a sentence of your own.

Activity pages

- Activity Page 2.1: Surprise! — Teacher Guide PDF page 108
- Activity Page 2.2: Energy Causes Change — Teacher Guide PDF page 109

Lesson 3: Moving Objects Have Energy

THE BIG QUESTION

How are energy, change, and movement of objects related?

Words to know

- **cause and effect** — is a relationship in which one thing makes another thing happen change. v. to become different
- **energy** — the ability to cause change
- **motion** — the process of an object changing position
- **energy of motion** — the energy an object possesses while it is moving
- **distance** — amount of space between two objects
- **energy change** — the conversion of one form of energy into one or more other forms of energy

Teacher's lesson plan

Follow the Teacher Guide, PDF pages 35–38: the steps, materials and timing for this lesson.

Read

Read Student Reader, Chapter 2: “Moving Objects Have Energy”: PDF pages 13–18. Look at the pictures and maps together.

Check for understanding

- Answer the Big Question in a sentence or two: How are energy, change, and movement of objects related?
- Use one of today's words in a sentence of your own.

Activity pages

- Activity Page 3.1: On the Move — Teacher Guide PDF page 110

Lesson 4: Investigating Energy and Speed

THE BIG QUESTION

How are energy and speed related?

Words to know

- **energy** — the ability to cause change
- **motion** — the process of an object changing position
- **speed** — a measurement of the distance an object travels over an amount of time
- **position** — the place an object occupies
- **variable** — something that is changed or is not consistent

Teacher's lesson plan

Follow the Teacher Guide, PDF pages 39–44: the steps, materials and timing for this lesson.

Talk it over

1. How do you know it had energy of motion?
2. Which time was the ball moving faster when it hit the sand?
3. Which time did the ball have more energy of motion when it hit the sand?
4. What evidence is there to indicate that the ball with more speed had more motion energy?

Answers are at the back of this pack.

Check for understanding

- Answer the Big Question in a sentence or two: How are energy and speed related?
- Use one of today's words in a sentence of your own.

Activity pages

- Activity Page 4.1: Ramp It Up! (Day 1) — Teacher Guide PDF page 111
- Activity Page 4.2: Drop It (Day 2) — Teacher Guide PDF page 112

Lesson 5: Energy and Speed Are Related

THE BIG QUESTION

How are energy and speed related?

Words to know

- **energy of motion** — the energy an object possesses while it is moving
- **speed** — a measurement of the distance an object travels over an amount of time
- **evidence** — anything that helps prove or disprove an idea

Teacher's lesson plan

Follow the Teacher Guide, PDF pages 45–50: the steps, materials and timing for this lesson.

Read

Read Student Reader, Chapter 3: “Energy and Speed Are Related”: PDF pages 19–22. Look at the pictures and maps together.

Talk it over

1. How were the results of today's demonstration similar to the results of your investigation in the last lesson?
2. How were the results different?
3. What happened to the motion energy of the ball when it hit the blocks?
4. Why did the ball slow down when the blocks started to move?
5. Reinforce, through discussion and additional context for vocabulary, that the greater an object's speed, the more energy that object has. Refer to the ball and blocks examples as evidence. Ask: How does motion energy relate to speed?

Answers are at the back of this pack.

Check for understanding

- Answer the Big Question in a sentence or two: How are energy and speed related?
- Use one of today's words in a sentence of your own.

Lesson 6: Sound Transfers Energy

THE BIG QUESTION

What evidence shows that sound transfers energy from one place to another?

Words to know

- **energy transfer** — movement of energy from one object to another or from one place to another
- **sound** — a form of energy that comes from a vibrating object
- **transfer** — to move from one place to another

Teacher's lesson plan

Follow the Teacher Guide, PDF pages 52-56: the steps, materials and timing for this lesson.

Talk it over

1. How is this an example of energy causing a change?
2. What evidence was there that sound transferred energy from place to place?

Answers are at the back of this pack.

Check for understanding

- Answer the Big Question in a sentence or two: What evidence shows that sound transfers energy from one place to another?
- Use one of today's words in a sentence of your own.

Activity pages

- Activity Page 6.1: Check — Teacher Guide PDF page 113

Lesson 7: Energy Transfer

THE BIG QUESTION

What evidence shows that energy transfers from place to place?

Words to know

- **cause and effect** — is a relationship in which one thing makes another thing happen change. v. to become different
- **energy transfer** — movement of energy from one object to another or from one place to another
- **evidence** — anything that helps prove or disprove an idea
- **forms of energy** — the different forms energy can be found in, such as light or heat

Teacher's lesson plan

Follow the Teacher Guide, PDF pages 57–61: the steps, materials and timing for this lesson.

Read

Read Student Reader, Chapter 4: “Energy Transfer”: PDF pages 23–30. Look at the pictures and maps together.

Talk it over

1. What is energy transfer?
2. What evidence shows that energy has transferred?
3. What changes when energy transfers?
4. What different forms of energy are in the hydroelectric power plant?
5. What evidence shows that energy was transferred in this example?
6. Is light a way in which energy is transferred?
7. How do you know energy is involved?
8. Why does the plate spin?
9. What observations can you make as evidence that electricity transfers energy?
10. What are some other examples of energy transfer that happen every day?
11. Did you read about any of these examples in the chapter?

Answers are at the back of this pack.

Check for understanding

- Answer the Big Question in a sentence or two: What evidence shows that energy transfers from place to place?
- Use one of today's words in a sentence of your own.

Activity pages

- Activity Page 7.1: Check — Teacher Guide PDF page 114

Lesson 8: Investigating Energy Transfer

THE BIG QUESTION

What evidence shows that light, heat, and electricity transfer energy from place to place?

Words to know

- **energy transfer** — movement of energy from one object to another or from one place to another
- **electricity** — a form of energy caused by the movement of electrons
- **heat** — a form of energy caused by the movement of atoms or molecules
- **light** — a form of energy caused by the movement of photons, which are little packets of energy

Teacher's lesson plan

Follow the Teacher Guide, PDF pages 62–65: the steps, materials and timing for this lesson.

Talk it over

1. At the station with the hot plate, were you seeing how heat transfers to colder objects or how cold transfers to warmer objects?

Answers are at the back of this pack.

Check for understanding

- Answer the Big Question in a sentence or two: What evidence shows that light, heat, and electricity transfer energy from place to place?
- Use one of today's words in a sentence of your own.

Activity pages

- Activity Page 8.1: Investigating Energy Transfer — Teacher Guide PDF pages 115–117

Lesson 9: Evidence of Energy Transfer

THE BIG QUESTION

What evidence shows that energy is transferred from place to place?

Words to know

- **energy** — the ability to cause change
- **energy transfer** — movement of energy from one object to another or from one place to another
- **claim** — a statement that answers a question or poses a solution to a problem collide. v. to come together with impact
- **sound** — a form of energy that comes from a vibrating object
- **electricity** — a form of energy caused by the movement of electrons
- **evidence** — anything that helps prove or disprove an idea
- **heat** — a form of energy caused by the movement of atoms or molecules
- **light** — a form of energy caused by the movement of photons, which are little packets of energy
- **observation** — the act of noting or viewing something
- **reasoning** — a scientific mindset that connects claims and evidence

Teacher's lesson plan

Follow the Teacher Guide, PDF pages 66–69: the steps, materials and timing for this lesson.

Talk it over

1. What are the forms of energy in these examples?
2. What are the sources of energy in these examples?
3. How are these examples similar to what you observed during the previous lesson's investigations?
4. What evidence do these examples provide that energy moves from place to place?

Answers are at the back of this pack.

Check for understanding

- Answer the Big Question in a sentence or two: What evidence shows that energy is transferred from place to place?
- Use one of today's words in a sentence of your own.

Activity pages

- Activity Page 9.1: Examples of Energy Transfer — Teacher Guide PDF page 118

- Activity Page 9.2: Claims, Evidence, and Reasoning About Energy Transfer — Teacher Guide PDF pages 119-120

Lesson 10: Collisions Transfer Energy

THE BIG QUESTION

How is energy involved in collisions?

Words to know

- **energy** — the ability to cause change
- **motion** — the process of an object changing position
- **speed** — a measurement of the distance an object travels over an amount of time
- **energy transfer** — movement of energy from one object to another or from one place to another
- **collision** — an instance of colliding
- **sound** — a form of energy that comes from a vibrating object
- **contact** — to be physically touching
- **position** — the place an object occupies
- **transfer** — to move from one place to another

Teacher's lesson plan

Follow the Teacher Guide, PDF pages 71–83: the steps, materials and timing for this lesson.

Read

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

Talk it over

1. What happens to the cars?
2. How does the collision change the motion of each car?
3. What other forms of energy does the collision transform the motion energy of the cars to?
4. Will the speed of the cars change? How?
5. Will the cars move the same way after the collision?
6. Will the second collision sound the same as the first?
7. What happens to the car?
8. What happens to the modeling clay?
9. Is there evidence of a change happening?
10. What happens to the modeling clay in this trial?
11. Did this collision transfer more or less energy than the first trial?
12. What evidence supports your answer?

13. How did your prediction compare to the trial result?
14. What pattern might you see if we kept using taller and taller ramps?
15. Will the sound be different between each collision?
16. What will be the difference in sound between each collision?
17. Which cars were used in each collision?
18. When you watched each of the two cars collide with the clay, how did their impacts differ?
19. What do you already know about collisions?
20. What happens to the motion energy of the objects that initiate a collision?
21. Have you ever performed a test before? What kind?
22. What were you trying to find out?

Answers are at the back of this pack.

Check for understanding

- Answer the Big Question in a sentence or two: How is energy involved in collisions?
- Use one of today's words in a sentence of your own.

Activity pages

- Activity Page 10.1: Check — Teacher Guide PDF page 121

Lesson 12: How Can Energy Transformations Solve Problems?

THE BIG QUESTION

How do energy transformations help people?

Words to know

- **conversion** — the process of being converted or changing form
- **energy transformation** — the change of one form of energy to another form of energy
- **engineering design** — a process used to develop a solution to a problem
- **design problem** — a problem for which a design solution should be applied
- **design solution** — the method someone develops to solve a design problem
- **forms of energy** — the different forms energy can be found in, such as light or heat

Teacher's lesson plan

Follow the Teacher Guide, PDF pages 85–90: the steps, materials and timing for this lesson.

Read

Read Student Reader, Chapter 6: “How Can Energy Transformations Solve Problems?”: PDF pages 37–42. Look at the pictures and maps together.

Talk it over

1. What problem does a (toaster, wind-up clock, etc.) solve?
2. How does a () use energy transformation?
3. What are some factors engineering designers had to consider when they were designing the ()?
4. What other factors not listed might an engineering designer need to consider?
5. What problems are solved by batteries?
6. How is energy transformation used in the solution to those problems?
7. What additional problems are solved by rechargeable batteries?

Answers are at the back of this pack.

Check for understanding

- Answer the Big Question in a sentence or two: How do energy transformations help people?
- Use one of today's words in a sentence of your own.

Activity pages

- Activity Page 12.1: Check — Teacher Guide PDF page 125

Lesson 13: Designing Devices to Transform Energy

THE BIG QUESTION

How can I design a device that transforms energy to solve a problem?

Words to know

- **energy** — the ability to cause change
- **energy transformation** — the change of one form of energy to another form of energy
- **engineering design** — a process used to develop a solution to a problem
- **design solution** — the method someone develops to solve a design problem
- **forms of energy** — the different forms energy can be found in, such as light or heat
- **transform** — to change the appearance or form of something; see also energy transformation

Teacher's lesson plan

Follow the Teacher Guide, PDF pages 91–99: the steps, materials and timing for this lesson.

Talk it over

1. How are you meeting the criteria?
2. What is the problem you are solving?
3. What problems are you having building your device?
4. What were the criteria (limitations)?
5. What was the final form of energy?
6. How did your team build it?
7. How did you refine your device?

Answers are at the back of this pack.

Check for understanding

- Answer the Big Question in a sentence or two: How can I design a device that transforms energy to solve a problem?
- Use one of today's words in a sentence of your own.

Activity pages

- Activity Page 13.1: Device Design Proposal (Day 1) — Teacher Guide PDF pages 126–127
- Activity Page 13.2: Device Test Results (Day 2) — Teacher Guide PDF page 128

- Activity Page 13.3: Device Presentation Plan (Day 3) — Teacher Guide PDF page 129
- Activity Page 13.4: Device Presentation Scoring Guide (Day 4) — Teacher Guide PDF page 130
- Activity Page 13.5: Energy Vocabulary Crossword Puzzle — Teacher Guide PDF page 131
- Activity Page 13.6: Energy Vocabulary Review — Teacher Guide PDF page 133

Lesson 14: Solving Problems and Designing Solutions: Thomas A. Edison

THE BIG QUESTION

How did Thomas Edison use his knowledge of energy transfer and transformation to solve problems?

Words to know

- **energy** — the ability to cause change
- **stored energy** — energy that has the ability to cause change at a later time
- **motion** — the process of an object changing position
- **energy of motion** — the energy an object possesses while it is moving
- **speed** — a measurement of the distance an object travels over an amount of time
- **energy transfer** — movement of energy from one object to another or from one place to another
- **collision** — an instance of colliding
- **sound** — a form of energy that comes from a vibrating object
- **conversion** — the process of being converted or changing form
- **energy transformation** — the change of one form of energy to another form of energy
- **engineering design** — a process used to develop a solution to a problem

Teacher's lesson plan

Follow the Teacher Guide, PDF pages 100–104: the steps, materials and timing for this lesson.

Read

Read Student Reader, Chapter 7: “Solving Problems and Designing Solutions: Thomas A. Edison”: PDF pages 43–48. Look at the pictures and maps together.

Talk it over

1. What problems did Edison try to solve as he designed his light bulb?
2. Think about your home. Where do you find light bulbs in your home?
3. What is an open flame?
4. Why did Edison place the filament inside the bulb?
5. Do you think light bulbs are safer than candles or lanterns?
6. Look closely at the picture of Edison's light bulb. Where do you think the transformation of electrical energy to light energy happens in his device?

7. When a light bulb turns on, what evidence shows that energy has transformed in the light bulb?
8. What energy transformations happen in a modern car?
9. Think about the word persistence. What do you think it means to persist?
10. What advantages and disadvantages does the design of the traditional light bulb have?
11. What advantages and disadvantages does the design of the CFL bulb have?
12. What advantages and disadvantages does the design of the LED bulb have?
13. Which examples in this chapter model Edison's persistence as a designer and an engineer?

Answers are at the back of this pack.

Check for understanding

- Answer the Big Question in a sentence or two: How did Thomas Edison use his knowledge of energy transfer and transformation to solve problems?
- Use one of today's words in a sentence of your own.

UNIT REVIEW

Unit review and assessment

- Unit Assessment (print for your student): Teacher Guide PDF pages 135–142
- How to mark it (for the teacher): Teacher Guide PDF pages 147–148
- Activity page answer key (for the teacher): Teacher Guide PDF pages 143–146
- Activity Page UR.1: Energy’s Big Questions — Teacher Guide PDF page 134

WORDS QUIZ

Energy Transfer and Transformation

Name: _____ Date: _____

Circle the letter of the best answer.

1. Which word means “the process of an object changing position”?
 - a) engineering design
 - b) motion
 - c) sound
 - d) energy transformation
2. Which word means “the energy an object possesses while it is moving”?
 - a) speed
 - b) energy of motion
 - c) conversion
 - d) energy
3. Which word means “the change of one form of energy to another form of energy”?
 - a) energy transformation
 - b) conversion
 - c) sound
 - d) speed
4. Which word means “a statement that answers a question or poses a solution to a problem collide. v. to come together with impact”?
 - a) claim
 - b) stored energy
 - c) cause and effect
 - d) sound
5. Which word means “a measurement of the distance an object travels over an amount of time”?
 - a) motion
 - b) speed
 - c) stored energy
 - d) sound
6. Which word means “the process of being converted or changing form”?
 - a) collision
 - b) sound
 - c) energy of motion
 - d) conversion

- 7.** Which word means “a process used to develop a solution to a problem”?
- a) engineering design
 - b) cause and effect
 - c) energy
 - d) energy of motion
- 8.** Which word means “is a relationship in which one thing makes another thing happen change. v. to become different”?
- a) collision
 - b) sound
 - c) claim
 - d) cause and effect
- 9.** Which word means “movement of energy from one object to another or from one place to another”?
- a) cause and effect
 - b) claim
 - c) energy transfer
 - d) stored energy
- 10.** Which word means “a form of energy that comes from a vibrating object”?
- a) engineering design
 - b) sound
 - c) collision
 - d) energy transformation
- 11.** Which word means “energy that has the ability to cause change at a later time”?
- a) stored energy
 - b) energy of motion
 - c) sound
 - d) energy transformation
- 12.** Which word means “the ability to cause change”?
- a) energy
 - b) energy of motion
 - c) conversion
 - d) engineering design

Answers

Lesson 1: Energy Causes Change

1. **How does the pencil change?**
It becomes shorter, and its tip becomes sharper.
2. **How does the pencil sharpener change?**
It goes from silent to making noise.
3. **What makes the changes happen?**
Electricity from the wall or batteries
4. **How does the rocket change?**
It changes from sitting still to lifting off.
5. **How does the area around the rocket change?**
It fills up with fire and smoke or steam.
6. **How are the examples similar?**
Did you write any examples on your scavenger hunt that are similar to the changes occurring with the rocket launch? How are the examples similar?

Lesson 2: Forms of Energy

1. **to describe what they observed in terms of cause and effect. What is the cause?**
Sound energy
2. **to describe what they observe. (The wax melts and drips, and then it solidifies again on the paper.) What is the cause?**
Heat energy

Lesson 4: Investigating Energy and Speed

1. **How do you know it had energy of motion?**
It caused a change when it hit the sand from either height.
2. **Which time was the ball moving faster when it hit the sand?**
When it was held higher
3. **Which time did the ball have more energy of motion when it hit the sand?**
When it was held higher
4. **What evidence is there to indicate that the ball with more speed had more motion energy?**
The sand moved more when the ball with more speed landed.

Lesson 5: Energy and Speed Are Related

1. **How were the results of today's demonstration similar to the results of your investigation in the last lesson?**
The investigations and demonstration showed that movements from greater heights have greater motion energy.

2. **How were the results different?**

Different materials and different motion energies were used, so some objects were moved more or less than others.

3. **What happened to the motion energy of the ball when it hit the blocks?**

The ball slowed down.

4. **Why did the ball slow down when the blocks started to move?**

Bumping into the blocks decreased the ball's motion energy.

5. **Reinforce, through discussion and additional context for vocabulary, that the greater an object's speed, the more energy that object has. Refer to the ball and blocks examples as evidence. Ask: How does motion energy relate to speed?**

The greater the speed, the greater energy of motion the object will have, provided it is the same object in each case.

Lesson 6: Sound Transfers Energy

1. **How is this an example of energy causing a change?**

The sound waves from tapping the cup pushed air from the cup to the sticky note.

2. **What evidence was there that sound transferred energy from place to place?**

The sticky note was not touched, but it moved.

Lesson 7: Energy Transfer

1. **What is energy transfer?**

Movement of energy from one object to another

2. **What evidence shows that energy has transferred?**

Examples of energy transfer can be seen when a ball moves from a kick, a light comes on from a flashlight, a sound is heard from an explosion, and a cup gets hot when hot soup is poured into it.

3. **What changes when energy transfers?**

The object that is touched moves or changes position.

4. **What different forms of energy are in the hydroelectric power plant?**

The flow of water, a downhill movement, a push on the turbine blades, a transfer of energy to the generator, and electrical energy to the power plant

5. **What evidence shows that energy was transferred in this example?**

Electricity goes through power lines to provide light and power from place to place.

6. **Is light a way in which energy is transferred?**

Yes

7. **How do you know energy is involved?**

Something has to give power to the flashlight—the batteries.

8. **Why does the plate spin?**

See below, Know the Science, for support.

9. **What observations can you make as evidence that electricity transfers energy?**
Electricity allows lights, appliances, and machines to work when they are turned on.
10. **What are some other examples of energy transfer that happen every day?**
Electricity or a battery makes a computer come on. A person's physical energy makes a bicycle move.
11. **Did you read about any of these examples in the chapter?**
What are some other examples of energy transfer that happen every day? (Electricity or a battery makes a computer come on. A person's physical energy makes a bicycle move.)

Lesson 8: Investigating Energy Transfer

1. **At the station with the hot plate, were you seeing how heat transfers to colder objects or how cold transfers to warmer objects?**
When you were working with the surge protector, what did you notice was happening to the electricity? SUPPORT—If needed, ask students to return to the Student Reader, Chapter 4, to support their answers with additional examples and appropriate use of Core Vocabulary.

Lesson 9: Evidence of Energy Transfer

1. **What are the forms of energy in these examples?**
Electrical, heat, sound, chemical
2. **What are the sources of energy in these examples?**
Electricity, fire
3. **How are these examples similar to what you observed during the previous lesson's investigations?**
Every transfer of energy has a source and an outcome.
4. **What evidence do these examples provide that energy moves from place to place?**
A toaster works because it uses electricity. Fireworks make big sounds when they are ignited.

Lesson 10: Collisions Transfer Energy

1. **What happens to the cars?**
They crash into one another.
2. **How does the collision change the motion of each car?**
They stop moving forward.
3. **What other forms of energy does the collision transform the motion energy of the cars to?**
Sound
4. **Will the speed of the cars change? How?**
They will go faster on a higher ramp.

5. **Will the cars move the same way after the collision?**
They may bounce back more distance than before.
6. **Will the second collision sound the same as the first?**
It will make a louder crashing sound.
7. **What happens to the car?**
It stops by running into the clay.
8. **What happens to the modeling clay?**
It gets pushed in a little.
9. **Is there evidence of a change happening?**
Yes
10. **What happens to the modeling clay in this trial?**
The clay has a larger dent.
11. **Did this collision transfer more or less energy than the first trial?**
More energy
12. **What evidence supports your answer?**
The car moved faster and hit the clay with more force.
13. **How did your prediction compare to the trial result?**
They were the same.
14. **What pattern might you see if we kept using taller and taller ramps?**
The energy, or force and speed of motion, will increase.
15. **Will the sound be different between each collision?**
Some of the collisions will sound very similar, but the larger cars will tend to make louder sounds than the smaller cars.
16. **What will be the difference in sound between each collision?**
A medium-sized car and large car will make a bigger sound than a small car and a smaller car.
17. **Which cars were used in each collision?**
The bigger car was used in the greater collision. The smaller car was used in the softer, gentler collision.
18. **When you watched each of the two cars collide with the clay, how did their impacts differ?**
The cars bounce away differently after the impact. One car bounced away farther than the other.
19. **What do you already know about collisions?**
They can be loud or quiet, hard or soft, or fast or slow.
20. **What happens to the motion energy of the objects that initiate a collision?**
Motion energy can gain speed or strength before the collision if an object is moving downhill or dropping from a height.
21. **Have you ever performed a test before? What kind?**
Sample answer: placing objects in water

22. What were you trying to find out?

Which objects sink or float

Lesson 12: How Can Energy Transformations Solve Problems?

1. What problem does a (toaster, wind-up clock, etc.) solve?

Browns toast, tells time

2. How does a () use energy transformation?

A toaster transfers electrical energy to heat energy.

3. What are some factors engineering designers had to consider when they were designing the ()?

The size of bread or bagels, safety

4. What other factors not listed might an engineering designer need to consider?

Materials, colors, size, shape, time required

5. What problems are solved by batteries?

They allow an object to be moved from place to place without needing to plug the object into a wall socket.

6. How is energy transformation used in the solution to those problems?

The stored energy in the battery is transformed to sound, light, and motion.

7. What additional problems are solved by rechargeable batteries?

The batteries will rarely, if ever, need to be changed.

Lesson 13: Designing Devices to Transform Energy

1. How are you meeting the criteria?

Students should be able to clearly describe their criteria, purposes, and plans.

2. What is the problem you are solving?

What energy transformation are you using?

3. What problems are you having building your device?

How are you dealing with the constraints you identified?

4. What were the criteria (limitations)?

What was the initial form of energy in the energy transformation?

5. What was the final form of energy?

Was there one or more than one kind of energy transformation?

6. How did your team build it?

What were the test results?

7. How did you refine your device?

Complete and have students complete a scoring guide after each presentation.

Lesson 14: Solving Problems and Designing Solutions: Thomas A. Edison

1. What problems did Edison try to solve as he designed his light bulb?

It is difficult to see in the dark. A candle, lantern, or fire provides light but can be dangerous.

2. **Think about your home. Where do you find light bulbs in your home?**
Lamps in every room, ceiling lights, new light bulbs stored in a cabinet
3. **What is an open flame?**
Light that is not contained
4. **Why did Edison place the filament inside the bulb?**
To reduce the chance of buildings catching on fire
5. **Do you think light bulbs are safer than candles or lanterns?**
Yes
6. **Look closely at the picture of Edison's light bulb. Where do you think the transformation of electrical energy to light energy happens in his device?**
Inside the bulb
7. **When a light bulb turns on, what evidence shows that energy has transformed in the light bulb?**
The electrical energy in the filament produces light energy in the light bulb, so the light comes on.
8. **What energy transformations happen in a modern car?**
The stored energy that is in fuel and batteries makes a transformation to motion energy when the car is started and begins to move.
9. **Think about the word persistence. What do you think it means to persist?**
To keep trying to solve a problem
10. **What advantages and disadvantages does the design of the traditional light bulb have?**
It might be less expensive and might fit into some older sockets.
11. **What advantages and disadvantages does the design of the CFL bulb have?**
It uses little heat, but the light is not very bright.
12. **What advantages and disadvantages does the design of the LED bulb have?**
It gives off a lot of light and very little heat, using little energy.
13. **Which examples in this chapter model Edison's persistence as a designer and an engineer?**
He identified problems and worked hard to develop solutions. He tested more than 6,000 materials to use for filaments. He made the first alkaline battery in 1901.

Unit quiz key

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