1 *Home Energy Use*

INVESTIGATION

1–2 CLASS SESSIONS

ACTIVITY OVERVIEW

NGSS CONNECTIONS

Students begin exploring energy transfer by analyzing qualitative data on energy use in two hypothetical homes in different environments. They explore the concept of *energy-efficiency* as they consider how certain features of a home may cause homeowners to use more or less energy. They begin tracking their understanding of energy transfer and strategies to increase home energy-efficiency, which they will finalize throughout the unit.

Prepare to teach the unit by reviewing *A Quick Start to Issues and Science*, found at the front of this Teacher Edition. This guide breaks down the resources and equipment needed to teach the unit. It calls out critical tools for planning the unit such as the *NGSS Overview*, the *Phenomena, Driving Questions, and SEPUP Storyline* overview and the *SEPUP Scoring Guides*. For more detailed information on the program as a whole, see the "Issues and Science Program Overview" section of the *Teacher Resources*.

If this is your ***first*** SEPUP unit, read through "Planning for First-Time Users," found on the last page of the *Quick Start*.

NGSS CORRELATIONS

Performance Expectations

Working toward MS-PS3-3: Apply scientific principles to design, construct, and test a device that either minimizes or maximizes thermal energy transfer.*

Working toward MS-PS3-4: Plan an investigation to determine the relationship among the energy transferred, the type of matter, the mass, and the change in the average kinetic energy of the particles as measured by the temperature of the sample.

Disciplinary Core Ideas

MS-PS3.A Definitions of Energy: Temperature is a measure of the average kinetic energy of particles of matter. The relationship between the temperature and the total energy of a system depends on the types, states, and amounts of matter present.

MS-PS3.B Conservation of Energy:

The amount of energy transfer needed to change the temperature of a matter sample by a given amount depends on the nature of the matter, the size of the sample, and the environment.

Energy is spontaneously transferred out of hotter regions or objects and into colder ones.

Science and Engineering Practices

Analyzing and Interpreting Data: Analyze and interpret data to provide evidence for phenomena.

Asking Questions and Defining Problems: Ask questions that arise from careful observation of phenomena, models, or unexpected results, to clarify and/or seek additional information.

Crosscutting Concepts

Cause and Effect: Cause and effect relationships may be used to predict phenomena in natural or designed systems.

Energy and Matter: The transfer of energy can be tracked as energy flows through a design or natural system.

Common Core State Standards—ELA/Literacy

WHST.6-8.9: Draw evidence from informational texts to support analysis, reflection, and research.

* *Performance expectations marked with an asterisk integrate traditional science content with engineering through a science and engineering practice or disciplinary core idea.*

INVESTIGATIVE PHENOMENA AND SENSEMAKING

Investigative Phenomena, Sensemaking

Some devices are less efficient than others. For example, some light bulbs get hotter than others.

Students are introduced to the issue of home energy use through a scenario about light bulbs. Students begin the sensemaking process by comparing two homes with different energy needs and features. Students discuss their initial ideas about improving energy-efficiency, and develop questions that need to be answered before they can design an evidence-based plan for increasing home energy-efficiency.

WHAT STUDENTS DO

Students brainstorm the uses of energy in the home and become aware of everyday energy consumption. They compare the features of two homes and suggest which home consumes less energy. Students develop an operational definition of *energy-efficiency*.

MATERIALS AND ADVANCE PREPARATION

- *For the teacher*
  - 1 Scoring Guide: EVIDENCE AND TRADE-OFFS (E&T)
  - Driving Questions Board cards and instructions

- *For each student*
  - 1 Student Sheet 1.1, "Anticipation Guide: Ideas About Energy"
  - 1 Student Sheet 1.2, "Home Energy-Efficiency Features"
  - 1 Scoring Guide: EVIDENCE AND TRADE-OFFS (E&T) (optional)

The Driving Questions Board cards and instructions can be found in the front pouch of your printed Teacher Edition or as a download on the "Tools and Resources" page in your online Teacher Portal.

The EVIDENCE AND TRADE-OFFS (E&T) Scoring Guide can be found in the Assessment tab in the back of this Teacher Edition.

TEACHING SUMMARY

GET STARTED

1. Engage students' interest by introducing the issue used to drive their learning in this unit.
   a. Either read aloud or have students read the vignette that opens the unit.
   b. Identify the societal issue that students will explore in the unit.
   c. Begin a Driving Questions Board.
2. Initiate students' sensemaking by having them share their current understanding of energy.
   a. Elicit students' initial ideas about energy by asking, "What is energy?" and "What are some examples of energy?"
   b. (SENSEMAKING) Have students complete the "Before" column on Student Sheet 1.1, "Anticipation Guide: Ideas About Energy."
   c. (SENSEMAKING) If needed, introduce the use of a science notebook.

DO THE ACTIVITY

3. Support students' sensemaking by having them consider their own household energy use.
   a. Have students read the vignette at the start of the activity that continues following Yasmin and her mother; ask, "What features of your own home affect how much energy your home uses?"
   b. Direct student groups to Procedure Step 1 to identify features in their homes that use *the most* energy.

c. Tell students that they will examine energy use in two homes, one in Texas and one in New York.

BUILD UNDERSTANDING

4. Students develop an initial understanding of energy-efficiency.
   a. When students complete Procedure Step 4, direct them to Analysis items 1–4.
   b. Use Analysis item 2 to have a class discussion on the concept of energy-efficiency.
5. If you have not previously done so, introduce the concept of trade-offs.
   a. Introduce the idea that decisions about solutions to scientific and engineering problems often involve trade-offs.
   b. Provide an example of trade-offs.
   c. Develop some examples of trade-offs in students' lives.
   d. (E&T QUICK CHECK) Direct students to Analysis item 5, and introduce them to the concept of trade-offs when making a home more energy-efficient.
   e. If you have not previously done so, introduce the SEPUP Assessment System.
   f. Provide an overview of the Scoring Guides.
   g. Explain the expectations for student growth over time.
6. Connect the unit issue to students' lives by having them begin recording home energy-efficiency strategies.
   a. Explain to students that throughout this unit, they will deepen their understanding of energy in order to develop an energy-efficiency plan to recommend to a fictional family.
   b. Distribute Student Sheet 1.2, "Home Energy-Efficiency Features."
   c. As students complete Analysis item 6, have them add their questions to the Driving Questions Board.

TEACHING STEPS

GET STARTED

1. Engage students' interest by introducing the issue used to drive their learning in this unit.

Anchoring Phenomenon

   a. Either read aloud or have students read the vignette that opens the unit.

   The vignette with Yasmin and her mother introduces the phenomenon of some light bulbs getting hotter than others. Ask the class if any of them have ever touched a very hot light bulb. Ask students to generate some questions they have about this physical phenomenon. If students are not familiar with the term *phenomenon* (or its plural form, *phenomena*), explain that a *phenomenon* is an observable fact or event. In this unit, students will investigate phenomena related to how some energy transfers and transformations are more efficient than others. They will plan and carry out investigations and design solutions to problems based on disciplinary core ideas and crosscutting concepts related to energy.

b. Identify the societal issue that students will explore in the unit.

Defining Issues

Have students read the description of what they will investigate in this unit on the bottom of the same page, and discuss how the unit may or may not answer their questions. Most importantly, identify that students will investigate the issue of energy-efficiency and energy use by understanding the concepts and ideas of energy transfer and transformation.

c. Begin a Driving Questions Board.

Driving Questions Board

In SEPUP, the Driving Questions Board elicits students' initial wonderings about the unit issue and the investigative phenomena; the class is then prompted to revisit the Driving Questions Board throughout the unit. Ideally, student questions generated at the start of each learning sequence can be condensed through class discussion into a unified driving question. As a scaffold to teachers who are new to this teaching strategy, Driving Questions cards are provided for each learning sequence and can be displayed as the unified driving question.

The driving questions are also identified on the Phenomena, Driving Questions, and SEPUP Storyline overview found in the NGSS and Common Core tab in the back of this Teacher Edition.

2. Initiate students' sensemaking by having them share their current understanding of energy.

a. Elicit students' initial ideas about energy by asking, "What is energy?" and "What are some examples of energy?"

Encourage students to express what they know about the topic of energy, building on their personal experiences. For examples of energy, they may respond with food, fuel, and sunlight.

Since it is quite challenging to closely define *energy* (even for professional scientists and engineers), do not try to create a formal definition of *energy* at this time. In fact, referring to the definition of energy in this first activity, out of context, may not be enlightening for students.

Be aware that many misconceptions are likely to surface from students during this discussion (see the Background Information). It is not necessary to dispel misconceptions at this time since many of them will be addressed in the unit. Focus instead on drawing out students' ideas around which they can develop accurate concepts as they progress through the unit.

b. (SENSEMAKING) Have students complete the "Before" column on Student Sheet 1.1, "Anticipation Guide: Ideas About Energy."

This Anticipation Guide provides a preview of important concepts in the unit. It gives students an opportunity to explore their initial ideas and to revisit and modify them when they have finished the unit.

Anticipation Guide

You might read the statements aloud and clarify any questions students have about their meaning. Be sure students understand that they should complete only the "Before" column at this time. They will fill in the "After" column as the unit unfolds, to see whether their ideas have changed or remained the same. For a sample of what a completed Anticipation Guide for this unit might look like, see the Sample Student Response to Student Sheet 1.1 at the end of this activity.

c. (SENSEMAKING) If needed, introduce the use of a science notebook.

Science Notebooks

Explain your expectations for the type and organization of students' notebooks. Keeping a science notebook helps students track data; record predictions, hypotheses, and questions as they investigate; process ideas; build scientific writing skills; and write lab reports. "Keeping a Science Notebook" in Appendix E of the Student Book provides suggested guidelines.

This activity starts a sequence of learning, which resumes with the "Energy Transfer Challenge" activity, around the driving question: Why do some light bulbs get hotter than others? (This driving question is identified in the Phenomena, Driving Questions, and SEPUP Storyline overview). Pose the questions, and have students share their ideas.

DO THE ACTIVITY

3. Support students' sensemaking by having them consider their own household energy use.

a. Have students read the vignette at the start of the activity that continues following Yasmin and her mother; ask, "What features of your own home affect how much energy your home uses?"

Encourage students to think about their own homes when answering this question. Accept all reasonable responses, and list them on the board or chart paper to refer to later in the activity. Keep this discussion brief; the purpose is simply to raise students' awareness of energy use in their home. Students may respond that energy is used to heat the house, to cook food, and to run devices (e.g., TVs and radios) and appliances (e.g., dishwasher or stove).

As noted above, although energy is a familiar idea, defining it is difficult. Energy is an abstract concept that is only observed when it's transformed or transferred. The energy referred to in this activity is that of energy use in the home. Students' everyday experiences with energy types (e.g., electricity, sunlight, thermal energy) provide a context for developing a conceptual understanding of energy throughout the unit.

b. Direct student groups to Procedure Step 1 to identify the features in their homes that use *the most* energy.

Point out that home features that affect energy use include devices (e.g., light bulbs, cell phones) and appliances (e.g., stoves and refrigerators). But they also include structural features (e.g., windows, doors, and walls). For example, gaps between a door frame and a door waste energy and can cause heating costs to rise in a cold climate.

Identifying features that affect energy use may be difficult for students to do accurately, but this exercise makes students aware that all energy uses are not quantitatively equal and that a number of features contribute to overall energy use. Consider having each group share what they think are the top two or three uses of energy in their homes. If a group's top choices were already mentioned by another group, have them share other items from their list.

c. Tell students that they will examine energy use in two homes, one in Texas and one in New York.

Have a brief class discussion about where the two homes are located and how the climates differ between Texas and New York.

You may want to tell students that home energy use accounts for about 22% of overall energy consumption in the United States. (The other major energy uses in the United States are for transportation, manufacturing, and business.) If students have difficulty connecting the home features to energy use, you may want to review each feature as students undertake Procedure Step 4. In addition to discussing how each feature is related to energy consumption, you may want to work with students to determine which of the two homes is likely to use less energy for each feature. An exact determination is not possible, as energy use depends not just on the devices and appliances in the home, but also on other factors (e.g., how frequently they are used).

BUILD UNDERSTANDING

4. Students develop an initial understanding of energy-efficiency.

   a. When students complete Procedure Step 4, direct them to Analysis items 1–4.

   Decide whether you want students to write responses to any of the items in their science notebooks, discuss in their groups, or both. At this point, students may not have any basis to judge whether oil or gas is more efficient for heating a home. Explain to students that they should note these kinds of questions in their science notebooks. Explain that they will learn much more about energy use and energy-efficiency throughout the unit, so they can revisit these questions later.

   b. Use Analysis item 2 to have a class discussion on the concept of energy-efficiency.

   Have students share their examples as a way for them to become more familiar with this concept.

5. If you have not previously done so, introduce the concept of trade-offs.

   a. Introduce the idea that decisions about solutions to scientific and engineering problems often involve trade-offs.

   Teacher Resources
   Evidence and Trade-offs

   This unit includes issues that relate to science and/or engineering and that may lead to decisions about the best solutions or designs for solving problems. One goal of this curriculum is to teach students that decisions about possible solutions often involve trade-offs and that identifying trade-offs involves analyzing evidence.

   Explain to students that in this unit, they will make several decisions about energy use and efficiency. In this activity, students begin to consider the trade-offs of these decisions. In a decision involving trade-offs, something positive (or desirable) is given up to gain another positive (or desirable) outcome. Since many decisions involve trade-offs, students should understand that a perfect choice is often not possible. It is possible, however, to recognize and analyze the trade-offs associated with each decision.

   b. Provide an example of trade-offs.

   For example, when asked, “Paper or plastic?” at a store checkout counter, most shoppers make the choice quickly. But there are several trade-offs attached to choosing paper or plastic. A shopper who chooses paper over plastic may do so to avoid generating plastic waste. In requesting the paper bag, though, they are contributing to other environmental problems, such as increased water and energy use, and the higher amounts of solid waste and carbon dioxide emissions associated with making paper bags. Neither choice is ideal, and both choices have a downside. Identifying the trade-offs helps clarify the reasoning that is being applied to make a decision.

c. Develop some examples of trade-offs in students' lives.

To further explore trade-offs, brainstorm with the class a list of decisions they make every day that involve trade-offs. Choose one, and talk through the associated trade-offs of deciding one way or another. This practice will familiarize students with ways to identify and consider trade-offs in this and subsequent activities.

d. Direct students to Analysis item 5, and introduce them to the concept of trade-offs when making a home more energy-efficient.

As defined in the Student Book, a *trade-off* is a desirable outcome given up to gain another desirable outcome. Help students understand this idea by using a concrete situation related to the comparison of Homes A and B. For example, ask students about the home feature of windows: "What is the trade-off involved in using single-pane instead of double-pane windows?" Students are likely to respond that the single pane is less expensive than the double pane. The trade-off for having a window that costs less initially is that it doesn't help as much to keep the house cool or warm and results in higher energy bills in the long run.

SEPUP Assessment System

e. If you have not previously done so, introduce the SEPUP Assessment System.

Explain that Analysis item 5 is the first assessment of students' work in this unit; use it as an example to introduce the SEPUP Assessment System to your students.

f. Provide an overview of the Scoring Guides.

Display or distribute the EVIDENCE AND TRADE-OFFS (E&T) Scoring Guide, and use it to model how the system works. Point out the levels in the first column of the Scoring Guide. Tell students that these levels are the same for all Scoring Guides and range from 0 to 4. Review the descriptions of each level. For example, a Level 4 response is complete and correct in all Scoring Guides. Point out that the scores (0–4) are based on the quality of students' responses and do not correspond to letter grades. Allow students to refer to the Scoring Guide as they prepare their answers. Be sure they understand that the Scoring Guides do not include the specific content students must provide in their responses; rather, the guides explain the overall expectations for responses at various levels of performance on the task.

g. (E&T QUICK CHECK) Explain the expectations for student growth over time.

Teacher Resources

Quick Checks

Let students know that they will not be formally assessed on their responses at this time. Rather, this item is a Quick Check, which is an opportunity for you to gauge students' abilities to identify evidence and trade-offs.

Explain to students that they aren't expected to always produce complete and correct work on their first attempts. Instead, they should work toward developing consistent Level 3 and Level 4 answers as they become more proficient with the concepts (both disciplinary core ideas and crosscutting concepts) and the science and engineering practices being assessed. It is not necessary (or even expected) that an "A" student will always write Level 4 responses, especially at the beginning of the course or when they are introduced to a new Scoring Guide. For a sample Level 4 response to Analysis item 5, see the Sample Responses to Analysis. Point out that real-life scientists and engineers do not always have perfect ideas the first time, and they often modify their ideas after obtaining more data and test results.

6. Connect the unit issue to students' lives by having them begin recording home energy-efficiency strategies.

   a. Explain to students that throughout this unit, they will deepen their understanding of energy in order to develop an energy-efficiency plan to recommend to a fictional family.

   What becomes apparent to students through this activity is how much more there is to know about how energy in a home works. They may have questions about the purpose of insulation or how warm air travels through the house. Encourage students to record their questions in their science notebooks, where they can refer to them later. Let students know that in upcoming activities, they will find answers to many of their questions.

   b. Distribute Student Sheet 1.2, "Home Energy-Efficiency Features."

   Explain to students that they will use this sheet to record their understanding of how each feature on the list affects energy use and, therefore, energy-efficiency. At this point, students will fill in their initial ideas and may leave much of the sheet blank. For example, they may not have any basis to judge the energy demands of heating compared with cooling. Explain to students that they should note these kinds of questions on the bottom of the Student Sheet to revisit later. As students learn about energy transfer and energy transformation throughout the unit, they will add to their explanations to this Student Sheet. Let them know that this information will all come together in the final activity of this unit, "Improving Home Energy-Efficiency."

Determine if you will fill out one row with students as an example, or if you will do this at the end of one of the next two activities. See the Sample Student Response to Student Sheet 1.2 at the end of this activity.

Students can add additional home features that affect energy use; they can use the back side of the student sheet for these additional features.

Teacher's Note: Specific Analysis items instruct students to revisit this Student Sheet at the end of the following activities: "Conservation of Energy," "Energy Transfer Challenge," "Conduction, Convection, and Radiation," and "Improving Home Energy-Efficiency."

c. As students complete Analysis item 6, have them add their questions to the Driving Questions Board.

Encourage students to think about their own homes and any questions they have about how their homes use energy. Remind students that they will revisit these questions as they progress through the unit.

STRATEGIES FOR TEACHING DIVERSE LEARNERS

Below are suggestions for differentiating instruction and assessment in this activity for diverse learners in your classroom:

Differentiated Instruction

- English learners: Introduce a class word wall for the *Energy* unit as a visual reminder of the new key scientific terms and to make words easily accessible. Begin constructing the word wall for this activity, and continue to add terms throughout the unit. Consider adding an explanatory picture or diagram for some (or all) of the terms.
- Academically gifted students: Have students gather weather and climate data for Texas and New York, the locations of the two homes in the activity.

These icons, ● ● ●, indicate where you can formatively assess students' proficiency with the three dimensions: ● = SEP, ● = DCI, ● = CCC.

SAMPLE RESPONSES TO ANALYSIS

1. How do the climates, or average weather conditions, in the locations of the two home influence the energy use in each home?

   Texas is a much warmer climate than New York, so New York homes are likely to use much more energy for heating, whereas Texans use more energy for cooling. Another example is demonstrated in the model homes from this activity. The amount of sunlight exposure is much less in New York than Texas, so it may be unnecessary to use reflective films on the windows.

2. **Energy-efficiency** means using less total energy to provide the same amount of useful energy. For example, a light bulb that uses less energy than another to provide the same amount of light is more energy-efficient. Based on your experience in this activity, give two examples of changes that could make a home more energy-efficient.

   An example might be the insulation of Homes A and B, where Home B uses more insulation that allows less hot air to seep out of the house. This should result in a more efficient use of energy in the home than having less insulation. Another example might be getting a water heater that has more insulation so that the water stays hot instead of some of that heat escaping into the room, or getting a hot water heater that only heats water when it is needed.

3. If the people who live in Homes A and B have similar lifestyles, which home do you think uses less energy in a year? Use your analysis and interpretation of the data in the table to support your choice.

   Students' responses will likely vary, since only limited information was provided in the activity. A sample response is shown here:

   Home B uses less energy overall because it has equal or better features in every category. Specifically, Home B uses more-efficient energy sources, such as natural gas instead of oil or electricity, and it holds energy within the house through insulation, windows, and shrubbery. It also has more efficient appliances and lights.

4. What could be done to reduce the energy needs of each home?

   a. Home A

      Home A could improve its insulation, add double- (or triple-) pane windows, increase its use of high-efficiency appliances and lights, and plant vegetation nearby.

   b. Home B

      Home B could improve its efficiency by changing the remaining single-pane windows to double- (or triple-) pane and changing the remaining incandescent lights to fluorescents. Adding reflective window film may or may not be useful in the climate.

5. (E&T QUICK CHECK) What are the trade-offs in making a home more energy-efficient? A **trade-off** is a desirable outcome given up to gain another desirable outcome.

   SAMPLE LEVEL 4 RESPONSE

   The trade-off to making a home more energy-efficient is that it can cost money to do this. I may have a stove that isn't energy-efficient, so it costs more to run, but I would have to spend money to buy a new stove. That would mean spending money right now, although it could save me money in the long run. Or, I could plant a tree to shade my house, but when the tree gets large, it may drop a lot of leaves that I would have to rake in the fall. So I would have to do more work, but it would save money.

6. **Revisit the issue:** What steps have you and your family taken to reduce energy use in your home? What questions do you have about energy-efficiency at home and at school?

   Students' responses will likely vary, depending on their experiences. A sample response is shown here:

   At my house, we have replaced our clothes dryer and a large freezer with ones that were listed as being energy-efficient. We try to turn lights off when we're not in a room. My mom always makes sure that we close the refrigerator door. In the summer when it's hot out, we keep our blinds and curtains closed to keep out as much heat as possible so our air conditioner doesn't have to work as hard to keep the house cool. I wonder if we have the new kind of light bulbs that Yasmin's mom bought. I would like to know why some light bulbs get so hot while others stay cool. I would also like to know why the inside walls of our house get so cold in the winter.

REVISIT THE GUIDING QUESTION

What does it take to reduce energy use in a home?

To reduce energy use in a home, we could do several things. We could use fewer appliances, use more energy-efficient appliances, better insulate our homes, or plant trees around our homes.

ACTIVITY RESOURCES

KEY VOCABULARY

energy-efficiency

trade-off

BACKGROUND INFORMATION

MISCONCEPTIONS ABOUT ENERGY

Some of the common ideas that students have about energy are as follows:

- Energy is associated only with living objects. (These students may incorrectly believe that since inanimate objects don't live and move on their own, they aren't associated with energy.)
- Energy is the same thing as force and/or power. (Some of these students incorrectly use *force*, *power*, and *energy* interchangeably.)

- Energy is a fuel. (These students see power plants, gasoline, and electricity as energy producers instead of energy transformers. These students tend to overlook the energy in living things.)
- Energy is a fluid, ingredient, or product. (These students may incorrectly think that energy is something that flows through things or something that is present when the right combination of ingredients is mixed.)

Name____ Date__________

STUDENT SHEET 1.1

ANTICIPATION GUIDE: IDEAS ABOUT ENERGY

Before starting the activity, mark whether you agree (+) or disagree (–) with each statement below.

After completing the activity, mark whether you agree (+) or disagree (–) with each statement below. Under each statement, explain how the activity gave evidence to support or change your ideas.

BEFORE	AFTER	
_______	_______	**1. An object has energy even when it is not moving.**
_______	_______	**2. Only living things are associated with energy.**
_______	_______	**3. When energy is used, it is gone forever.**
_______	_______	**4. Electrical energy can be transformed into light, sound, or thermal energy.**
_______	_______	**5. Thermal energy and temperature are different.**
_______	_______	**6. Energy cannot be measured.**
_______	_______	**7. The water heater in a home uses more energy than the refrigerator.**
_______	_______	**8. All houses use the same amount of energy.**
_______	_______	**9. Purchasing more-efficient large appliances is the only way to improve the energy-efficiency of a home.**

Name____ Date____________

STUDENT SHEET 1.2

HOME ENERGY-EFFICIENCY FEATURES

You will use this Student Sheet to keep track of your understanding of how different features of your home affect energy use. Because you will eventually develop a plan to increase energy-efficiency, be sure to note which features use a lot of energy.

Home feature	Use in home	Amount of energy used or saved: 1: little 2: medium 3: a lot	How feature affects transfer or transformation of energy	How feature affects energy-efficiency
Window type				
Window treatment				
Appliances				
Heating				
Cooling				
Lighting				
Insulation				
Trees and shrubs				

Idea Catcher: ____

(continue on reverse side if necessary)

Name *Sample student response* Date

STUDENT SHEET 1.1

ANTICIPATION GUIDE: IDEAS ABOUT ENERGY

Before starting the activity, mark whether you agree (+) or disagree (–) with each statement below.

After completing the activity, mark whether you agree (+) or disagree (–) with each statement below. Under each statement, explain how the activity gave evidence to support or change your ideas.

BEFORE	AFTER	
______	+	**1. An object has energy even when it is not moving.** *In the "Drive a Nail" and "Roller Coaster Energy" activities, I learned that objects have potential energy even when they are not moving.*
______	–	**2. Only living things are associated with energy.** *In the "Drive a Nail" activity, the steel and aluminum rods had gravitational potential energy that was converted into kinetic energy when they fell. In the "Roller Coaster Energy" activity, I learned that roller coasters also have potential and kinetic energy. In the "Shake the Shot" activity, the shot gained thermal energy when it was shaken.*
______	–	**3. When energy is used, it is gone forever.** *In the "Conservation of Energy" activity, I learned that energy cannot be created or destroyed. In "Follow the Energy," I learned that energy can be transformed into different types.*
______	+	**4. Electrical energy can be transformed into light, sound, or thermal energy.** *In "Follow the Energy," I learned that energy can be transformed into different types. In the "Hot Bulbs" activity, we transformed electrical energy into light and thermal energy.*
______	+	**5. Thermal energy and temperature are different.** *In the "Mixing Hot and Cold Water" activity, I learned that thermal energy is related to the total internal energy of a substance due to the movement of those particles and that temperature is related to the average kinetic energy of the particles.*
______	–	**6. Energy cannot be measured.** *In the "Hot Bulbs" activity, we calculated the electrical energy supplied to the light bulbs and measured the thermal energy produced by the bulbs.*
______	+	**7. The water heater in a home uses more energy than the refrigerator.** *I think this will depend on how much the water heater and the refrigerator are used, but I believe that the water heater will use a lot of energy because in the "Thermal Energy Storage" activity, I learned that water requires a lot of energy to heat up. In the "Improving Home Energy-Efficiency" activity, the Energy-Efficiency Factor cards don't indicate anything that makes me change my mind.*
______	–	**8. All houses use the same amount of energy.** *In the "Improving Home Energy-Efficiency" activity, each Family Energy Profile had a different annual energy cost. This makes sense because each house would have different appliances and could have different numbers of people and be in climates where heating and cooling needs would be different.*
______	–	**9. Purchasing more-efficient large appliances is the only way to improve the energy-efficiency of a home.** *In the "Improving Home Energy-Efficiency" activity, I calculated the savings from a variety of energy improvements. Some improvements involved large appliances, but many did not.*

Name *Sample student response* Date

STUDENT SHEET 1.2

HOME ENERGY-EFFICIENCY FEATURES

You will use this Student Sheet to keep track of your understanding of how different features of your home affect energy use. Because you will eventually develop a plan to increase energy-efficiency, be sure to note which features use a lot of energy.

Home feature	Use in home	Amount of energy used or saved: 1: little 2: medium 3: a lot	How feature affects transfer or transformation of energy	How feature affects energy-efficiency
Window type	*To keep temperature in home consistent (cool in summer, warm in winter)*	*3: Homes have many windows, so this can add up to a lot of savings if all of them are double-pane.*	*The double-panes slow down or prevent transfer of thermal energy from warm areas to cool areas.*	*Using double-pane windows uses less energy to keep the home at the desired temperature.*
Window treatment	*To keep sunlight out or to keep heat from escaping the home*	*1: Helps a little when it is very hot outside, especially if all windows have the treatment.*	*The window treatments slow down or prevent transfer of thermal energy from warm areas to cool areas.*	*Using window treatments uses less energy to keep the home at the desired temperature.*
Appliances	*Used for various tasks, including washing and drying clothes, and cooking*	*2: Some appliances, like a dryer, use more energy than other appliances, like a television.*	*Appliances transform one kind of energy, like electricity, into another kind of energy, like thermal or sound.*	*Energy-efficient appliances transform more of the original type of energy into the desired type of energy.*
Heating	*Used to warm up the home in cold temperatures*	*3: Uses a lot of energy during the winter.*	*Heating systems transform one kind of energy, like electricity, into thermal energy.*	*Using energy-efficient heating systems uses less energy to keep the home at the desired temperature.*
Cooling	*Used to cool down the home in hot temperatures*	*3: Uses a lot of energy during the summer.*	*Cooling systems transform electricity to remove thermal energy from the home.*	*Using energy-efficient cooling systems uses less energy to keep the home at the desired temperature.*
Lighting	*Used to light rooms and work areas when it is dark and for safety*	*2: Amount of energy used depends on how many and for how long the lights are on.*	*Light bulbs transform one type of energy, like electricity, into other types of energy, especially light energy.*	*Energy-efficient light bulbs transform more of the original type of energy into light energy.*
Insulation	*Used to keep temperatures in the home consistent: cool in summer, warm in winter*	*3: If we don't have insulation in our walls or ceiling, it will take more energy to keep the home warm in winter.*	*Insulation slows down or prevents the transfer of thermal energy from warm to cool areas.*	*Using more insulation uses less energy to keep the home at the desired temperature.*
Trees and shrubs	*Used to provide shade to prevent the sun from hitting the roof and walls directly*	*1: Helps a little when there are leaves on the trees and shrubs.*	*Trees and shrubs slow down the transfer of thermal energy from warm areas to cool areas.*	*Planting trees and shrubs uses less energy to keep the home at the desired temperature.*