Grade 6
Science
Unit 5: Properties of Energy

Time Frame: Approximately five weeks

Unit Description

This unit introduces the student to the basic forms of energy with an emphasis on the properties of energy. Energy transferal and transformation are also explored. Relationships between forms of energy and classifications of renewable, nonrenewable, and inexhaustible resources will be considered.

Student Understandings

Students need to understand how energy can be transformed or transferred. Forms of energy (i.e., light, heat, and sound) are explored as are the ways to transform energy for practical use. Students should be able to distinguish renewable, nonrenewable, and inexhaustible energy resources.

Guiding Questions

1. Can students identify examples of common uses for the various forms of energy?
2. Can students trace various forms of energy as they are transformed from one form to another?
3. Can students identify renewable**,** nonrenewable, and inexhaustible resources?
4. Can students describe how light is reflected and refracted?
5. Can students identify ways in which people can reuse, reduce and recycle resources?

Unit 5 Grade-Level Expectations (GLEs)

GLE #	GLE Text and Benchmarks
Science as Inquiry	
Note: The following Science as Inquiry GLEs are embedded in the suggested activities for this unit. Other activities incorporated by teachers may result in additional SI GLEs being addressed during instruction.	
1.	Generate testable questions about objects, organisms, and events that can be answered through scientific investigation (SI-M-A1)
2.	Identify problems, factors, and questions that must be considered in a scientific investigation (SI-M-A1)
3.	Use a variety of sources to answer questions (SI-M-A1)

GLE #	GLE Text and Benchmarks
4.	Design, predict outcomes, and conduct experiments to answer guiding questions (SI-M-A2)
5.	Identify independent variables, dependent variables, and variables that should be controlled in designing an experiment (SI-M-A2)
6.	Select and use appropriate equipment, technology, tools, and metric system units of measurement to make observations (SI-M-A3)
7.	Record observations using methods that complement investigations (e.g., journals, tables, charts) (SI-M-A3)
8.	Use consistency and precision in data collection, analysis, and reporting (SI-M-A3)
11.	Construct, use, and interpret appropriate graphical representations to collect, record, and report data (e.g., tables, charts, circle graphs, bar and line graphs, diagrams, scatter plots, symbols) (SI-M-A4)
12.	Use data and information gathered to develop an explanation of experimental results (SI-M-A4)
13.	Identify patterns in data to explain natural events (SI-M-A4)
14.	Develop models to illustrate or explain conclusions reached through investigation (SI-M-A5)
15.	Identify and explain the limitations of models used to represent the natural world (SI-M-A5)
16.	Use evidence to make inferences and predict trends (SI-M-A5)
19.	Communicate ideas in a variety of ways (e.g., symbols, illustrations, graphs, charts, spreadsheets, concept maps, oral and written reports, equations) (SI-M-A7)
21	Distinguish between observations and inferences (SI-M-A7)
22.	Use evidence and observations to explain and communicate the results of investigations (SI-M-A7)
23.	Use relevant safety procedures and equipment to conduct scientific investigations (SI-M-A8)
25.	Compare and critique scientific investigations (SI-M-B1)
33	Evaluate models, identify problems in design, and make recommendations for improvement (SI-M-B4)
Physical Science	
7.	Simulate how atoms and molecules have kinetic energy exhibited by constant motion (PS-M-A4)
24.	Describe and give examples of how all forms of energy may be classified as potential or kinetic energy (PS-M-C1)
25.	Compare forms of energy (e.g., light, heat, sound, electrical, nuclear, mechanical) (PS-M-C1)
26.	Describe and summarize observations of the transmission, reflection, and absorption of sound, light, and heat energy (PS-M-C1)
28.	Explain the law of conservation of energy (PS-M-C2)
30.	Trace energy transformations in a simple system (e.g., flashlight) (PS-M-C2)
31.	Compare types of electromagnetic waves (PS-M-C3)

GLE #	GLE Text and Benchmarks
32.	Identify and illustrate key characteristics of waves (e.g., wavelength, frequency, amplitude) (PS-M-C4)
33.	Predict the direction in which light will refract when it passes from one transparent material to another (e.g., from air to water, from prism to air) (PS-M-C4)
34.	Apply the law of reflection and law of refraction to demonstrate everyday phenomena (e.g., how light is reflected from tinted windows, how light is refracted by cameras, telescopes, eyeglasses) (PS-M-C4)
35.	Determine through experimentation whether light is reflected, transmitted, and/or absorbed by a given object or material (PS-M-C4)
36.	Explain the relationship between an object's color and the wavelength of light reflected or transmitted to the viewer's eyes. (PS-M-C4)
37.	Compare how heat is transferred by conduction, convection, and radiation (PS-M-C5)
38.	Identify conditions under which thermal energy tends to flow from a system of higher energy to a system of lower energy (PS-M-C5)
39.	Describe how electricity can be produced from other types of energy (e.g., magnetism, solar, mechanical)
Science and the Environment	
42.	Identify energy types from their source to their use and determine if the energy types are renewable, nonrenewable, or inexhaustible (SE-M-A6)
43.	Explain how the use of different energy resources affects the environment and the economy (SE-M-A6)
46.	Identify ways people can reuse, recycle, and reduce the use of resources to improve and protect the quality of life (SE-M-A6)

Sample Activities

Activity 1: Safety for Energy Investigations (SI GLE: 23)

Materials List: safety rules from Unit 1

Prior to beginning this unit, have students identify and discuss what they think would be relevant safety concerns when studying energy. Stress responsible behaviors regarding electricity and other energy sources, and pay particular attention to assignments completed at home. Emphasize care and the use of protective materials when dealing with heated items.

Activity 2: Home Energy Hunt (SI GLEs: 3, 7, 19, 21, 22, 23; PS GLEs: 25; SE GLE: 42)

Materials List: Home Energy Hunt BLM, textbooks, reference materials, websites if internet access is available, large class chart on which to transfer results of the Home Energy Hunt, science learning logs

In this activity students should be familiar with the different forms of energy that may be used in the home (electricity, chemical, solar heat and light, biomass, or fossil fuels). Use textbooks, posters, internet, or reference materials to help students develop an understanding of these different types of energy before they identify them at home.

Once students have a grasp of each of the different forms of energy, challenge them to identify where in the home these sources are used to power familiar objects or provide services. Give each student a copy of the Home Energy Hunt BLM. Instruct students to locate and identify things that are powered in the home, what the source of energy is for each, and the form the energy takes in the use of the object or service. The students should then identify whether or not they believe the source to be (R) Renewable, (NR) Nonrenewable, or (IE) Inexhaustible. The following website provides a resource that helps explain *inexhaustible resources*: http://reference.howstuffworks.com/conservation-encyclopedia.htm

Example:

Energy user	R	NR	IE	Form of energy used	The product of the energy use
Calculator				Solar Powered	Electricity, light
Lamp				Electricity	Heat, light

The teacher should have the students share the results of their Home Energy Hunt in a way that allows the students to assess the accuracy of their conclusions (on a chalk or white board, chart paper, etc.) Reserve the R / NR / IE columns to complete during closure.

The teacher will review the *form of energy used* column on the Home Energy Hunt BLM to make certain students can accurately track the energy used to provide power for the objects or appliances they listed. *The product of the energy use* column should reflect an understanding of the different types of energy. As an example, students often identify the wind produced by fans as wind power. They may need guidance to see that the electrical energy used to power a fan produces mechanical energy to move the fan blades. Another difficult concept involves the use of batteries (chemical energy) to produce electrical energy to power lights, games, etc.

Once misconceptions have been cleared and the students have a good grasp of the examples of energy use in the home, the teacher should have the students enter several examples from their corrected list into their science *learning log* (view literacy strategy descriptions).

The teacher should create a large, class-sized Energy Hunt chart onto which samplings of their results may be recorded. A variety of energy users should be recorded. The teacher should also add a narrow column between energy user and source of energy to include check marks or a code (R = Renewable, NR=Nonrenewable, IE=Inexhaustible).

As a part of closure, the teacher should work with the students to classify the forms of energy used by putting a checkmark in the appropriate column (R, NR, or IE) for each item listed. Typically, the check marks overwhelmingly point to how much electricity we use in the home and this should lead neatly into a discussion of how their electricity is generated and what alternative energy sources are available in the area in which students live.

The completed chart will be used to discuss energy transformations in the next activity. See websites such as, www.eia.doe.gov/kids/energyfacts/science/formsofenergy.html, for a concise list and descriptions of the forms of energy. The teacher should also take this opportunity to clarify the difference between observations and inferences. Remind the students to be specific when noting what they have observed and identify inferences as the conclusions they draw after their observations. Brainstorm with the students to fill any voids in the class chart. Retain chart for future discussions.

Activity 3: Conservation of Energy (SI GLEs: 1, 7; PS GLEs: 7, 24, 25, 26, 28, 30, 39)

Material List: Energy Hunt class chart from Activity 2, wide strips of chart paper or sentence strips for each group (for flow chart graphic organizers)

Introduce students to the Law of Conservation of Energy and the concept that energy is neither created nor destroyed, but changes from one form to another. Use the Energy Hunt class chart to identify the different forms energy may take (light, heat, sound, chemical, mechanical, electricity). Point out to students that while energy is found in many forms, they can all be placed into two main categories: kinetic and potential.

Student groups will select several energy users from the class chart or from their own Home Energy Hunt charts and create a *graphic organizer* (view literacy strategy descriptions) or flow chart that illustrates how the use of one form of energy produces another form of energy. They should track each transformation of energy from start to finish.

Example: incandescent bulb lamp → electrical → heat→light
blow dryer → electrical→heat & mechanical (fan)→wind
flashlight →chemical (battery) →electrical→light
radio→electrical→sound

The flow charts should be written on sentence strips or chart paper to encourage students to produce large flow charts. Each group should be able to complete at least five different paths of energy. The groups will exchange flow charts to critique the accuracy of the transformations tracked. Students must create a corrected version of the tracking in question if they disagree with any. They may not change the original group's version; just provide their own corrected version.

Once each group has completed their critiquing,

- Have the groups that challenge any of the paths present their version and justify why they believe it to be more accurate.

- Add the more accurate paths to the collection and remove those less accurate.
- Post the results in the room for all students to see.
- Have students identify the sources of energy for each object tracked on the strips. Can they trace the producer of the energy source for the object back to its origin? (e.g., Blow dryer → runs on electricity → produced by burning coal)

Challenge students to locate and identify the energy plants in Louisiana and the source of fuel for the production of energy.

Review the concept that heat is internal energy or kinetic energy and that this energy can be transformed. Help students recognize that kinetic energy involves motion of waves, electrons, atoms, molecules and objects. When students rub their hands together to demonstrate friction, heat is produced and the demonstration can, on a simple scale, simulate the movement or kinetic energy of particles and the production of heat. Students should be able to identify energy that is stored as potential energy and other forms of energy as kinetic. (Remind students that they also observed kinetic energy changing to potential energy and back to kinetic energy when they did the pendulum investigation in Unit 1 and with catapults in Unit 4.)

Identify the energy users that produce heat.

- Is the heat transferred through direct contact (*conduction*), such as the hot plate on a coffee pot or the flat plate of an iron?
- Is the heat transferred through the air (*convection*), such as a blow dryer, central heat unit, or a convection oven?
- Is the heat transferred as it radiates from the source (*radiant*), such as incandescent light bulbs, regular ovens, or fireplaces?

Students should identify any energy transformations that involve an energy source that produces electricity. Examples would include solar powered calculators, battery powered objects, or crank- type weather radios. If these examples do not show up in the student explorations, bring examples that allow the students to discover this connection. Ultimately, students should be able to describe how electricity can be produced from other types of energy (solar, chemical, mechanical). The students should also be able to look at the big picture and connect state energy producers to the sources used for energy production (coal, hydropower, natural gas, nuclear energy, petroleum, and biomass).

Activity 4: Waves (SI GLEs: 1, 2, 4, 7, 23; PS GLEs: <u>25</u>, 26, 28, <u>31</u>, <u>32</u>, 35, 36, 37, 38)

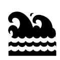
Material List: for DEMO: 1 large spring toy or long, flexible spring from hardware store, for ACTIVITY: copy of the electromagnetic spectrum for each student or for whole class use, empty food cans (2 per group, top removed, nail hole in center bottom), string, flashlights, hot water, coffee mug, pot holder, science learning logs, class Energy Hunt chart from Activity 2, safety goggles, Vocabulary Word Card Guide BLM for each student

Safety Note: Caution needs to be taken that spring toys are not overstretched or suddenly released; injury may result. Protective eye goggles should be worn by the teacher and assistant while using a metal coiled spring toy or spring.

Part 1- DEMO: the teacher will model wave types and demonstrate the movement of energy along the wave. A metal-coiled spring toy is the modeling instrument of choice (Inspect all metal spring toys before and after laboratory use.) Long, flexible springs are also available at hardware stores.

Select a student to assist in a demonstration of the movement of waves and how energy is transferred along the wave. Lead students to describe what they see and explain their observations with appropriate vocabulary: *waves*, *amplitude*, *frequency*, *crest*, *trough*, *speed*, and *energy*.

Have students create *vocabulary word cards* (view literacy strategy descriptions) to strengthen their understanding of the wave vocabulary. Distribute the Vocabulary Word Card Guide BLM to each student to use as an example. Students will place one vocabulary word in the center of each card; add a diagram to one corner, a definition to another corner, a sentence that correctly uses the term in the third corner, and a related word (an opposite or a word that goes with the center word) in the last corner.

Disturbance that carries energy from place to place		The wave carried Sam to the shore.
	WAVE	
		ocean, seismic, sound

Provide examples of where they may see waves in action and provide information on the difference between transverse waves (i.e., light, water) and longitudinal waves (i.e., sound). Students should be able to draw a correlation between the information they gain from the wave demonstrations and the Law of Conservation of Energy.

PART 2

Ask students how they think light, sound, and heat energy get from one place to another. Set up a student investigation involving how light travels (students use a flashlight and pay attention to how the light moves across the room, and through different media), how sound travels (students use two cans with a string knotted through the bottom and pulled taut in order to talk to another student across the room), and how heat travels (fill a coffee mug with hot water; warmth comes through the cup materials from the heated liquid).

Heat always moves from a warmer medium (material through which it travels) to a cooler medium. When we *lose* heat it is moving to that cooler medium. Can students identify specific instances where *thermal energy* or *heat* travels from higher energy to lower energy?

Heat can travel from material to material by *conduction*, from material through the air by *convection*, and by radiating out from a source like the Sun in *radiant heat from the Sun*. Students should revisit the class Energy Hunt chart of energy users from the home and review which involve radiant heat (fireplace, gas heaters, etc.), which involve heat conduction (coffee maker, hot plate, stove tops), and which involve convection (blow dryers, convection ovens, central heat in the home).

Sound needs a medium through which to travel, which is why we cannot hear in the vacuum of space. Speaking into the can sent sound vibrations (*waves*) traveling along the string to the other can.

Light does not need a medium in order to travel and so we can see the light of stars through the vacuum of space. This will be explored in a following activity but can be incorporated at this time, if the teacher chooses.

Students will examine a diagram of the electromagnetic spectrum and identify the parts of the spectrum of which they are familiar. Have students compare the wavelengths of each part of the spectrum and identify what type of energy falls on either side of the visible spectrum. Can students recognize the relationship between shorter wavelengths and higher frequencies? Students should add this observation to their science *learning log* to expand their documentation of the characteristics of waves.

The teacher will need to help students understand that a red tomato reflects red back to the eye of the viewer and that an object's color is related to the wavelength of light transmitted to the observer's eye.

See NASA's website on the electromagnetic spectrum to provide information for this.
http://imagine.gsfc.nasa.gov/docs/science/know_l1/emspectrum.html
or for a copy of the electromagnetic spectrum see
http://www.nasa.gov/centers/langley/images/content/114284main_EM_Spectrum500.jpg

PART 3
Review the vocabulary of waves (*trough, crest, frequency, and wavelength*) and the *electromagnetic spectrum*. Challenge each student to select light, heat, or sound and create a home investigation to identify the ways their energy topic can be absorbed, reflected, transferred and transformed. Create testable investigation questions with the students such as

- How does this energy travel?
- What substance is most efficient or least efficient as a medium for travel?
- How is this energy reflected, absorbed, transferred, or changed to a new form?

Students will use a variety of resources to collect information on the various energy forms as they plan their home investigation. Students must present safety considerations along with their investigation plan. The home investigations should include a component that indicates that parents are aware of the object of the investigation. Students will plan investigations, create chart or tables for data, record their observations /data and communicate their results with others in the class. They must identify potential problems, safety aspects, and questions that should be considered in the investigation.

Set aside one day for *professor know-it-all* (view literacy strategy descriptions). Students with similar energy sources (light, heat, sound) will form a team to act as the energy *travel agents*. All students will generate several questions to ask of the other groups and to respond to regarding their own topic. The teams may take a question, huddle, and have a spokesperson from the team of *professor know-it-alls* answer the question.

Activity 5: Refract and Reflect Exploration Centers (SI GLEs: 1, 4, 7, 12, 13, 15, 16, 22, 23; PS GLEs: 26, 33, 34, 36)

Materials List: glass containers or plastic cups, water, white tempura paint, several flashlights, two cardboard boxes with insides painted white, small working fluorescent fixture with bulb, incandescent bulb in working lamp base, small black-light bulb and fixture, access to electricity, prisms or discarded CDs, mirrors, water in a bowl with a light source over it, small mirrors, small stick-on convex mirrors (auto parts stores), squares of transparent colored plastic sheets in red, blue, and yellow, clear overhead transparency sheets cut into fourths, eyedroppers or pipettes, pencils, diffraction (*rainbow)* glasses (available from catalogue and online novelty stores), ½ project board to serve as a table-sized visual obstacle, several small brightly colored objects (apple, lemon, ball, etc.), newspaper or magazine pages, science learning logs

Have students identify and discuss the safety concerns that must be addressed before beginning this activity (moving from center to center carefully, keeping glass and lights away from the edge of tables, flashlights not to be shined in anyone's eyes, keeping cords away from avenues of travel, etc.).

Set-up exploration centers in the room to demonstrate some of the unique phenomena that can be demonstrated by examining some of the properties of light**.** Students should use their science *learning logs* (view literacy strategy descriptions) when recording their observations, illustrations, and explanations.

Center options include:

- Two glass containers, vases or clear plastic containers, water with 2 ml of white tempura paint added for one container and clear water for the other, and a flashlight. Students will investigate the properties involved when the light is shined through the water at various angles. Where does the light go in? Where does it come out? What difference is noted between shining the light through the milky water and the clear water? (light shined into the cloudy water is absorbed and does not pass through the container)
- Two cardboard boxes with one end open and painted white in both interiors, one small fluorescent light (bulb in fixture), and one incandescent light (bulb in fixture). Place or install a light source in each box and provide a set of brightly colored objects to view, describe, and compare under each light source. A third station with a black light may also be set up. Students should note the subtle differences in the colors of the objects under each light source. Student's science *learning log* entries should include reference to the relationship of an object's color and how the viewer sees colors that are reflected versus those that are absorbed.
- Have diffraction glasses available for students to view the different types of light used (incandescent, fluorescent, and black-light). They should note any differences in the widths of the colors of the spectrum they see while using the glasses to view each light (the width of each band of the spectrum appears in different widths according to the type of light viewed).
- Provide research that explains the workings of a black-light for students to read. The following website explains how a black-light works.

http://science.howstuffworks.com/black-light.htm

- A clear cup filled with water. Place a pencil in the glass and look at it at eye level. Ask: What is different about the image as seen under water? Students should illustrate what they observe from the top and side. Draw a diagram of the pencil as seen from the top and as seen from the side. Students should also hold the pencil straight in the center of the cup and note the difference in the submerged portion of the pencil (the pencil will appear broken or bent as the object is viewed through the water).
- A prism or a discarded CD and a flashlight. Shine the flashlight through the prism or over the unprinted side of the CD. Students should note what is seen (a rainbow) and draw and color their observations exactly as seen.
- Provide sections of colored clear plastic (red, yellow, blue) through which students may shine their lights and observe the color combinations, as well as the paths of the light. They may even be able to see the combination of all three colors will create white light.
- Provide a flashlight, a large cardboard tabletop divider (1/2 project boards work well), and several small mirrors. An obstacle is placed between two students, with one student facing the obstacle and the other holding the flashlight. Challenge the students to use the mirrors to direct the light around the obstacle to where the other student can see the light. How does this explain the workings of a periscope? Students should diagram the solution they create to the problem. (A good lead in for the teacher to discuss the *angle of incidence = angle of reflection*!)
- Provide small clear plastic sheets (cut transparencies into fourths), pipettes, sections of newspaper pages or magazine pages, and water. Have students use the drops of water on the transparencies and create a water drop lens. Have students draw the set-up and the resulting view or the print through the "lens."
- Provide several different sized stick-on convex mirrors (often used to increase viewing area on side view mirrors) and a flashlight. Have students shine the light into the lens and observe the angle at which the beam is reflected.

Students should summarize their observations at each station in brief, but concise, science *learning log* entries and include sketches and drawings when appropriate. They should be able to generalize any patterns in data they recognize and what those patterns may indicate.

Once observations have been made, the teacher should guide a class discussion regarding the properties of light and how these properties were observed in their explorations. Students should also give examples of where these phenomena are seen in everyday life. Through the discussion, students may be able to identify the limitations of the models used to represent natural phenomena.

The teacher should present information on the Laws of Reflection and Refraction, along with terms such as *angle of incidence*, *angle of reflection*, *diffused light*, *transparent*, *translucent*, and *spectrum*. Have students add these words (and others as identified) to their science *learning logs* where they apply. Students should be able to describe in their learning log entries, how light was reflected, absorbed, or transmitted.

Activity 6: Flashlight Investigation (SI GLEs: 1, 11, 12, 14, 19, 22, 23, 25, 33; PS GLEs: 30)

Material List: working flashlight for each pair of students, unlined paper for each pair of students, pencils

Have students review and discuss safety guidelines for investigations using batteries and lights.

Distribute flashlights and paper. Instruct students to determine how the flashlight works and then draw a detailed, labeled diagram or model of all the workings of the flashlight. Students will explain the points where energy is transformed into a different form of energy (chemical, light, heat). They should label these points on their illustrations.

Each pair of students will work together to disassemble the flashlight and determine the flow of energy required to light the bulb. As the students are generating their testable questions regarding the energy flow through the flashlight, they should be able to identify factors that should be considered in a scientific investigation.

Each team will draw an illustration to show the path of the energy and label the energy transformations that occur within the flashlight. They must work with their partner to provide the most detailed and accurate illustration of every step involved in the operation of the flashlight.

The teacher should display the results and discuss the interpretations. While drawings should be compared and critiqued, the accuracy of the path of energy is the focus. Have students check to make sure contact is visible throughout the entire path of electricity for the flashlight. Peers should make recommendations for improvement of those models where the path of electricity is not clear or connected.

Direct students to research the development of personal light sources and identify areas in which this technology has changed the way we do things. This exploration also sets the stage for a guest speaker such as an electrician who could present the path of energy that runs to and through the school and powers the equipment there. Students may also track energy paths in common household or classroom objects (toaster, projector, fans, lamps, etc.). Safety must be a priority in home investigations, also. Suggest students visit http://www.howstuffworks.com/ for explanations of how simple appliances work.

Activity 7: Solar Collector: (SI GLEs: 1, 2, 4, 5, 6, 7, 8, 11, 12; PS GLEs: 26, 37, 38)

Materials List: colored paper, water, plastic cups, rocks, paint, thermometers, timers, plastic wrap, aluminum foil, fabrics, tape, foam, science learning logs, internet access

Begin with a discussion on dressing appropriately for the weather. Students will need to be guided through a discussion of how wearing certain colors will impact our comfort on warm days. Lead them to conclude that dark colors tend to absorb heat (make us hotter) and lighter colors tend to reflect heat (keep us cooler).

Set up an investigation to provide proof that darker colors do absorb more heat than lighter colors and that lighter colors reflect more heat than darker colors. Suggested sites for this investigation:

- http://www.all-science-fair-projects.com/science_fair_projects/58/728/1bbc768c13fc337d3c85917052da2c51.html
- http://www.reachoutmichigan.org/funexperiments/agesubject/lessons/smores.html

From this point move to a discussion of how people keep warm in the winter months (wear coats, hats and gloves and maybe they'll add Wear dark colors!) Lead them to a discussion of the benefit of wearing a hat and the heat loss that occurs through our heads or through other exposed body parts. This is where students should be able to connect the flow of thermal energy (heat) from a system of high temperatures to a system of lower temperatures. This is the "we don't get cold; we lose heat" concept.

Challenge the students to create a way to measure the collection of radiant energy and retain the radiant energy as thermal energy. They must formulate a question to investigate before they begin the actual investigation. (Example: Will the number of layers of fabric help insulate to prevent the loss of thermal energy for a longer period of time?)

Have students review safety guidelines and include a plan for a safe investigation.

Provide a collection of materials that they can use to evaluate their ability to gather thermal energy and other materials that might be used to contain or insulate the loss of thermal energy. Suggested materials might include colored paper, water, plastic cups, rocks, paint, thermometers, timers, plastic wrap, aluminum foil, fabrics, tape, foam, etc. Make certain the students/student teams provide a system of methodically collecting data that will ensure consistency and precision when they prepare the report summarizing their findings.

Student teams should then critique and analyze their investigation model and the model of the other teams.

- Were independent and dependant variables identified?
- Were all variables controlled?
- Does the data collected reflect consistency and accuracy?
- Was the metric system utilized in the collection of data?

The students need to be able to plan their investigation thoroughly and then show reflective evidence that their plan addresses the initial goals of collecting and retaining thermal energy. Their conclusions should be presented to the class in an oral report and the presentation should reflect a conclusion based on their findings. This may take several days to complete.

Students should recognize the importance of the information they generate regarding the use of collecting, reflecting, and storing energy and its relevance to daily living.
During the investigations and once the investigations are completed students may add reflective entries to their science *learning logs* (view literacy strategy descriptions) that are based on *SPAWN* (view literacy strategy descriptions) w*riting prompts.*

Using the following prompts, encourage reflective writing at the start of class periods, for homework, and at the end of the investigation.

S – Special Powers
You have the power to collect energy and transfer it to anything you deem in need. What form does your energy take and how is it transformed?

P-- Problem Solving
We've been studying how thermal energy is retained. How might this knowledge be used to improve the quality of life for people?

A – Alternative Viewpoints
Your parents keep fussing about your opening the refrigerator and staring inside for a snack. Why do you think they see this as a waste of energy?

W – What If?
What would you do if your heat went out early this winter and the repair man said it would be 24 hours before he could fix it? How would you deal with the lower temperatures in your house (besides going to another place to stay!)?

N – Next
You've just learned that because the moon has one side that is always lit by the Sun, NASA is going to set up a solar energy station there. What do you think will be the next step of that plan?

Activity 8: Saving Energy @ Home (SI GLEs: 3, 11, 19; SE GLEs: 43, 46)

Materials List: Internet access, copies of selected survey for each student, poster materials

Locate a home energy use survey online (see below) or by contacting a local energy company or cooperative extension service/county agent.

Energy Scavenger Hunt and energy saving activities and games:
http://www.energyhog.org/childrens.htm
Home energy survey:
http://www.energyquest.ca.gov/library/documents/2007_HOME_ENERGY_SURVEY.PDF
Teacher guide:
http://www.energyhog.org/adult/educators.htm

Students will survey the use and/or waste of energy in the home. Some students may want to investigate the energy use at school as an alternative. Students should also explain how the use of different energy resources affects the environment and the economy.

Students can track the use of energy and the impact that energy consumption has. Create "campaign" posters to encourage people to conserve energy and/or resources. Posters can also focus on ways to reuse, recycle, and reduce energy use.

Sample Assessments

General Guidelines

Assessment will be from teacher observation/checklist notes of student participation in unit activities, the extent of successful accomplishment of tasks, and the degree of accuracy of oral and written descriptions/responses. Journal entries provide reflective assessment of class discussions and laboratory experiences. Performance-based assessment should be utilized to evaluate inquiry and laboratory technique skills. All student-generated work, such as drawings, data collection charts, models, etc., may be incorporated into a portfolio assessment system

- Students should be monitored throughout the work on all activities.
- All student-developed products should be evaluated as the unit continues.
- When possible, students should assist in developing any rubrics that will be used and provided the rubric during task directions.
- Team assessment should also be based on a rubric developed with student input.

General Assessments

- The students will describe the transfer of energy from one form to another and connect this with real life examples.
- The students will diagram/illustrate the flow of energy in a flashlight.
- The students will design and report on sound, light, or heat experiments.
- The students will identify and describe how light, heat, and sound energy travel.
- The students will be able to correctly use the terms reflection and refraction when describing how light travels.
- The students will be able to compare renewable, nonrenewable, and inexhaustible resources and give examples of each.

Activity-Specific Assessments

- Activity 2: Students will correctly and completely track the energy transformations in common household items and appliances.

- Activity 4: Students will correctly utilize appropriate wave vocabulary to describe wave phenomena and to illustrate the parts of a wave. Entries in their science *learning logs* should reflect an understanding of the terms used, also.

- Activity 6: Students will correctly illustrate the flow of energy through a flashlight, beginning with the switch and ending with the light produced. Students should also produce a reasonable diagram of the path of energy and the transformation of energy as it travels through the flashlight.

- Activity 8: Students will create posters that demonstrate an understanding of how resources can be sustained through recycling, reducing, and reusing our natural resources.

Resources

- NASA provides illustrations and information regarding visible light http://science.hq.nasa.gov/kids/imagers/ems/visible.html
- Cooling underwear at this one http://www.nasaexplores.com/show_58_teacher_sh.php?id=02123180757
- *Saving Energy and Energy Conservation.* Available online at http://www.energyquest.ca.gov/story/chapter19.html
- *Do It Yourself Energy Quiz* for students. Available online at http://www.epatrol.org
- *Forms of Energy and Energy Consumption* by Source, Available online at http://www.eia.doe.gov/kids/energyfacts/science/formsofenergy.html
- *Solar Collectors*. Available online as science fair projects http://www.need.org/energyfair.php
- *Energy Transfer / Energy Rules*. Available online at http://www.uwsp.edu/cnr/wcee/keep/Mod1/Rules/EnTransfer.htm
- *Potential Energy*. Available online at http://www.glenbrook.k12.il.us/gbssci/phys/Class/energy/u5l1b.html
- *Waves.* Available online at http://www.glenbrook.k12.il.us/gbssci/phys/Class/waves/u10l1a.html