Sixth Grade Companion Document

6-Unit 1: Matter and Energy

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Introduction to the K-7 Companion Document
An Instructional Framework

Overview

The Michigan K-7 Grade Level Content Expectations for Science establish what every student is expected to know and be able to do by the end of Grade Seven as mandated by the legislation in the State of Michigan. The Science Content Expectations Documents have raised the bar for our students, teachers and educational systems.

In an effort to support these standards and help our elementary and middle school teachers develop rigorous and relevant curricula to assist students in mastery, the Michigan Science Leadership Academy, in collaboration with the Michigan Mathematics and Science Center Network and the Michigan Science Teachers Association, worked in partnership with Michigan Department of Education to develop these companion documents. Our goal is for each student to master the science content expectations as outlined in each grade level of the K-7 Grade Level Content Expectations.

This instructional framework is an effort to clarify possible units within the K-7 Science Grade Level Content Expectations. The Instructional Framework provides descriptions of instructional activities that are appropriate for inquiry science in the classroom and meet the instructional goals. Included are brief descriptions of multiple activities that provide the learner with opportunities for exploration and observation, planning and conducting investigations, presenting findings and expanding thinking beyond the classroom.

These companion documents are an effort to clarify and support the K-7 Science Content Expectations. Each grade level has been organized into four teachable units- organized around the big ideas and conceptual themes in earth, life and physical science. . The document is similar in format to the Science Assessment and Item Specifications for the 2009 National Assessment for Education Progress (NAEP). The companion documents are intended to provide boundaries to the content expectations. These boundaries are presented as “notes to teachers”, not comprehensive descriptions of the full range of science content; they do not stand alone, but rather, work in conjunction with the content expectations. The boundaries use seven categories of parameters:

a. **Clarifications** refer to the restatement of the “key idea” or specific intent or elaboration of the content statements. They are not intended to denote a sense of content priority. The clarifications guide assessment.
b. **Vocabulary** refers to the vocabulary for use and application of the science topics and principles that appear in the content statements and expectations. The terms in this section along with those presented

within the standard, content statement and content expectation comprise the assessable vocabulary.

c. **Instruments, Measurements and Representations** refer to the instruments students are expected to use and the level of precision expected to measure, classify and interpret phenomena or measurement. This section contains assessable information.
d. **Inquiry Instructional Examples** presented to assist the student in becoming engaged in the study of science through their natural curiosity in the subject matter that is of high interest. Students explore and begin to form ideas and try to make sense of the world around them. Students are guided in the process of scientific inquiry through purposeful observations, investigations and demonstrating understanding through a variety of experiences. Students observe, classify, predict, measure and identify and control variables while doing “hands-on” activities.
e. **Assessment Examples** are presented to help clarify how the teacher can conduct formative assessments in the classroom to assess student progress and understanding
f. **Enrichment and Intervention** is instructional examples the stretch the thinking beyond the instructional examples and provides ideas for reinforcement of challenging concepts.
g. **Examples, Observations, Phenomena** are included as exemplars of different modes of instruction appropriate to the unit in which they are listed. These examples include reflection, a link to real world application, and elaboration beyond the classroom. These examples are intended for instructional guidance only and are not assessable.
h. **Curricular Connections and Integrations** are offered to assist the teacher and curriculum administrator in aligning the science curriculum with other areas of the school curriculum. Ideas are presented that will assist the classroom instructor in making appropriate connections of science with other aspects of the total curriculum.

This Instructional Framework is NOT a step-by-step instructional manual but a guide developed to help teachers and curriculum developers design their own lesson plans, select useful portions of text, and create assessments that are aligned with the grade level science curriculum for the State of Michigan. It is not intended to be a curriculum, but ideas and suggestions for generating and implementing high quality K-7 instruction and inquiry activities to assist the classroom teacher in implementing these science content expectations in the classroom.

6th Grade Unit 1:
Matter and Energy

Content Statements and Expectations

Code	Statements & Expectations	Page
P.EN.M.1	**Kinetic and Potential Energy – Objects and substances in motion have kinetic energy. Objects and substances may have potential energy due to their relative positions in a system. Gravitational, elastic, and chemical energy are all forms of potential energy.**	1
P.EN.06.11	Identify kinetic or potential energy in everyday situations (for example: stretched rubber band, objects in motion, ball on a hill, food energy).	1
P.EN.06.12	Demonstrate the transformation between potential and kinetic energy in simple mechanical systems (for example: roller coasters, pendulums).	3
P.EN.M.4	**Energy Transfer – Different forms of energy can be transferred from place to place by radiation, conduction, or convection. When energy is transferred from one system to another, the quantity of energy before the transfer is equal to the quantity of energy after the transfer.**	3
P.EN.06.41	Explain how different forms of energy can be transferred from one place to another by radiation, conduction, or convection.	3
P.EN.06.42	Illustrate how energy can be transferred while no energy is lost or gained in the transfer.	4
P.CM.M.1	**Changes in State – Matter changing from state to state can be explained by using models, which show that matter is composed of tiny particles in motion. When changes of state occur, the atoms and/or molecules are not changed in structure. When the changes in state occur, mass is conserved because matter is not created or destroyed.**	4
P.CM.06.11	Describe and illustrate changes in state, in terms of arrangement and relative motion of the atoms or molecules.	4
P.CM.06.12	Explain how mass is conserved as a substance changes from state to state in a closed system.	5

6 – Unit 1: Matter and Energy

Big Ideas (Key Concepts)

- Objects and substances in motion have kinetic energy.
- Objects and substances have potential energy due to their relative position in a system.
- Heat energy is transferred by radiation, conduction, and convections.
- Physically changing states of matter does not create a new substance.
- Everything we do is connected to energy in one form or another.

Clarification of Content Expectations

Standard: Energy

Content Statement – P.EN.M.1

Kinetic and Potential Energy – Objects and substances in motion have kinetic energy. Objects and substances may have potential energy due to their relative positions in a system. Gravitational, elastic, and chemical energy are all forms of potential energy.

Content Expectations

P.EN.06.11 Identify kinetic or potential energy in everyday situations (for example: stretched rubber band, objects in motion, ball on a hill, food energy).

Instructional Clarifications

1. Identify means recognize the properties of kinetic energy and potential energy in everyday situations.
2. Energy is the ability to do work or the ability to make things change. Energy occurs in two primary types, potential and kinetic.
3. Kinetic energy is energy of motion found in objects or substances. Only moving objects have kinetic energy.
4. Objects and substances may have potential energy due to their relative positions in a system. Common examples include:
    a. An object placed on a high shelf has greater potential energy than one placed on a low shelf.
    b. A stretched elastic band has greater potential energy than one that is not stretched.

    c. Large molecules such as sugar have greater potential energy than smaller molecules such as carbon dioxide and water.
5. Potential energy can b e converted to kinetic energy. For example, potential energy of a battery can be converted to kinetic energy in an electric motor.
6. Kinetic energy can be converted to potential energy. For example, a windmill's kinetic energy can be converted to potential energy as it charges storage batteries.
7. Energy may be changed from one form to another, but the amount of energy stays the same.

Assessment Clarifications

1. Energy is the ability to do work or the ability to move an object. Energy occurs in two primary types, potential and kinetic
2. Kinetic energy is energy of motion found in objects or substances. Only moving objects have kinetic energy.
3. Potential energy is energy possessed by an object as a result of its position or height above the ground rather than its motion. The amount of potential energy depends on its mass and height. Potential energy can be converted to kinetic energy.

P.EN.06.12 Demonstrate the transformation between potential and kinetic energy in simple mechanical systems (for example: roller coasters, pendulums).

Instructional Clarifications

1. Demonstrate is to show through manipulation of materials, drawings, and written and verbal explanations the transformation between potential and kinetic energy in simple mechanical systems.
2. Energy is the ability to do work. Energy has many forms and can transfer from one form to another. Several different forms of energy, including kinetic, potential, thermal, gravitational, elastic, and chemical have been defined to explain all known natural phenomena.
3. Transformation between potential and kinetic energy is the change in the motion or position of an object from one form to another.
4. The transformation from potential energy to kinetic energy occurs when the object is in motion. The roller coaster car has potential energy at the top of each rise in the track and transforms to kinetic energy as the car moves down the track. The higher the roller coaster car, the greater the potential energy.
5. The transformation from kinetic energy occurs when an object transfers from a moving object to an object in a position with potential energy.
6. A mechanical system is an arrangement of parts that work together.
7. Simple mechanical systems use potential and kinetic energy, such as a roller coaster, pendulum, tossing a basketball, doing a long jump, a car going down a ramp, jumping on a pogo stick, and blowing on a pinwheel.

Assessment Clarifications

1. Potential energy changes to kinetic energy and back again.

2. The transformation from potential energy to kinetic energy occurs when the object is in motion. The roller coaster car has potential energy at the top of each rise in the track and transforms to kinetic energy as the car moves down the track. The higher the roller coaster car, the greater the potential energy.
3. The transformation from kinetic energy occurs when an object transfers from a moving object to an object in a position with potential energy.
4. A simple mechanical system like a roller coaster or pendulum shows that potential and kinetic energy change from potential energy and kinetic energy and back again.

Content Statement – P.EN.M.4

Energy Transfer – Different forms of energy can be transferred from place to place by radiation, conduction, or convection. When energy is transferred from one system to another, the quantity of energy before the transfer is equal to the quantity of energy after the transfer.

Content Expectations

P.EN.06.41 Explain how different forms of energy can be transferred from one place to another by radiation, conduction, or convection.

Instructional Clarifications

1. Explain is to clearly describe by means of illustrations (drawing), demonstrations, and/or verbally how different forms of energy can be transferred from place to place by radiation, conduction, or convection.
2. Energy is the ability to do work. Several different forms of energy, including kinetic, potential, thermal, gravitational, elastic, chemical, and mass have been defined to explain all known natural phenomena.
3. Energy can be transferred (travel) from place to place.
4. Heat is given off when an object's thermal energy is transferred. Thermal energy can be transferred in three ways: by conduction, by convection, and by radiation.
5. Radiation is the transfer of energy by waves.
6. Conduction is the transfer of heat energy by direct contact between particles.
7. Convection is the transfer of heat energy through liquids and gases by moving particles.

Assessment Clarifications

1. Energy can travel from place to place.
2. Radiation is the transfer of energy by waves.
3. Conduction is the transfer of heat energy by direct contact between particles.
4. Convection is the transfer of heat energy through liquids and gases by moving particles.

P.EN.06.42 Illustrate how energy can be transferred while no energy is lost or gained in the transfer.

Instructional Clarifications

1. Illustrate is to clarify by way of drawings, diagrams, verbally, and/or written examples or comparisons how energy can be transferred while no energy is lost or gained in the transfer.
2. Energy is the ability to do work. Several different forms of energy, including kinetic, potential, thermal, gravitational, elastic, chemical, and mass have been defined to explain natural phenomena.
3. Energy is not lost or gained when it is transferred (moved) from potential to kinetic energy.
4. As an object falls, potential energy decreases and kinetic energy increases.
5. As an object is raised (elevated) kinetic energy decreases, and potential energy increases.

Assessment Clarifications

1. Energy is not lost or gained when energy is moved from potential to kinetic energy.
2. As an object falls, potential energy decreases and kinetic energy increases.
3. As an object is raised (elevated) kinetic energy decreases, and potential energy increases.

Standard: Changes in Matter

Content Statement – P.CM.M.1

Changes in State – Matter changing from state to state can be explained by using models, which show that matter is composed of tiny particles in motion. When changes of state occur, the atoms and/or molecules are not changed in structure. When the changes in state occur, mass is conserved because matter is not created or destroyed.

Content Expectations

P.CM.06.11 Describe and illustrate changes in state, in terms of arrangement and relative motion of the atoms or molecules.

Instructional Clarifications

1. Describe is to tell or depict in spoken or written words how changes in state happen in terms of arrangement and relative motion of atoms or molecules.

2. Illustrate is to clarify by way of drawings, diagrams, verbally, and/or written examples or comparisons changes in state, in terms of arrangement and relative motion of atoms or molecules.
3. The term change refers to physical change.
4. A material will change from one state to another at specific combinations of temperature and surrounding pressure.
5. The states of matter include solid, liquid, gas, and plasma.
6. Processes such as freezing, melting, evaporation, condensation, sublimation, and deposition are various changes in states of matter.
7. The temperature of a material will increase or decrease until it reaches the point where the change takes place. It will stay at that temperature until that change is completed.
8. The motion of molecules or atoms will increase or decrease as temperature increases or decreases.
9. Atoms are the smallest particles that make up all matter; molecules are a combination of two or more atoms.

Assessment Clarifications

1. The term change refers to physical change.
2. A material will change from one state to another at specific combinations of temperature and surrounding pressure.
3. The states of matter include solid, liquid, gas, and plasma.
4. Processes such as freezing, melting, evaporation (boiling point), condensation, are various changes in states of matter.
5. The temperature of a material will increase or decrease until it reaches the point where the change takes place. It will stay at that temperature until that change is completed.
6. The motion of molecules or atoms will increase or decrease as temperature increases or decreases.
7. Atoms are the smallest particles that make up all matter; molecules are a combination of two or more atoms.

P.CM.06.12 – Explain how mass is conserved as a substance changes from state to state in a closed system.

Instructional Clarifications

1. Explain is to clearly describe by means of illustrations (drawing), demonstrations, written reports, or verbally how mass is conserved as it changes from state to state in a closed.
2. Mass is the amount of matter an object contains.
3. When mass is conserved the amount of matter stays the same.
4. A closed system is a contained or isolated environment without influence or interaction with outside environments.
5. An example of conservation of mass in a closed system would be an ice cube (solid) in a covered jar that is allowed to melt (liquid). The mass before and the mass after would be conserved or the same. The closed system ensures that the melting ice cube is not influenced by evaporation or other atmospheric conditions from the outside environment.

Assessment Clarifications

1. When mass is conserved its stays the same.
2. A closed system is a contained or isolated environment without influence or interaction with outside environments.
3. An example of mass in a closed system would be an ice cube (solid) in a covered jar and that is allowed to melt (liquid). The mass before and the mass after would be conserved or the same. The closed system ensures that the melting ice cube is not influenced by evaporation or other atmospheric conditions from the outside environment.

Inquiry Process, Inquiry Analysis and Communication, Reflection and Social Implications

Inquiry Process
S.IP.06.11 Generate scientific questions based on observations, investigations, and research concerning energy and changes in matter.
S.IP.06.12 Design and conduct scientific investigations to understand energy and changes in matter.
S.IP.06.13 Use tools and equipment (models, thermometers) appropriate to scientific investigations of energy and changes in matter.
S.IP.06.14 Use metric measurement devices in an investigation of energy and changes in matter.
S.IP.06.15 Construct charts and graphs from data and observations dealing with energy and changes in matter.
S.IP.06.16 Identify patterns in data dealing with energy and changes in matter.
Inquiry Analysis and Communication
S.IA.06.11 Analyze information from data tables and graphs to answer scientific questions on energy and changes in matter.
S.IA.06.12 Evaluate data, claims, and personal knowledge through collaborative science discourse about energy and changes in matter.
S.IA.06.13 Communicate and defend findings of observations and investigations about energy and changes in matter using evidence.
S.IA.06.14 Draw conclusions from sets of data from multiple trials about energy and changes in matter using scientific investigation.
S.IA.06.15 Use multiple sources of information on energy and changes in matter to evaluate strengths and weaknesses of claims, arguments, or data.
Reflection and Social Implications
S.RS.06.11 Evaluate the strengths and weaknesses of claims, arguments, and data regarding energy and changes in matter.
S.RS.06.12 Describe limitations in personal and scientific knowledge regarding energy and changes in matter.
S.RS.06.13 Identify the need for evidence in making scientific decisions about energy and changes in matter.
S.RS.06.14 Evaluate scientific explanations based on current evidence and scientific principles dealing with energy and changes in matter.
S.RS.06.15 Demonstrate scientific concepts concerning energy and changes in matter through various illustrations, performances, models, exhibits, and activities.
S.RS.06.16 Design solutions to problems on energy and changes in matter using technology.
S.RS.06.17 Describe the effect humans and other organisms have on the balance of the natural world when matter is changed and/or energy is transferred.
S.RS.06.18 Describe what science and technology in regards to energy and changes in matter can and cannot reasonably contribute to society.
S.RS.06.19 Describe how science and technology of energy and changes in motion have advanced because of the contributions of many people throughout history and across cultures.

Vocabulary

Critically Important – State Assessable	Instructionally Useful
energy transfer heat transfer states of matter conduction convection radiation kinetic energy potential energy atoms molecules mass closed system transformation	matter mechanical systems motion solid liquid gas phase change plasma calorie Joule melting boiling point condensation freezing evaporation sublimation deposition conservation of energy

Instruments, Measurements, Representations

Measurements	Instruments/Tools	Representations
temperature	thermometer, hot plate	Celsius
time	stop watch, times, clock with second hand	seconds, minutes

Instructional Framework

The following Instructional Framework is an effort to clarify possible units within the K-7 Science Grade Level Content Expectations. The Instructional Framework provides descriptions of instructional activities that are appropriate for inquiry science in the classroom and meet the instructional goals. Included are brief descriptions of multiple activities that provide the learner with opportunities for exploration and observation, planning and conducting investigations, presenting findings, and expanding thinking beyond the classroom. The Instructional Framework is ***NOT*** *a step-by-step instructional manual, but a guide intended to help teachers and curriculum developers design their own lesson plans, select useful and appropriate resources and create assessments that are aligned with the grade level science curriculum for the State of Michigan.*

Instructional Examples

Kinetic and Potential Energy: P.EN.06.11, P.EN.06.12
Energy Transfer: P.EN.06.41, P.EN.06.42
Changes in State: P.CM.06.11, P.CM.06.12

Objectives

- Distinguish between kinetic and potential energies as found in everyday situations.
- Show how potential energy can become kinetic energy.
- Show how kinetic energy can become potential energy.
- Explain how heat energy is transferred from place to place by radiation, conduction, or convection.
- Describe changes in states of matter in terms of motion and arrangements of atoms and molecules.

Engage and Explore

- Students explore how different heights affect the potential energy of an object, and discover that a rubber ball and ping-pong ball bounce higher and a clay ball changes shape more when it is dropped from a high height. (P.EN.06.11, P.EN.06.12)
- Pop popcorn by using each of the transfer methods. (1) Pop popcorn in a pan on the stove – conduction, (2) Pop popcorn in a hot air popcorn popper – convection, and (3) Pop popcorn in the microwave – radiation. (P.EN.06.41, P.EN.06.42)
- Divide the students into groups. Each group selects at least three samples such as ice cream, stick of butter, gelatin, and ice cube. Place the items on a pie plate. Heat the items on the hot plate. Note the order in which items melt. Organize the data by placing the items that melted

last at the top of the list and the items that melted first at the bottom. (P.CM.06.11, P.CM.06.12)

Explain and Define

- Students analyze and explain their investigations into different samples as they change state of matter.
- As a class define the terms kinetic and potential energy. Kinetic energy is energy of motion found in objects or substances. Potential energy is the energy possessed by a body as a result of its position or condition rather than its motion. Energy may be changed from one form to another, but the amount of energy stays the same. (P.EN.06.11, P.EN.06.12)
- Heat energy can travel only by being carried along in some kind of material. In a pan on the stove, the pan heats the popcorn because the stove by means of conduction heats the pan. In a hot-air popcorn popper, the popcorn is heated by the hot air causing the popcorn to pop by means of convection. Finally, in a microwave oven, the popcorn is popped by means of radiation (micro-waves). (P.EN.06.41, P.EN.06.42)
- As a class, define the states of matter, solids, liquids, and gases in terms of the motion of the molecules. Make a "human model of a substance in each state. Have students stand shoulder to shoulder, packed closely together and jiggle or vibrate to demonstrate the motion of molecules in a solid. To make a "human model" of a liquid have students join hands and move around without letting go of each other. The final "human model" of a gas allows the students to roam around the room, bump into each other and move away, and move out the door if the door is open. Describe examples of weather conditions that show all three states of water. (P.CM.06.11, P.CM.06.12)

Elaborate and Apply

- Hold a rubber ball and a ping-pong ball at the height of 1 m. Release the balls and another student measures how high the balls bounce. Record the heights. Do this 3 times with each ball to. Then drop the rubber ball and ping-pong ball from 2 m. Again record the height. Repeat the activity with a clay ball the same size as the rubber and ping-pong balls at both 1 m and 2 m. What happened to the clay ball? (P.EN.06.11, P.EN.06.12, S.IP.06.11)
- Graph the results of the ping-pong ball and rubber ball. What was the relationship between the height and the bounce? What was expected/ predicted when the height was raised? When was potential energy changed to kinetic energy? When did the kinetic energy change back to potential energy? Was any energy lost in the process? (P.EN.06.11, P.EN.06.12)
- After popping the popcorn, the class will do a taste test as the preferred method of popping popcorn. Which method took the longest? Which of the methods - conduction, convection, radiation - was the "messiest?"

Poll the class as to the preferences. Make a table to show the results. (P.EN.06.41, P.EN.06.42)

- Each group selected at least three samples such as ice cream, stick of butter, gelatin, and ice cube. The items were placed a pie plate and heated. Note the order in which items melt. Organize the data by placing the items that melted last at the top of the list and the items that melted first at the bottom. This activity focuses on solids and liquids. Is there a way that the items can be changed to a gas? Graph the results on a graph within the small group, then compile a list for the whole group and graph the results on a large graph. Was the results predicted by the group before starting? Did the predictions and the results match? What type of materials melted the fastest? (P.CM.06.11, P.CM.06.12, S.IP.06.12)

Evaluate Student Understanding

Formative Assessment Examples

- What evidence was observed for potential energy using the ping-pong ball and rubber ball prior to being released at 1 m and then at 2 m? What happened to the amount of energy stored in the balls as they were raised from 1 m to 2 m? What happened to the energy stored in the balls when they were released? Some materials store energy when they change shape as they strike a surface. Then they release the energy. Which material, rubber, plastic, or clay, store energy this way? How was this determined? (P.EN.06.11, P.EN.06.12)
- Experiments that use transferring of energy, states of matter, and potential and kinetic energy and make inferences on what is expected to happen in each case. (P.EN.06.41, P.EN.06.42, P.EN.06.11, P.EN.06.12)
- Classroom discussion on transferring energy, states of matter, and potential and kinetic energy. (P.EN.06.41, P.EN.06.42, P.EN.06.11, P.EN.06.12)
- Student journal explaining the results of experiments conducted concerning transferring of energy, states of matter, and potential and kinetic energy. (P.CM.06.11, P.CM.06.12, P.EN.06.41, P.EN.06.42, P.EN.06.11, P.EN.06.12)
- With a partner or as a group, role play changes in matter and how potential energy changes to kinetic energy and back again. (P.EN.06.11, P.EN.06.12)
- Take a museum tour and/or alterative energy tour. What was learned about different forms of alternative energy? (P.EN.06.41, P.EN.06.42)
- Was there a time difference on how long it took the popcorn to pop? Was there a flavor difference? Each student is to write an essay on the three types of heat transfers, and how they apply to the popcorn. (P.EN.06.41, P.EN.06.42)
- After graphing the results, is there any inference that can be made about types of materials and how fast they melt? Individually, write a paragraph explaining the results of the experiment. What statements can

be made about matter changing states? (P.CM.06.11, P.CM.06.12, S.IP.06.15, S.IP.06.16)

- Summative Assessment Examples
- End of unit test covering states of matter, transferring energy, and kinetic and potential energy. (P.CM.06.11, P.CM.06.12, P.EN.06.41, P.EN.06.42, P.EN.06.11, P.EN.06.12)
- Each student designs and presents a poster, brochure, or Power Point presentation on energy transfer. (P.EN.06.41, P.EN.06.42)
- Each student writes report on uses/benefits of alternative power. (P.EN.06.41, P.EN.06.42)

Enrichment

- Observing kinetic and potential energy: Have the students jump on a pogo stick.
- Have students divide into groups and design a roller coaster. What happens if they change the design of their roller coaster? Students can research different roller coasters at amusement parks. What are some unique characteristics of the most popular roller coasters? What makes each roller coaster unique? When are the potential and kinetic energy the greatest and least for these roller coasters?
- Testing States of Matter: Students should take home and inflate and tie off the balloon. Carefully tie the string so that it is tight around the outside of the balloon. Put the balloon and string inside of the freezer for 30 minutes. After that time, check the balloon and record you observations. Check the balloon after an hour and record your observations. Write predictions as to what will happen to the balloon over time. The following class asks students: (a) what happened to the balloon? (b) How did the size change? (c) In what way might particle movement have changed for this to be observed? (d) Would collisions between particles have increased, decreased, or stayed the same? (e) Would the overall movement of the particles have increased, decreased, or stayed the same? (f) What might happen if the balloon was heated instead of cooling it? (g) Is there a way to test this?
- Writing: Explain to students that early Greek thinkers assumed that all matter was composed of fire, water, air, and earth. The properties of these ingredients include hot, cold, wet, and dry. Have students create a story that explains why the early thinkers had such ideas about matter.

Intervention

- Transferring energy: Using a pinwheel: (1) spin with your finger, (2) spin by blowing, and (3) spin when holding over a lamp. Questions to ask the class: (a) how was the pinwheel used to show transferring of energy? (b) Compare and contrast each situation making the pinwheel move.
- Potential Energy and Kinetic Energy: Using a rubber band and a Styrofoam cup cut in half lengthwise. Use the half-cup and a smooth; level surface to figure out how the potential energy in a stretched rubber band depends on the distance it is stretched. Stretch the rubber band and fire it at the half-cup so that it hits the cup at center back. Note how far the rubber band was stretched and how far the cup was moved. Now stretch the rubber band twice as far and repeat. What happened to the distance the cup moved?
- Student wearing roller skates is standing still. Another student walks up and pushes the student on roller skates. Student walking stops his/her

motion, student on skates moves forward. Note movement of students. Explain energy transfer. Two students wear roller skates facing each other. Students push against each other. What was the movement? What energy was transferred?

Examples, Observations, and Phenomena (Real World Context)

Investigating wind power, solar power, hydroelectric power, and biodiesel can provide a timely exploration into radiation, conduction, and convection heat transfer. Exploring these topics can provide the means to incorporate.

Conduction is the transfer of heat and electrical energy from one molecule to another. This transfer occurs when molecules hit against each other, similar to a game of pool where one moving ball strikes another, causing the second to move. Conduction takes place in solids, liquids, and gases, but works best in materials that have simple molecules that are located close to each other. For example, metal is a better conductor than wood or plastic, Newton's cradle transfers impact energy from one to another. A common example of conduction is the conduction of electrons through a copper wire to produce electricity and heat.

Convection is the movement of heat by a liquid such as water or a gas such as air. The liquid or gas moves from one location to another, carrying heat along with it. This movement of a mass of heated water or air is called a current. Examples of the above can be observed in weather and ocean currents, the space above a candle flame.

Heat travels from the sun by a process called radiation. Radiation is the transfer of heat by electromagnetic waves. When infrared rays strike a material the molecules in that material move faster. In addition to the sun, light bulbs, irons, and toasters radiate heat. When we feel heat around these items, however, we are feeling convection heat (warmed air molecules) rather than radiated heat since the heat waves strike and energize surrounding air molecules. Example would be a pizza solar oven. Cells burn food to release energy, some of which is changed into heat energy. Through cellular activity, organisms are able to maintain their body temperature through radiation.

A swimming pool and a teacup filled with water might both be at the same temperature; their molecules would be moving at the same rate. The swimming pool would contain much more potential thermal energy because it contains more molecules. Potential and kinetic energy can be seen in a swing. The potential energy is at each end of the swinging motion, while the kinetic energy is the actual motion of the swing.

Literacy Integration

Literacy Integration

Reading

R.IT.06.01 Students will analyze the structure, elements, features, style, and purpose of informational genre, including research reports, “how-to” articles, and essays.

R.CM.06.01 Students will connect personal knowledge, experiences, and understanding of the world to themes and perspectives in text through oral and written responses.

R.CM.06.02 Students will retell through concise summarizations grade-level narrative and informational text.

R.CM.06.04 Students will apply significant knowledge from grade-level science, social studies, and mathematics texts.

Books:
Energy (Eye-Witness), Jack Challoner, 1993
Energy (See for Yourself), DK Publishing, Chris Woodford, 2007

Read the book *Energy (Eye-Witness)* by Jack Challoner, 1993. After the students have read the book, have them compile lists of different ways they use energy each day.

Writing

W.PR.06.01 Students will set a purpose, consider audience, and replicate author’s styles and patterns when writing a narrative or informative piece.

W.PR.06.03 Students will revise drafts for clarify, coherence, and consistency in content, voice, and genre characteristics with audience and purpose in mind.

W.PS.06.01 Students will exhibit personal style and voice to enhance the written message in both narrative and informative writing.

- Students are to write a poem about a drop of water that changes state. Have students read their poems to the class.
- Students create a diagram showing three different ways (conduction, convection, and radiation) in which energy can be transferred.

Speaking

S.CN.06.01 Students will adjust their use of language to communicate effectively with a variety of audiences and for different purposes by asking and responding to questions and remarks to engage the audience when presenting.

S.CN.06.02 Students will speak effectively using rhyme, rhythm, cadence, and word play for effect in narrative and informative presentations.

- Small groups of students create and perform skits that show physical properties of the three states of matter.

Mathematics Integration

N.ME.06.16 Understand and use integer exponents, excluding powers of negative bases; express numbers in scientific notation.

N.FL.06.11 Find equivalent ratios by scaling up or scaling down.

A.PA.06.01 Solve applied problems involving rates, including speed.

A.RP.06.08 Understand that relationships between quantities can be suggested by graphs and tables.

M.UN.06.01 Convert between basic units of measurement within a single measurement system.

D.PR.06.02 Compute the probabilities of events from simple experiments with equally likely outcomes.