

# Energy Unit

By Carole Demers

## I Introduction

Assessment of Prior Knowledge:

What does energy do for us?

Motion, heat, light, makes technology work (electrical), makes things grow

Forms of Energy Overview

Chemical, radiant, thermal, mechanical, nuclear, electrical

## II Hands-on Science

Learning about the forms of energy:

Tracing energy flows, storing mechanical energy, endothermic and exothermic reactions, potential and kinetic energy, friction produces heat, electrical circuits and motors, static electricity, making electrical motors and electromagnets, magnets, photovoltaic cells, radiometer, glow sticks, electrochemical cells.

## III Sources of Energy

Team research, write reports and present information about geothermal, hydropower, coal, natural gas, nuclear, solar, propane, petroleum, biomass and wind energy. This includes a brief history as well as information about the energy source and its uses.

## IV Energy Conservation

Conservation of energy, heat loss and transfer of energy--insulation

Team Project (pairs)--How long can we keep an ice cube frozen?

Class Project

## V Assessment

Includes essays, test with multiple choice questions etc.

The unit is quite long, so I test after each portion of the unit.

### *Notes:*

At the beginning of the unit an assessment of prior knowledge is helpful. This could be in the form of a multiple choice test or a classroom discussion about the aspects of the unit.

I begin questioning about what energy does for us (motion, light, makes technology work, electrical and makes things grow,) and then move to the six forms of energy (chemical, radiant, thermal, mechanical, nuclear, and electrical.)

I integrate the hands-on component of this unit with videos and text readings. We read a current text on energy and take notes on as we move through the unit. Students research, write reports and present information about the source of energy they choose. This unit integrates science, reading, math, social studies and language arts.

In addition to the lessons developed in this unit I have the students review electricity and circuits by making complete circuits with bulbs, switches, motors, bells etc. We also

revisit magnetism and make a simple motor. We use an apple to make electrochemical cell. We use an EMF meter to measure the electrical flow. We use yo-yos, home-made toys and cars to demonstrate kinetic and potential energy. We use a radiometer to measure radiant energy, We discuss and diagram how photovoltaic cells on a calculator work. We use small solar cells to run engines. I use GEMS, AIMS, NEED and other sources for the activities.

I would like help with refining the unit and ideas for more experiments and projects that use inexpensive materials and are engaging for students. I would really appreciate any other endothermic and exothermic reactions you might know about.

**Alaska Science Education Standards:**

- ✓ A9) Understand the transfers and transformations of matter and energy that link living things and their physical environment – from molecules to ecosystems.
- ✓ B1) Use the processes of science, observing, classifying, measuring, interpreting data, inferring, communicating, controlling variables, developing models and theories, hypothesizing, predicting and experimenting.
- ✓ C2) Understand that scientific knowledge is validated by repeated specific experiments that conclude in similar results.
- ✓ D1) Apply scientific knowledge and skills to understand issues and everyday events.
- ✓ D5) Participate in reasoned discussions of public policy related to scientific innovations and proposed technological solutions to problems.

For a description of Alaska Education Standards visit the State of Alaska Department of Education & Early Development Website: [www.eed.state.ak.us](http://www.eed.state.ak.us)

Hands-on Science Units

*UNIT 1*

**Theme:** Heat

**Focus:** Friction

**Concept:** Friction produces heat

**Time:**

2-3 days

**Materials:**

- ✓ jars of sand
- ✓ watches or timers
- ✓ thermometers
- ✓ graph paper

**Gear-Up:**

Students place their hands on their cheeks to feel the thermal warmth of their hands. Then have students rub them for one minute and place them on their cheeks. Discuss the results and what friction is and what it does. Then have students shake a jar about half full of sand as they pass it around. Pass another jar around, labeled DO NOT SHAKE! At the end of about three minutes compare the temperature. Discuss the results.

*Gear-Up process skills:*

Observing, inferring, measuring, identifying variables, graphing, collecting data, defining operationally, interpreting results, predicting, hypothesizing.

**Explore:**

Question what would happen if we shook containers of sand for five minutes. Discuss the possible variables; i.e. different amounts of time or the amount of sand in the jars.

In teams of four to six, have students shake plastic jars (peanut butter jars work well) Have them 1/4, 1/2 and 3/4 full. Measure the temperature of the sand before they start for comparison. Shake for five minutes and then measure the temperature, Compare the results with other teams and graph the data. For comparison, some teams could use the same amount of sand in each jar, but vary the amount of time they shook the jar in one-minute intervals.

*Explore process skills:*

Observing, Measuring, Inferring, Identifying and defining variables, Graphing, Hypothesizing, Predicting, Communicating.

**Generalize:**

Discuss what produced the heat in the jars, variables, possible effect of insulation, results obtained and interpret graphs.

**Apply/Assess:**

Discuss real life applications; i.e. tire wear, effects of lubrication.

**Extensions:**

Will other materials respond in the same way?

**UNIT 2****Theme:**

Chemical Reactions

**Focus:**

Endothermic and exothermic reactions

**Concept:**

All chemical reactions involve heat. 90% are exothermic. The others are endothermic.

**Materials:**

- ✓ vinegar
- ✓ baking soda
- ✓ quart-size Ziploc® bags
- ✓ measuring spoons
- ✓ sealed, small, commercial hand warmers
- ✓ bag of iron oxide filings
- ✓ calcium chloride
- ✓ candles
- ✓ thermometers
- ✓ heater meals

**Time:**

2-3 days (You could do the exothermic reactions one day and the endothermic the next.)

**Gear-Up:**

Demonstrate a heater meal. If you have the budget, you could have one per four students. Discuss how they work. Taste a spoonful of the heater meal after you have recorded the temperature, pass around several unopened hand warmers quickly around the class. Ask the class what they are and how they work. Usually several students will have used or seen both of them, Show students what iron oxide looks like and take the temperature of the container.

**Explore:**

In groups of four, have students open the hand warmers and pass them around. Take the temperature and record.

*Explore process skills:*

Classifying, observing, collecting data, predicting, interpreting data, inferring, controlling variables, defining operations, measuring, communicating

**Generalize:**

What caused the heat? Discuss the chemical reaction. Iron + Oxygen = Iron Oxide (rust) + heat energy.

**Apply:**

Then have students experiment with another exothermic reaction using water and calcium chloride. Take the temperature of two ounces of water in a Ziploc® bag. Then add a teaspoon of calcium chloride. If you have graduated cylinders, use equivalent measurements. Take the temperature and compare. Discuss and demonstrate the use of commercial ice melters.

Light a candle and feel the heat given off and compare to the burning of fossil fuels. Discuss the chemical reaction and compare it to the hand warmers. Then mix one ounce of vinegar, take the temperature and add one teaspoon of baking soda. Take the temperature and compare. Discuss endothermic reactions. These are not as common as exothermic.

**Extensions:**

Discuss photosynthesis and compare the reactions. Add on any other exothermic or endothermic reactions. Balance equations if appropriate. Discuss and model energy transfer. Read text.

*UNIT 3*

**Theme:**

Energy

**Focus:**

Chemical energy

**Concept:**

Phospholuminescence

**Materials:**

- ✓ Glow sticks (on sale after Halloween)
- ✓ Hot and cold water

**Time:**

1 day

**Gear-Up:**

Break out the glow sticks!! Discuss what they think happens when you breaks the inner vial.

**Explore:**

Pass out one glow stick per 4 students, more if you have the budget. Explore.

**Generalize:**

Discuss what they observe. Discuss how chemical energy is changed into radiant energy when the ampule of hydrogen peroxide is mixed with the liquid called an ester in the plastic tube. Discuss whether they think temperature could effect the reaction.

*Generalize process skills:*

Observing, Predicting, Interpreting data, Communicating

**Apply/Assess:**

Have 1/3 of the students place their glow sticks in hot water, 1/3 in cold water and let the other glow sticks remain at room temperature. Discuss what happened. Does it affect the brightness or the length of time they glow?

**Extensions:**

Learn about how materials can absorb light and then radiate it at night. Research fire flies.

*UNIT 4***Theme:**

Energy Conservation

**Focus:**

Insulation

**Concept:**

Conservation of Energy (Heat Loss) and Energy Transfer

At the end of this unit we learn about energy conservation and global warming. We learn ways to reduce, reuse and recycle. We try and set a class goal for everyone to try to convince their families to recycle aluminum and newspapers. We recycle old Xerox paper to use whenever possible. We read about current energy shortages, problems and solutions. We compare our energy usage with less-developed countries. We learn ways to better insulate new and older homes. The culmination of the unit is the “How Long Can You Keep an Ice Cube Frozen Contest” as well as a traditional test assessment. Students also write an essay about energy use and conservation.

**Time:**

2-3 days

**Materials:**

- ✓ clean 1/2 gallon milk containers (the “house”)
- ✓ gallon-size Ziploc® bags for the ice cubes
- ✓ tape
- ✓ staplers
- ✓ “house” decorating materials if desired

**Materials** continued:

- ✓ a variety of insulating materials; i.e. fiberglass(handle with latex gloves), polar fleece, cotton balls, wool, sawdust, dirt, moss, Crisco® (blubber,) foam, feathers, fur, hay, newspaper, foil, etc.

**Gear-Up:**

Describe the *Annual Ice Cube Contest*. Brainstorm ways we could keep an ice frozen for as long as possible. Discuss the role of insulation in our lives from clothing, homes and its use in nature. Brainstorm and record all the possible natural and man-made insulators we can think of in ten minutes.

**Explore:**

Using double gallon zip-lock bags and a variety of materials, have student make insulated mittens to dip in tubs of ice water. Be sure and use a mitt without any insulation for the constant. Record their observations.

**Generalize:**

Discuss their findings. Discuss ways they might insulate their ice cube. Devise a fair test for the contest. What are the constants? (Same sized milk cartons and ice cubes in a Ziploc® bag and the time factor. What is the variable (insulation materials?) Discuss how to collect data.

**Apply/Assess:**

Start this contest first thing in the morning if possible and check the ice cubes before lunch, at the end of the day and the next morning. Use a thermometer to measure the water temperature of any ice cubes that have completely melted at one of the checkpoints. If you have ice cubes the next morning, weigh them to determine the largest ice cube in grams.

Pairs of students will insulate their milk carton houses and when everyone is ready ice cubes in Ziploc® bags will be placed upright in the middle of their carton and will be taped or stapled shut. Cartons can be decorated with construction paper if desired. If you allow insulation on the outside of the houses, it must be a uniform thickness for all the cartons.

Place the cartons away from the heater in the same area on a table, spaced apart. Collect data at regular intervals. Discuss the results.

*Apply/Assess process skills:*

Communication, Predicting, Defining variables, Hypothesizing, Collecting data, Making models, Interpreting data, Classifying, Observing, Measuring, Defining operationally.

**Extensions:**

Have a local builder or energy consultant visit the class to talk about energy efficiency, ratings of homes and infrared pictures that can determine energy loss in a building. Check out Web sites about energy efficiency.

## Scoring Guide: Energy Unit

Standard	Rating 1 = Poor	Rating 2 = Fair	Rating 3 = Competent	Rating 4 = Outstanding
<b>A-9</b>	Student uses 1-3 energy terms in discussion.	Student uses 4-6 energy terms in discussions.	Student uses more than 6 energy terms correctly and confidently.	Student uses, and aids other in understanding, all unit terms.
<b>B-1</b>	Student follows general directions for experimentation.	Student follows the details of directions for experiments.	Student is competent in recording and evaluating experiment.	Student is competent in all phases of experiment & analysis of results.
<b>C-2</b>	Student does not compare results of experiments	Student compares results of similar experiments.	Student compares results of similar experiments and reports details/validation of previous findings.	Student anticipates and creates experiments to validate previous finding.
<b>D-1</b>	Student makes obvious connections between energy use and self (stoves for cooking.)	Student makes relationship decisions on everyday energy use (insulation needs.)	Student makes strong relationship between energy needs and creating methods of meeting those needs.	Makes strong relationship between energy needs, cons. methods or alternatives (super insulation) & news events (oil issues, etc.)
<b>D-5</b>	Student participates little in discussion.	Student's participation based on family applications.	Student's participation based on community or state applications.	Student's participation based on global events.