# Ice Cube Race

**Student Objective**
The student:
- will be able to explain several methods of transferring energy
- will be able to explain what is meant by the second law of thermodynamics.

**Materials (per group)**
- small block of ice (5 oz water frozen in paper cup and then removed)
- plastic bag with zip seal
- graduated cylinder
- Science Journal

**Key Words:**
change of state
conduction
convection
energy source
energy transfer
friction
kinetic energy
physical change
potential energy
radiant energy
thermal energy

**Time:**
1 class period

**Background Information**
There are several forms of energy, subdivided into two categories--kinetic and potential**:**

**Kinetic Energy**
- Electrical Energy
- Radiant Energy (i.e. solar energy)
- Thermal Energy
- Motion Energy
- Sound

**Potential Energy**
- Chemical Energy
- Stored Mechanical Energy (i.e. a spring)
- Nuclear Energy
- Gravitational Energy

By this time, students should know several points about energy transfer:
- When warmer objects are put with cooler ones (at a distance or next to each other), the warmer objects transfer internal energy (emitted as heat) to the cooler ones until they all reach the same temperature.
- Things that give off heat can also give off other sorts of energy, including light.
- Heat is produced any time one thing rubs against something else, and by mechanical and

electrical machines.
- Some materials transmit heat energy much better than others. Materials, called insulators, are poor conductors and can reduce the transmission of heat from one object to another.

Further investigations should help middle-school students learn the following four points about energy transformation:
- Energy cannot be created or destroyed, but only changed from one form into another.
- Most of what goes on in the universe—from exploding stars and biological growth to the operation of machines and the motion of people—involves some form of energy being transformed into another. Energy in the form of heat is almost always one of the products of an energy transformation.
- Heat can be transferred through materials by the collisions of atoms or across space by radiation.
- Energy appears in different forms. Heat energy is in the disorderly motion of molecules; chemical energy is in the arrangement of atoms; mechanical energy is in moving bodies or in elastically distorted shapes; gravitational energy is in the separation of mutually attracting masses.

At this early stage, there may be some confusion in students' minds between energy and energy sources. Focusing on energy transformations will help them to understand the difference. Food, gasoline, and batteries obviously get used up. But the energy they contain does not disappear; it is changed into other forms of energy through physical or chemical processes.

**Procedure**

1. Divide class into groups of two.
2. Explain procedure to class;
    - each group will place a 5 oz ice cube in a baggie
    - they will have 5 minutes to transfer as much energy as they can to their cube (to melt it). They may place the baggie anywhere they want or do anything to it, as long as the bag remains sealed.
    - at the end of 5 minutes each group will measure the amount of water in their bag using a graduated cylinder
3. Pass out materials and begin timing
4. Help students as needed during the five minute interval
5. After students measure their water, lead a discussion on which methods produced the most water, emphasizing what type of energy transfer is occurring in each case.
6. Students should complete their Science Journal.

**Related Research**

1. Have the students do a second trial using what they learned from the first trial. Graph the results of both trials to see the class improvement.
2. Write the different types of energy on the board. Have the students design another version of the experiment that uses a form of energy (one they haven't tried before) to

melt the ice. Graph the results by energy form on the board to find out which were most successful. Have the students critique the other experiments

- Were the groups using only the form of energy that they claimed, or were there other forms involved also?
- How could they use this form of energy differently to obtain better results?
- Is it possible to do an energy transfer without having some thermal energy involved also?

**Related Reading**

- **Exploring Energy With Toys: Complete Lessons for Grades 4 - 8** by Beverley A.P. Taylor, National Science Foundation (McGraw-Hill, 1997)
  Classroom-tested projects using toys illustrate basic concepts of physical science. Topics include the energy of motion, stored energy, energy conservation, and more.

**Internet Sites**

**http://www.learner.org/exhibits/parkphysics/**

An Annenberg/CPB site, Amusement Park Physics with information on the forces behind amusement park rides. Includes interactive roller coaster building, prediciting the outcome of bumper car crashes, and a weightless water 'trick'.

# Ice Cube Race

| | | | .1 | .2 | .3 | .4 | .5 | .6 | .7 |
|---|---|---|---|---|---|---|---|---|---|
| **Nature of Matter** | **Standard 1** | **SC.A.1.3-** | | | | **X** | **X** | | |
| | **Standard 2** | **SC.A.2.3-** | | | | | | | |
| **Energy** | **Standard 1** | **SC.B.1.3-** | **X** | **X** | | **X** | **X** | | |
| | **Standard 2** | **SC.B.2.3-** | **X** | | | | | | |

**Benchmark SC.A.1.3.4** - The student knows that atoms in solids are close together and do not move around easily; in liquids, atoms tend to move farther apart; in gas, atoms are quite far apart and move around freely.
**Grade Level Expectations**
The student:
*Sixth*
- understands that matter may exist as solids, liquids, and gases

*Seventh*
- knows the direction of energy flow when a change in the phase of matter occurs

*Eighth*
- understands that changes in energy cause phase changes.

**Benchmark SC.A.1.3.5** - The student knows the difference between a physical change in a substance and a chemical change producing new substances with different characteristics.
**Grade Level Expectations**
The student:
*Sixth*
- knows the difference between a physical and chemical change

*Seventh*
- knows that physical changes do not result in new substances

*Eighth*
- knows how to use clues to determine whether a change is chemical or physical.

**Benchmark SC.B.1.3.1** - The student identifies forms of energy and explains that they can be measured and compared.
**Grade Level Expectations**
The student:
*Sixth*

- understands that energy can be converted from one form to another

*Eighth*

- understands that energy can be transferred by radiation, conduction, and convection.

**Benchmark SC.B.1.3.2** - The student knows that energy cannot be created or destroyed, but only changed from one form to another.

**Grade Level Expectations**

The student:

*Sixth*

- understands that energy can be changed in form
- uses examples to demonstrate common energy transformations.

**Benchmark SC.B.1.3.4** - The student knows that energy conversions are never 100% efficient.

**Grade Level Expectations**

The student:

*Seventh*

- knows that useful energy is lost as heat energy in every energy conversion

*Eighth*

- knows that energy conversions are never 100% efficient and that some energy is transformed to heat and is unavailable for further useful work.

**Benchmark SC.B.1.3.5** - The student knows the processes by which thermal energy tends to flow from a system of higher temperature to a system of lower temperature.

**Grade Level Expectations**

The student:

*Eighth*

- knows the processes by which thermal energy tends to flow from a system of higher temperature to a system of lower temperature.

**Benchmark SC.B.2.3.1** - The students knows that most events in the universe involve some form of energy transfer and that these changes almost always increase the total disorder of the sytem and its surroundings, reducing the amount of useful energy.

**Grade Level Expectations**

The student:

*Eighth*

- understands that as energy is transferred from one system to another there is a reduction in the amount of useful energy
- knows that energy transfer is not efficient.

## Ice Cube Race

**change of state** - a physical change that occurs when matter changes to another state

**conduction** - the transmission of heat across matter

**convection** - heat transfer in a gas or liquid by the circulation of currents from one region to another.

**energy source** - object or material that produces energy by changing it from one source to another

**energy transfer** - a change of energy from one form to another

**friction** - a force that opposes the relative motion of two material surfaces in contact with one another

**kinetic energy** - the energy possessed by an object because of its motion

**physical change** - a change in matter from one form to another, without forming new substances

**potential energy** - the energy of a particle or system of particles derived from its position, or condition, rather than motion. For example: a raised weight, coiled spring, or charged battery

**radiant energy** - energy that is transmitted in the form of electromagnetic radiation (i.e. solar); energy that exists in the absence of matter; energy that can travel through space

**thermal energy** - the kinetic energy of the motion and of vibrations of microscopic particles such as molecules and atoms. Thermal energy is quantified by temperature.

## Ice Cube Race

1. How much water did you have at the end of 5 minutes?

2. What did you do to your baggie to help melt the ice?

3. What type of energy (s) did you use?

4. In your class, what method seemed to melt the ice the best?