



Science Unit: *Matter*

Lesson 5: *Heat and Matter*

School year: 2005/2006

Developed for: McBride Elementary School, Vancouver School District

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Grade level: Presented to grades 2 - 3; appropriate for grades 1 - 4 with age appropriate modifications.

Duration of Lesson: 1 hour and 20 minutes

Objectives

1. Review properties of liquids and solids.
2. Learn about changing states of matter by heating and cooling.
3. Learn about materials that are good conductors and insulators.
4. Learn that heat makes matter expand, and cooling makes matter contract.

Background Information

Matter is anything that occupies space. The three states of matter are solids, liquids and gases. Heat and cold can change the state of matter from a solid to a liquid to a gas and back again. The change of state depends on temperature and the composition of the matter. Heat moves through solids by conduction. Inside the substance heat energy is passed from atom to atom. Materials that conduct or pass heat easily are called good conductors. Materials which do not transfer heat easily are called good insulators or bad conductors. When heating solid matter the temperature is raised until it reaches the melting point. This is when the solid will change to a liquid. Molecules break apart and start to move around. If matter is heated further it can change into a gas (water, if boiled long enough will turn into steam or water vapour). Some matter, when heated will change appearance and when cooled will return to its original state (eg. Water). These changes are reversible. Some matter when heated changes permanently (bread, when heated changes into toast).

Materials

- Chocolate (bar which is pre-divided into small squares)
- Butter
- Wax
- Sugar
- Tin foil squares (4cm x 4 cm) bent into little dishes
- Stir sticks or plastic spoons
- Ice and ice chest or fridge space
- Electric heating pads or flexible desk lamps as heat source
- Metal cookie trays
- ice cubes

Materials Needed for Demonstration (Insulators /Conductors, Balloon and Hot Air, Melting Sugar)

- Three dabs of butter
- Large metal spoon
- Large wooden spoon
- Ceramic or heat-proof mixing bowl
- Large plastic spoon
- Boiling water



- Balloon
- Basin of hot water
- Metal spoon
- Sugar
- Empty bottle
- Candle
- Matches

In the Classroom

Introductory Discussion

1. Ask what happens when matter is heated? What happens when you leave ice cream out on a hot day? Or cheese or butter? Some matter melts or liquefies when heated. What happens when you put things back in the fridge or the freezer? They get hard again or solidify (turn into a solid). Do some things melt at a lower temperature than other things? What about metal? Or plastic?
2. Ask do some materials hold the heat better than others? What material do we use to make cookware? (Metal – as it is a good conductor) Why? What material do we use to keep things hot or cold (insulating materials such as Styrofoam coolers)? **Insulators/Conductors:** Put three spoons (plastic, wooden, and metal) in a mixing bowl. Add equal sized dabs of butter near the top of the handles. Let students make predictions as to which spoon will heat up first and send the dab of butter sliding down the handle into the water. Pour boiling water into the bowl and observe.
 - What is happening to the three dabs of butter?
 - What type of spoon heats up fastest? Why?
 - What spoon was the slowest to heat up? Why?
3. **Balloon and Hot Air:** Does matter take up equal, more or less space when it is heated? What happens when matter is cooled? Does it take up the same amount of space? Put a slightly-inflated balloon over the mouth of an empty bottle. Place the bottle in a basin of very hot water. The balloon should expand. Then take the bottle out of the hot water and run the bottle under very cold, running water. The balloon should deflate. Why?

Matter (in this case, air in the bottle) heats up and the molecules move faster and further apart. The air in the bottle spreads out and takes up more space (the balloon inflates). When the air is cooled, the molecules huddle closer together, occupying less space (the balloon deflates).

Science Activity/Experiment

Each group of students should make 15 small tinfoil “trays”.

In each of 5 foil trays put equal amounts of butter, sugar, ice cube, wax and chocolate. Repeat two more times so that each group has three sets of the 5 types of matter. (3 butter, 3 sugar, 3 ice cubes, 3 wax, and 3 chocolate)

Place one set of the 5 types of matter on the table at room temperature. Place the second set on ice in an ice chest or in the fridge. Place the third set on cookie sheets on heating pads or under desk lamps as a heat source.

Wait for 10-15 minutes. While students are waiting they can make predictions and record on their activity sheets.

After 10-15 minutes students may observe matter at the three different temperatures. Record observations on the activity sheet.



Closure Discussion

1. Discuss predictions, observations and results for the activity.
2. Were your predictions the same as your observations?
3. Did any of your predictions surprise you?
4. What melted fastest? What did not melt? What did not change states at the three different temperatures? Did anything melt in the fridge or in the ice chest? (Ice – discuss melting temperature of ice (0 degrees Celsius).
5. At this time you could do the **Melting Sugar Demonstration**: Light a candle. Place a small amount of sugar in a metal spoon. Place the spoon over the flame and observe. The sugar should rapidly melt and turn into liquid. Show the students. When the flame is extinguished the sugar should then re-solidify. Show students the back of the spoon. They should see carbon deposits on the back of the spoon. Talk about different matter having different melting points (eg. Water, metal, chocolate, sugar).

References

1. Drago, C. (Ed.). 2000. The Big Book of Experiments: An Encyclopedia of Science. Pp. 14-15. Brown Watson, England. (English Edition).
2. Mellett, Peter. 2001. Hands-On Science: Matter and Materials. Pp. 12-13, 20-21. Kingfisher Publishing. Boston.
3. Nicholson, Sue (Ed.). The Kingfisher Young Discoverers Encyclopedia of Facts and Experiments. Pp. 96. Larousse Kingfisher Chambers. New York.
4. Oxlade, Chris. 1999. Energy. Pp. 10-13. Heinemann Library, Reed Educational and Professional Publish. Chicago.
5. <http://www.school-for-champions.com/science/matterstates.htm>

Extension Lesson

Drawing Initials with Saltwater on Black Paper

Objectives

1. Students will learn about dissolving solids in liquids.
2. Students will then see the process of evaporation before their eyes.

Materials

- Black construction paper
- Salt
- Water
- Jars
- Paint brushes



SCIENTIST IN RESIDENCE PROGRAM

- Portable hair dryers
- Spoons

In the Classroom

Introductory Discussion

Review introductory discussion in the beginning of this lesson (page 1).

Science Experiment

1. Students work in groups. Materials are shared at their desks/tables.
2. Students dissolve 3-5 Tbsp salt in a small jar of water. Stir until salt has dissolved. Then with a paint brush they can paint their initials or a simple design on the black paper. They can paint over it several times, always remembering to swirl the contents of the jar with their paintbrush before painting to ensure they are getting enough salt.
3. With a portable hair dryer they can dry the black paper and the design or initials should appear as a white residue of salt once the water has evaporated. If it does not appear, add more salt to the water and repaint design.

Closing Discussion

Review what happens when heat is applied to matter. What happens in this case when heat from the hair dryer is applied?

References

VanCleave, Janice. 1996. Janice VanCleave's Play and Find Out About Science: Easy Experiments for Young Children. John Wiley and Sons. New York. 122 pp.

Heat and Matter

Name: _____

I predict:

I observed:

Type of Matter	Temperature		
	Fridge	Room Temp.	Hot Spot
Chocolate			
Ice			
Butter			
Wax			
Sugar			

I learned:
