

Properties of Matter



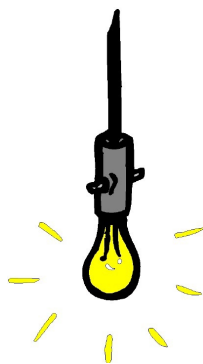
An Interdisciplinary Thematic Unit for Grades 4 - 5

By Jean Eric Imbert, MPA



Contents

- Describe objects
- Define Matter
- Define Element, Atom, and Molecule
- Identify the States of Matter
- Changes of State
- Properties of Matter: Intensive Versus Extensive
- Physical Changes
- Chemical Changes
- Distinguish between Chemical and Physical changes of Matter



Properties of Matter

An Interdisciplinary Thematic Unit for Grades 4 - 5

By Jean Eric Imbert, MPA

Content Goal:

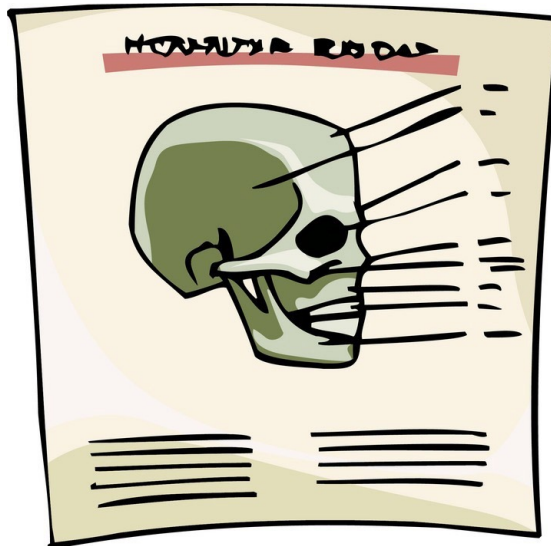
1. The students will be able to distinguish between physical changes and chemical changes.
2. The students will be able to distinguish between Intensive and Extensive properties of matter.
3. The students will be able to identify the states of matter.

Attitudinal Goal:

1. The students will be able to develop a positive attitude toward matter.
2. The students will be able to develop a positive attitude toward learning science.

Process Goal:

1. The students will be able to develop skills for sharing scientific information.
2. The students will be able to develop skills for investigating and testing hypotheses.



Purpose of Unit

This unit is designed for grades four to five students; however it may be extended up to grade eight. It is intending to give to the students a positive feeling about science. It will help them not only to gain knowledge about the properties of matter but also develop other skills in English, Math, and Social Studies. It will provide ways for students to be involved by having "hands on activities". By involving them, they will develop a sense of partnership, engagement and belonging which will help in changing their attitude toward the subject. It will also help them to solve problems in class which can be transferred into daily activities of life. You will find many experiments, several choices of activities, and also a variety of teaching methods. This unit will allow you and your students to have fun while learning about the concepts of matter.

General Overview of the Unit

Vocabulary to teach

Properties
 A Hypothesis
 A scientist
 Mass
 A scale
 State
 Release
 Heavy
 A solid
 A liquid
 A gas
 Shape
 Length
 Melt
 Freeze
 Evaporate
 Condense
 Physical change
 Chemical change
 Temperature
 Intensive property
 Extensive property
 Exhale, inhale
 Release
 Property
 Challenge
 Containers
 Thermometer



Teaching Methods

games
 didactic questions
 cooperative learning
 experiments
 exercises
 discussion
 explicit teaching
 work stations

Methods of Evaluation

student notebook
 observation checklist
 work sheets (experiments)
 exercises
 Quiz and exam

Common Essential learnings to teach

creative and critical thinking
 numeracy

Grammar structures

the heaviest // longest // shortest

Lesson 1: Properties of objects

Objective:

Describe objects in terms of their properties (shape, color, size, smell, texture, hardness and mass).

Materials for the teacher:

A balloon, a glass of water, a pencil, a blackboard and chalk

Materials for the students:

A notebook, pencil crayons, a pencil

Teaching methods:

Games, didactic questions, cooperative learning

Engaging activity:

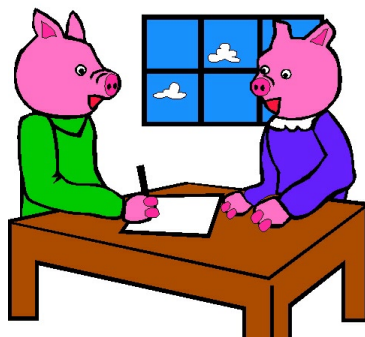
"I see an object. It is orange; it is big; it is heavy, etc." Describe the object until a student identifies it. Describe and identify one more object. Ask one student to do the same.

Activities:

1. Bring a balloon to class. Draw it on the board. Ask the students to name the properties of the balloon. Write their answers on a sample table below. Point out that the properties named are the shape, color, size, smell, texture, hardness and mass.
2. The students copy the table into their notebook.
3. Next, in groups of two, the students draw and write down the names and properties of:
 - a. a glass of water
 - b. a pencil
 - c. etc.

Names	Properties

4. Closure: It should be brought to their attention that:
All the things that surround us and that we can touch are examples of matter. When we describe an object, we are naming its properties. Matter has properties. A property is a quality that we use to describe an object.



5. Draw an object that you see in the classroom or in your bedroom. Write at least one descriptive paragraph about the object, and if you have to change something in it what would you do to make it better?

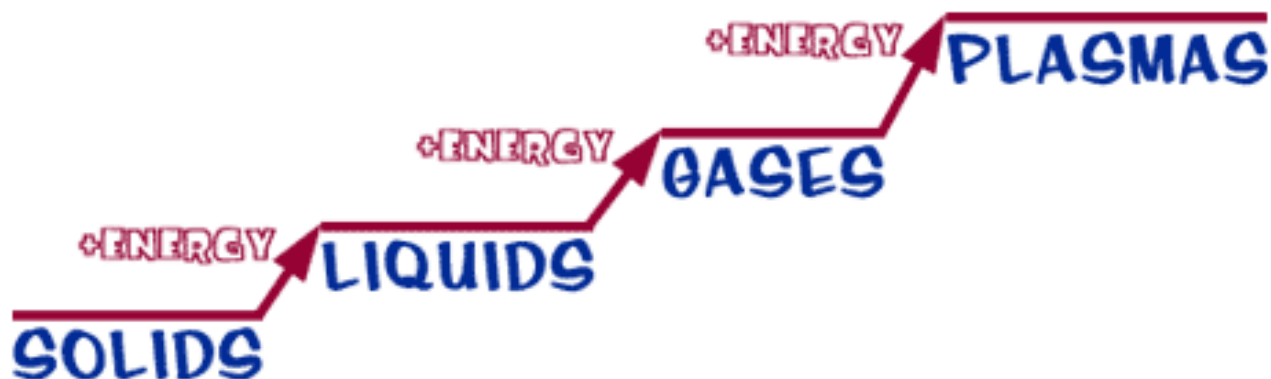
For additional information: www.stf.sk.ca/teaching_res/library.

Lesson 2: Matter

Objective: Describe matter and recognize the different states.

Concept: Matter (Materia, Matéria, Matière)

Matter is anything that takes up space or has a mass of any kind. Except in a vacuum, matter is everything. Every thing you can touch is made of matter. If it is made of anything, that anything is matter. There are three classic states of matter: solid, liquid and gas; however, plasma is considered by some scientist to be the fourth state of matter. The plasma state is not related to blood plasma. At extreme temperatures such as the Sun, matter can undergo changes which means lose electron and become ionized. This matter, along with turbulence caused by the heat, results in a phase called a plasma.



www.chem4kids.com/files/matter_states.html

Solid: A solid is matter in which the molecules are very close together and cannot move around. The material has a definite volume or size and distinct shape at a given temperature. Examples include rocks, wood, and ice (frozen water).

The periodic table of the elements

	1A	2A	3A	4A	5A	6A	7A	8	1B	2B	3B	4B	5B	6B	7B	0		
1	H															He		
2	Li	Be									B	C	N	O	F	Ne		
3	Na	Mg									Al	Si	P	S	Cl	Ar		
4	K	Ca	Sc	Ti	V	Cr	Mn	Fe	Co	Ni	Cu	Zn	Ga	Ge	As	Se	Br	Kr
5	Rb	Sr	Y	Zr	Nb	Mo	Tc	Ru	Rh	Pd	Ag	Cd	In	Sn	Sb	Te	I	Xe
6	Cs	Ba	L	Hf	Ta	W	Re	Os	Ir	Pt	Au	Hg	Tl	Pb	Bi	Po	At	Rn
7	Fr	Ra	A															
			L	La	Ce	Pr	Nd	Pm	Sm	Eu	Gd	Tb	Dy	Ho	Er	Tm	Yb	Lu
			A	Ac	Th	Pa	U	Np	Pu	Am	Cm	Bk	Cf	Es	Fm	Md	No	Lr

■ Metals
■ Metalloids
■ Non-metals
■ Transition Metals
■ Gases

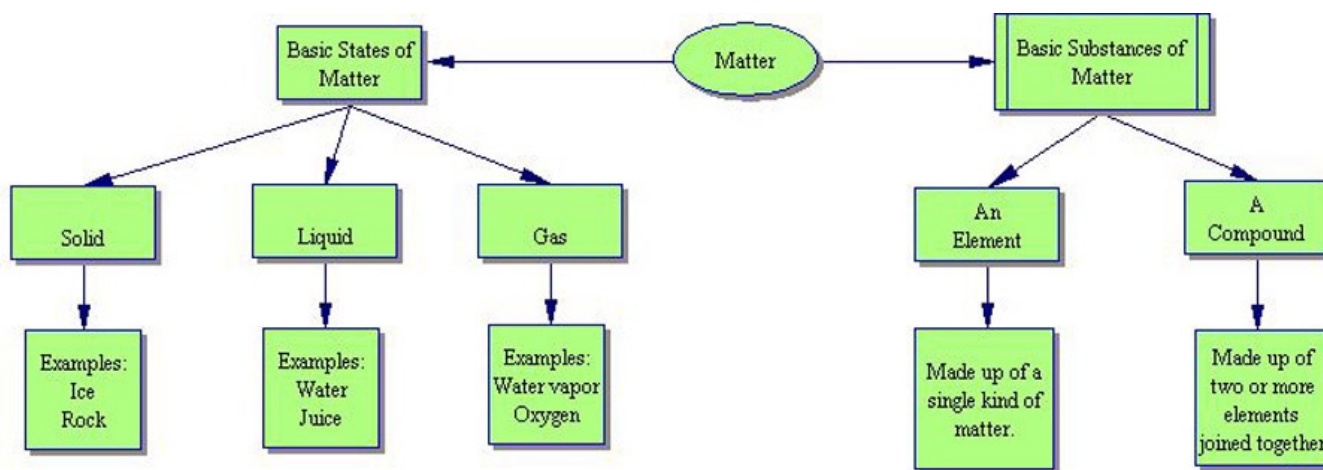
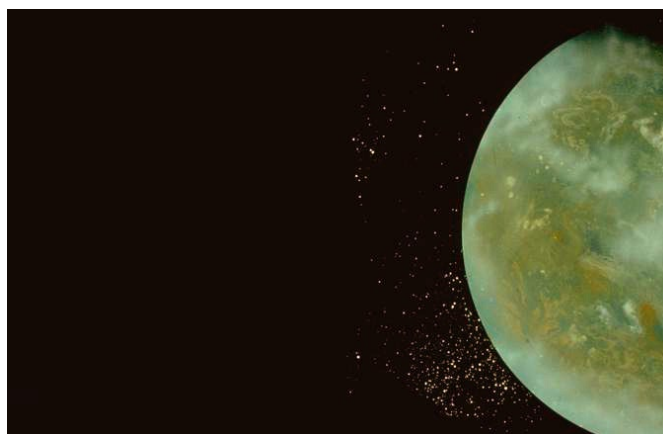
Copyright © 2002 RCSI

ccinfo.ims.ac.jp/periodic/periodic-main.html

Liquid: A liquid is matter in which the molecules are close together and move around slowly. A liquid has a definite volume, but it takes the shape of its container with the help of gravity. Examples include water, mercury at room temperature, and lava (molten rock).

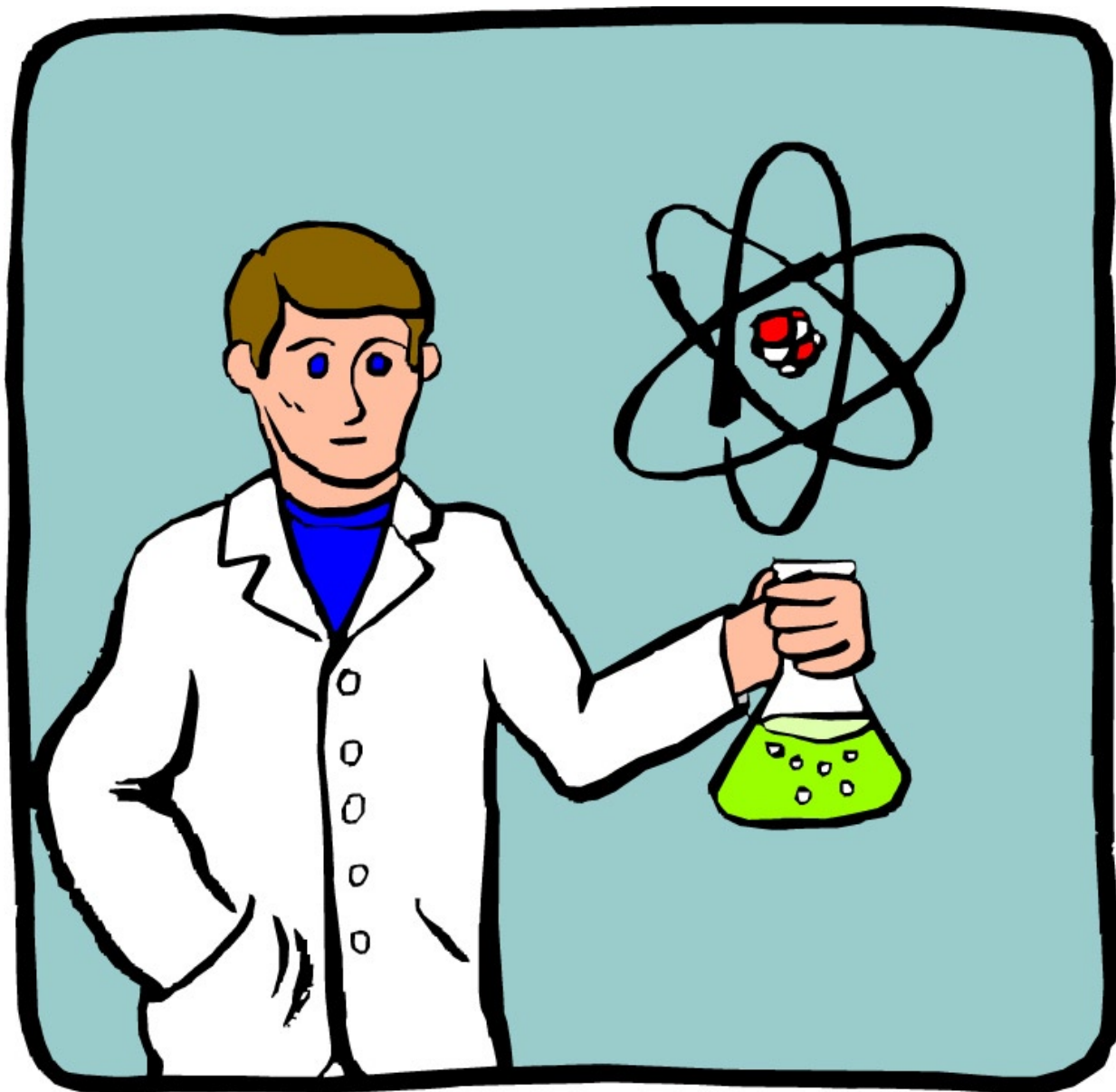
Gas: A gas is matter in which the molecules are widely separated, move around freely, and move at high speeds. Examples include the gases we breathe (nitrogen, oxygen, and others), the helium in balloons and water vapor.

Plasma: A plasma is a gas that is composed of free-floating ions, and free electrons. A plasma conducts electrical currents. There is plasma in stars (including our Sun), and the solar wind in our Solar System is made of plasma.



Enrichment Activity:

Encourage students to research an element or a compound that has generated environmental concerns. How does the compound or element affect people's lives? What should be done to alleviate the problems caused by the chemical? What solutions have been found so far? Have students present their information in class using power point if possible.



Lesson 3: Element, Compound, Atom and Molecule

Objective: The student will be able to see and describe the relationship between atoms and molecules by explaining how atoms join to become molecules.

Materials for the teacher:

Molecular model of an element, atom and molecule.

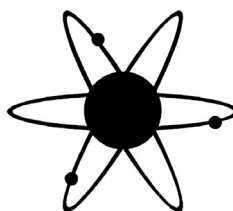
Material for the students:

Shoe box with a lid, 8 or 10 ping-pong balls, scissors, Velcro circles, felt marker, glue.

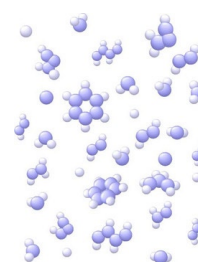
Teaching methods:

Discussion, explicit teaching, experiment, demonstration, and class activity.

Atom of Carbon (C)



Molecules



Engaging activity:

What is an atom?

How are molecules formed?

Show a picture of an atom and a molecule.

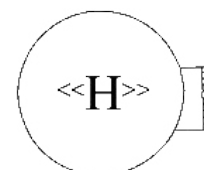
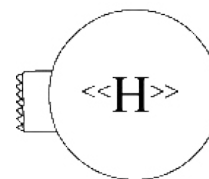
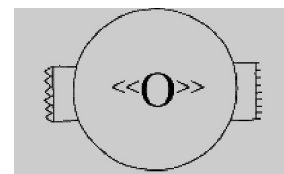
Concepts:

There are only 112 basic kinds of matter, called elements. An element is any material made up of a single kind of matter. An atom is the smallest part of an element that has the properties of that element. All the atoms in a given element are the same. A Compound is a kind of matter made up of two or more elements that are joined together. In many compound, the atoms are bound together in molecules. A molecule is a neutral group of atoms that act as a unit.

Procedure:

1. Explain that each ball represents an atom.
2. Write "O" on one of the balls. This represents "oxygen".
3. Glue two circles of Velcro on the ball.
4. Two balls represent hydrogen atoms. Write "H" on these balls.
5. Glue one circle of Velcro on each atom of hydrogen.
6. Put all the balls in the box, even some without Velcro.
7. Close the box and shake it.
8. Open the box to see if a molecule of water has formed: H₂O.

* This experiment can be done with several kinds of molecules.



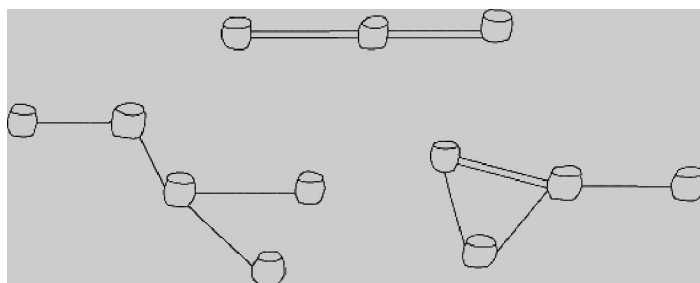
Enrichment:

Using toothpicks and marshmallows, the student will be able to create models of molecules in order to better understand their structure.

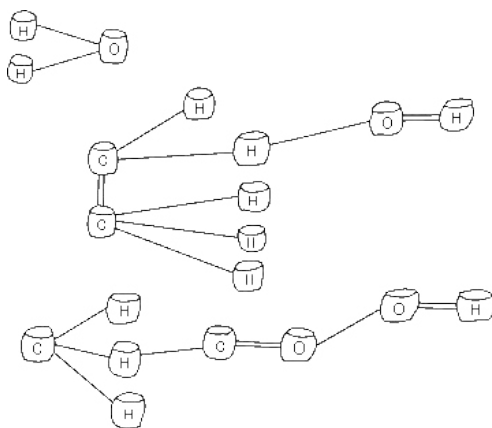
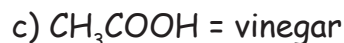
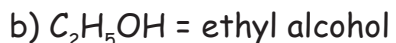
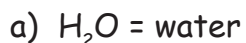
Procedure:

Explain to the students that each marshmallow represents an atom and that they should use toothpicks to make molecules.

1. Once the marshmallows are stuck together with the toothpicks, they form molecules. As a group, examine all the structures discovered by the students.
2. Use colored marshmallows. For example, use two green marshmallows (hydrogen) and one pink marshmallow (oxygen) to create a molecule of water. Name several other known substances and ask students to make them.



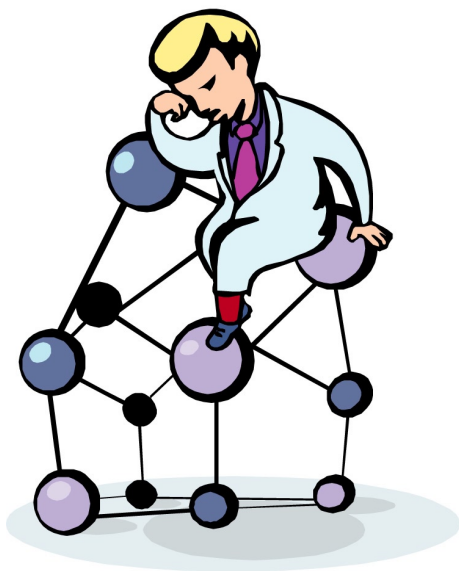
3. Encourage the students to find several ways of attaching the molecules. For example:



www.stf.sk.ca/teaching_res/library/teach_mat_centre/tmc/e10637/e10637.htm.

Let the students play with this substance

- * Each atom has a different color (e.g.: C = pink marshmallow, H = green marshmallow, O = white marshmallow)
- * Let the students construct their own substance and other students can guess what it is.



Lesson 4: States of Matter - Hands on things.

Objective: Recognizing the different states of matter.

Materials for the teacher:

A solid, a liquid, and a gas, a blackboard, chalk, a magazine, a balloon, a cup filled with water.

Material for the students:

Notebooks, pencils, glue, magazine, an apple, a book, a balloon, a stick, a sponge, wind, scales, graduated cylinder, a cup of water, ruler.

Teaching methods:

Discussion, explicit teaching and class activity.

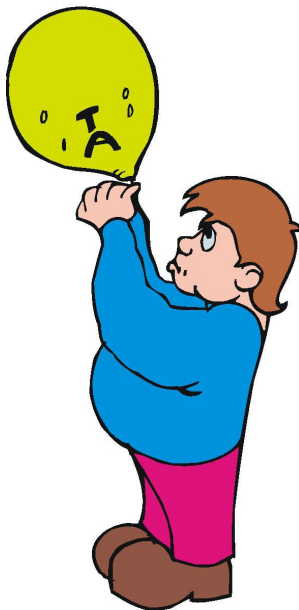
Engaging activity:

Walk around with a balloon. Let the air escape in the direction of the students. Walk around with a glass of water. Sprinkle a little on the students.

Activities:

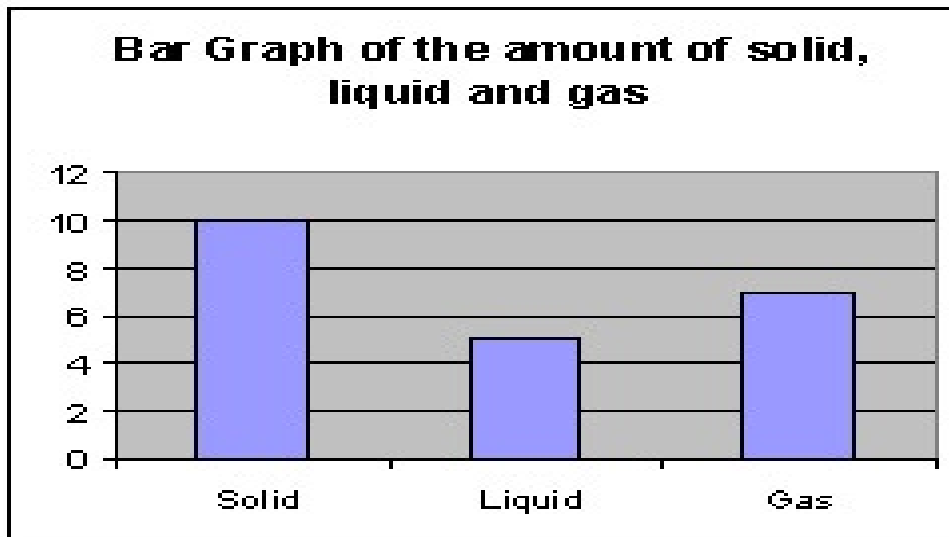
Tell the students to complete the chart below in groups of 2. Afterward, they must totalize the amount of solid, liquid, gas, and draw a bar graph. Then calculate the percentage of solid, liquid, gas, and draw a Pie graph. Students will discuss their observations and write an individual report.

Objects	Solid(X)	Liquid(Y)	Gas(Z)	Mass	Volume	Change shape(Y/N)	Take space(Y/N)
Total	X= 10	Y= 5	Z= 7				

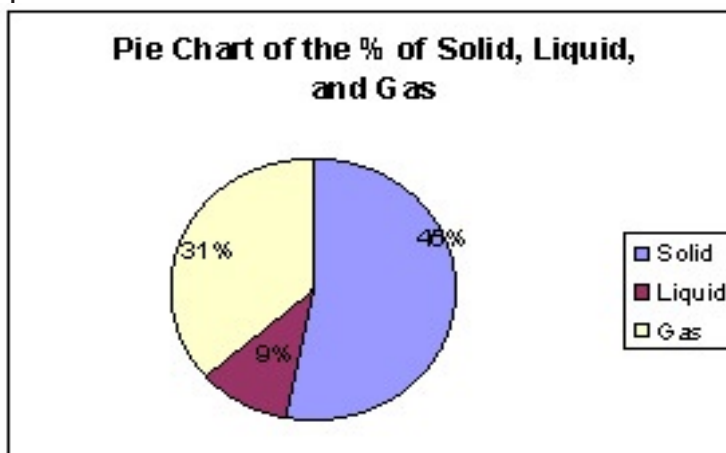


Examples: (use Microsoft Excel)

b) Bar graph



c) Pie Graph



Questions to be answered in their report:

1. Does matter take up space? How?
2. What will happen if you try to put:
 - a) more water in the cup when it is filled?
 - b) adding sugar in the cup when it is filled?
3. What will happen if you put more and more air into the balloon? Why?
4. Which object is the heaviest? How can you explain that?
5. Which object is the lightest? How can you explain that?



Lesson 5: Changes of State

Objective: Identify the change of state, and write down the change in temperature.

Materials for the teacher:
Card, blackboard, chalk

Material for the students:
Notebooks, pencils, ruler, thermometer

Teaching methods:
Discussion, explicit teaching and class activity.

Engaging activity:
Have the students pass the ice cube from one to another. Ask them to explain what is happening to the ice cube.

Concepts:

A substance can be a solid, liquid or a gas depending on its temperature. In order for a substance to change state from solid to liquid, from liquid to gas, enough energy must be added to overcome the intermolecular forces that keep the atoms or molecules together.

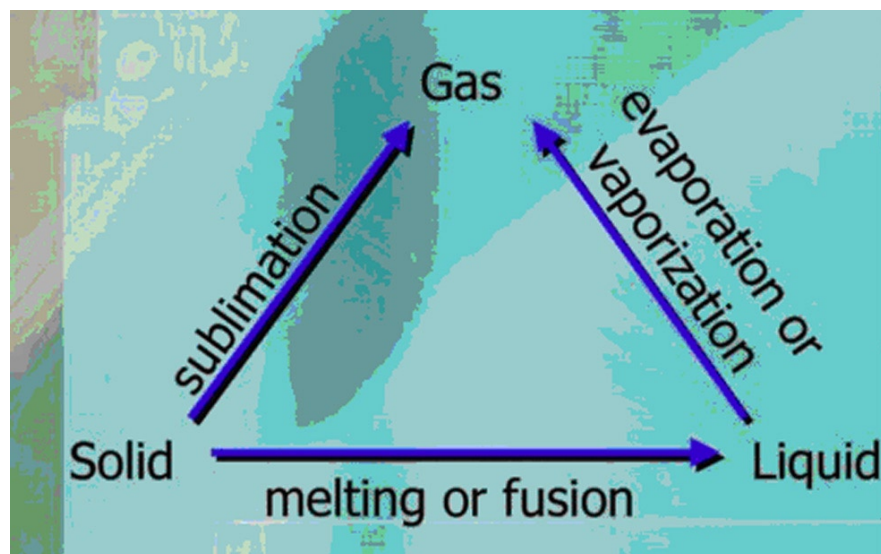
Sublimation is the direct conversion of a solid to a gas. Example - dry ice

Melting or Fusion is the conversion of a solid to a liquid. Example - melting of ice

Freezing is the conversion of liquid to a solid. Example - water in the freezer

Evaporation or Vaporization is the conversion of a liquid to a gas. Example - boiling water

Most materials will first melt and then vaporize as the temperature is raised.



Activities:

Do a brainstorming about changes of state. Here are a few ideas:

A snowman in spring;

A chocolate bar in the car in the summer;

Water in the freezer;

Discuss the cause of all these changes

Changes of state caused by the temperature:



Procedure:

Tell the students to complete the chart below in groups of 2. Students will discuss their observations and write an individual report. Indicate the change of state that takes place (freezing, melting ect.)

- a) ice cream which melts(quickly or slowly)
- b) butter on the table
- c) Puddles of water in the fall, the spring, the summer
- d) Exhaling in winter (see your breath)
- e) Ice cube in the class
- f) Sugar in water

Items	Estimate temp.	Colder(Y/N)	Warmer(Y/N)	Change of State (melt, freeze...)

Enrichment Activities:

- g) Research from the local newspaper or the Internet the weather reports from 8-10 days. Record the temperature, humidity and precipitation for each of the days. Find some relationship between humidity and precipitation as well as between temperature and humidity. Present your findings in graph or table form.
- h) What would happen if food such as milk, and meat were left outside for two days during summer or winter?
- i) How might your eating habits change if you didn't have a refrigerator?

Lesson 6: Properties of Matter

Objective: Identify the physical and chemical properties of matter.

Materials for the teacher:

Card, blackboard, chalk

Material for the students:

Notebooks, pencils, ruler, thermometer

Teaching methods:

Discussion, explicit teaching and class activity.

Engaging activity:

Think about an object in the classroom. Have the students ask questions in order to identify the object. They can only ask questions which would have yes or no for an answer.

Concepts:

A property is a characteristic of a substance that allows you to describe it. It can be either physical or chemical.

Physical properties are the properties of an object that can be observed. Examples color, shape and texture are all physical properties. Physical properties of matter are categorized as either Intensive or Extensive.

Intensive properties do not depend on the amount of the matter present. Examples odor, luster, melting.

Extensive properties do depend on the amount of matter present. Examples mass, weight, volume. (www.chem.tamu.edu/class/majors/tutorialnotefiles)

Chemical properties describe how a substance changes into a new substance. Solid, liquid, and gases can be easily recognized by their different properties such as:

Density: the mass of matter divided by its volume

Shape: Is it fixed or take the shape of the container?

Compressibility: if we apply pressure, does the volume decrease?

Thermal expansion: how much does the volume change when heated?



Procedure:

Tell the students to complete the chart below in groups of 2. Students will describe the properties of matter and write an individual report.

- a) salt
- b) sugar cube
- c) baking soda
- d) alcohol
- e) iron
- f) copper
- g) milk
- h) vinegar
- i) cotton
- j) a piece of cloth etc.

Property	State		
	Solid	Liquid	Gas
Density	High	High	Low
Shape	Fixed	Takes shape of container	Expands to fill container
Compressibility	Small	Small	Large
Thermal expansion	Very small	Small	Moderate

Objects	I see(eyes) Color, size, shape, dull or shiny, soft or rough, solid, liquid, gas	I hear Tic-tac, whistling silence	I smell Pleasant or sour Smelly or odorless	I taste Sour, bitter or sweet	I touch Wet or dry, soft or hard, warm or cold, heavy or light, stretchy or rigid

Enrichment Activities:

- 1) Art with the 3 states: solid-paper, liquid-paint, gas-air that you blow a straw. Pour some paint onto a sheet of paper. Blow through the straw to move the paint around. Make a picture.
- 2) What do you think is the most economical materials to use for bottling soft drinks? Which is the most environmentally friendly material? Give reasons for the choice you make.
- 3) Draw a semantic map that shows at least 7-10 concepts learned at this point, and write 3-4 paragraphs about them.



Lesson 7: Physical changes and Chemical changes

Objective: Explain physical and chemical changes.

Materials for the teacher:

A rusty nail, cardboard, matches, a dish in which you can burn some paper.

Material for the students:

Notebooks, pencils, ruler, thermometer

Teaching methods:

Discussion, explicit teaching, experiment, demonstration, and class activity.

Engaging activity:

1. What do I have in my hand? (a rusty nail). Has it always been like this? What happened? Name some objects which rust.
2. Take a piece of paper and tear it into pieces. Is it still the same? Yes, no
3. Then take one piece and burn it in a dish. Is it still the same? Yes, no

Concepts

In a physical change, the chemical composition of the original substances remains unchanged, and no new substances are formed. In a chemical change, new substances are formed. Most of the time changes can be identified by using the following criteria:

Physical Change

- * generally reversible
- * by thermal process alone(ice-water-steam)
- * salt dissolve in water, but can reclaim the solid
- * salt by evaporation

Chemical Change

- * generally not reversible
- * formation of gas bubbles
- * formation or disappearance of a
- * permanent change in color
- * heat or light given off or taken in
- * production of electricity



Procedure:

Tell the students to complete the chart below in groups of 2. Students will classify the following changes using the table and write an individual report

- | | |
|-----------------------|------------------------------|
| a) a cake in the oven | h) sulfur melting |
| b) a tarnished coin | i) an egg frying |
| c) crush rocks | j) sugar dissolving in water |
| d) cut paper | k) leaves changing color |
| e) burn a match | l) glass breaking |
| f) boiling coffee | m) clouds formation |
| g) making popsicles | n) Iodine + bread |

Objects #	Physical change	Chemical change

Enrichment Activity

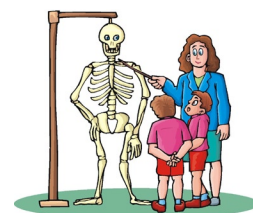
1. Research the invention of plastic or its inventor, and write a report.
2. Cars use water to keep their engines cool, but when the temperature outside is very low, there is a danger that the water will freeze. Find out how adding anti-freeze to a car's radiator helps solve this problem.





References:

1. Addison-Wesley, Chemistry, SI Edition. Copyright 1993 Addison-Wesley Publishers
2. Discovering Matter & Energy, Coop Clark Pitman Ltd.
3. Discovery Works, Houghton Mifflin Science Discovery works
4. Dueck, Gwen; Layh, Jan; Opening the Door to Cooperative Learning. SIDRU/SPDU, Regina, 1992
5. Journeys in Science; Maxwell MacMillan Canada, 1991
6. Makhmaltehi, Vivian; Hands on Science, Activities for Grades 4-6; Trelis Books, USA, 1992; ISBN 0 8167-2592-6
7. Molyneux, Lynn; Cooperative Learning, Science and Success Step-by-Step Activities, Illustrated by Rosemary Park; Trelis Books, Canandaigu, NY, 1992
8. States of matter: www.chem4kids.com/files/matter_states
9. Chemistry Basics: www.chem.tamu.edu
10. Matter / mass / atoms / molecules: www.edtech.kennesaw.edu/web/matter
11. States of matter: www.hartcourtschool.com
12. The Fourth State of matter: <http://liftoff.msfc.nasa.gov/academiy>
13. Which Biological Molecule Are You? <http://quizilla.com/users/ScOtty/quizzes/>
14. Webquest: www.webquest.com
15. States of Matter: www.school-for-champions.com/science/matterstates.htm
16. Matter: www.schools.pinellas.k12.fl.us/educators/tec/Davis2/matter.ppt/index.ht
17. Properties of matter: www.stf.sk.ca/teaching_res/library/teach_mat_centre/tmc/e10637/e10637.htm.
18. Physical and Chemical properties: www.usoe.k12.ut.us/curr/science/sciber00/8th/matter/sciber/init
19. Chemistry: <http://ull.chemistry.uakron.edu>
20. Structure of matter: www.webtech.kennesaw.edu/jnaclerio/webquest.htm
21. Plasma Balls: www.worldinnovations.co.uk/moreinfo.php



Resources:
Appendix - 1

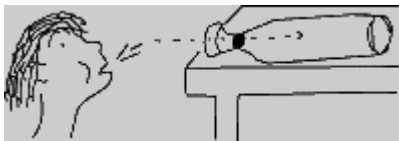
Question of the week



The students need to learn to reason things out and to look for answers on their own. To promote this skill, you can put up a "Question of the week" near the door in a small plastic Ziploc™ bag. The students can look for the answer at home with their parents or during their spare time, during the week. Each week the teacher can collect the science logs to see if the students have finished the work. Ask the students to include their hypotheses and well as the steps followed and to justify their results. (See the example on the next page.)

Here are a few sample questions:

1. Does hot water freeze more quickly than cold water? Do an experiment to discover the answer (Curriculum Guide, page 512, activity 10).
2. Lay a bottle on a table. Place a piece of crumpled up paper in the neck of the bottle. Try to blow the paper into the bottle. What happens? Why?



3. Can you blow up a balloon inside a bottle? Slip a balloon into the neck of the bottle. Fold the balloon over the neck of the bottle. Try to blow it up. Is it possible?



4. Find a large glass bottle (a one liter soft drink bottle). You need a shelled hard boiled egg. Set fire to a piece of paper and put it into the bottle. Take the egg and put it into the neck of the bottle. What will happen? Take a guess!

Appendix-2

Format for lab. Report

Question: _____

Hypothesis: _____

Materials: _____

Procedure: _____

Justification: _____

Conclusion: _____



Appendix-3

The Role of Each Group Member

Facilitator

- participates in the group work
- reads the information aloud
- encourages his or her teammates to stay on the topic

Secretary

- participates in the group work
- takes notes for the group
- asks for clarification if necessary

Spokesperson

- participates in the group work
- leads the group discussions
- represents the group during the exchange of information with other groups

