

PROPERTIES OF MATTER-
SOLIDS INVESTIGATION

CONCEPT: Classifying Properties of solids.

NATIONAL SCIENCE STANDARDS:

A	B	C	D	E	F	G

BACKGROUND:

Prior to this activity, students will need to have general knowledge about states of

matter and density. It will also be helpful if they know how to organize information

using a data table.

OBJECTIVES:

Students will be able to:

1. classify solids into groups with similar properties e.g., color, size, texture, malleability, resiliency, and optical properties.
2. conduct tests on solids to determine their density, and reactions with an acid and a base.
3. record observations in a data table.

GRADE LEVEL: 6-9

ESTIMATED TIME:

Preparation: approximately 2 hours.

Activity: Introduce the activity by reviewing the states of matter and discussing the various

tests that will be performed.

one period to introduce the activity

two or three to conduct test and wrap-up

MATERIALS:

The following are recommended per group of 2-4 students:

- safety goggles (for each student)
- testing materials
- individual containers for the solid samples (spot plate, test tubes, cups, etc.)
- hotplate
- aluminum foil
- hammer
- magnifying lens
- two eye droppers (or pipettes)
- magnet
- conductivity tester (commercial or simple homemade circuit tester-9 volt with battery harness or C or D cells with wires and flashlight bulb)

Solids

- paraffin
peanut, these
- Ecofoam® (starch packing)
- Friendly Plastic® (craft stores)
solubility in water) can be identified by their
- carbon (charcoal)
- rock salt
- iron filings or pieces
- aluminum
- marble or limestone
- small wood pieces (approximately 1/8 – 1/4 inch pieces)
- glass beads or rods (fire polished or no sharp edges)
- Nylon® (or other polymer samples, a local plastic molding shop is a good source of conveniently sized samples)

Liquids

- water
- vinegar
- ammonia (Household cleaner concentration)
- salt water solution (This should be a saturated solution. Prepare by dissolving as much salt as possible in distilled water and filtering the liquid away from the solid)
- cooking oil
- glycerin

PROCEDURE

★ **NOTE: All classroom activities must be performed in a manner that follows your school district's safety guidelines. It is each teacher's responsibility to determine if this activity is appropriate for your classroom. Students must wear goggles when doing this activity.**

SETUP: Stations may be set up for each test or materials for the tests may be arranged on

separate trays which may be dispensed to student teams from a central location.

OVERVIEW: This activity focuses on classification. It is important that students devise their own methodology for this, so teachers are encouraged to limit introductory explanations to safety considerations, and basic techniques.

- Students should construct a data table to record their observations.
- Have students examine and test each of the solid substances as indicated below.
- Encourage each team to classify the materials into groups with similar properties.
- Each team of students could display and explain their groupings to the class for comparison and discussion.

Suggested Day One Tests and Observations:

- **Color**
- **Size/Shape** - be sure to measure the actual size
- **Texture** –rough, smooth, shiny, etc
- **Response to light** –determine if the solid is *translucent* (can barely see through it), *transparent* (can see through it), *opaque* (can't see through it)
- **Magnetism** - use of a Magnetic Wand® works well. They are available from Dowling Magnet Co. 1-800-624-6381 \$1.99 ea.
- **Electrical conductivity** – use a conductivity tester to determine each solid's electrical conductivity (see "Materials" section in this activity for information on how to make an inexpensive conductivity tester.)
- **Malleability** – using a hammer or a mallet on a hard surface, determine if the solid can be pounded into a thin sheet. (Supervision

strongly suggested) The traditional method is to use a hammer to determine if a solid is malleable. An alternative would be to press the sample with pliers.

- **Resiliency** - ability to spring back to normal shape when bent, compressed or stretched

Suggested Day Two Tests and Observations:

- **Density** – determine if the solid sinks or floats in the following: water, saturated salt water, oil, glycerin (e solids that are soluble in these liquids are not suitable for this test)
- **Reaction with a weak acid** – test the reaction of the solids with vinegar. Use eye droppers and spotting plates or petri dishes and record observations. (for example, fizzes, dissolves, bubbles)
- **Reaction with a weak base** - test the reaction of the solids with household ammonia. Use eye droppers and spotting plates or petri dishes as above and record observations.

Suggested Teacher Demonstration (or carefully supervised activity)

- **Response to heat** – determine which samples melt when heated by placing them on aluminum foil on a hot plate. Be sure not to allow the samples to burn as hazardous gases may be emitted!

SAFETY AND DISPOSAL:



- Students must wear goggles throughout the activity!!
- For the reaction with acid (vinegar) and base (household ammonia), use only small amounts of each material and a few drops of vinegar or ammonia. Household ammonia may be diluted to reduce its odor.
- Use small amounts (pea-sized) of each material and a few drops of vinegar and household ammonia.
- For the heating test, the samples may be placed on aluminum foil on a hot plate. Be sure not to allow samples to burn.
- Some plastics give off toxic fumes when burned, therefore it is suggested that they only be melted not burned.

- Glass samples should be chosen carefully so that no sharp pieces are used. Only use glass beads or rods that have fire polished ends.
- Malleability may be done at a central location rather than at each team's workstation so that teams may share hammers and be supervised. NOTE: Glass should not be struck with a hammer to test for malleability!
- Solids should be disposed of in accordance with your schools guidelines. Liquids except glycerin and cooking oil may be diluted and washed down the drain. Used glycerin and cooking oil should be collected in separate containers and disposed of according to local guidelines.

EXTENSION ACTIVITIES

1. Students could develop additional classification tests for these or other solids.
2. Compare the properties of different polymer samples.
3. Student teams could read about the recycling of plastics and then put together a “commercial” about each type of plastic.
4. The density component of the lab could be expanded to include mass and volume measurements.
The density of each sample then could be calculated.
5. An interactive review employing every day solids found in a kitchen, could be done using Motorola's "My House" from the unit, *Earth Generation*.

REFERENCES/RESOURCES

1. Science Education for Public Understand (SEPUP) "Materials" unit.
2. Alper, Joseph and Nelson, Gordon L. Polymeric Materials: Chemistry for the Future. American Chemical Society, Washington DC., 1989.
3. Motorola, Earth Generation, "My House" interactive games.
4. “Hands-on Plastics” kit produced by American Plastics Council.
5. Web sites with information about Classification of Matter
<http://www.hcc.hawaii.edu/hccinfo/instruct/div5/sci/sci22/atomic/matter/matclas.html>

Discussion Questions:

Sample

Classification of Types of Matter

Name _____

Period _____

1. Classify the following types of matter into groups with similar properties.

paraffin
carbon
iron filings

nylon
aluminum
limestone

wood
polystyrene
Friendly Plastic®

rock salt
glass
Ecofoam®

2. Explain why you chose the groupings in #1.

3. Were there any items that could fit into more than one category? If so, which ones?
How
did you decide where they should be?