

The Properties of Matter

Chapter 2: V is for Volume!
Lecture 2

V is for Volume

- ✓ Briefly, volume is the amount of space something takes up.
- ✓ Whether it's a speck of dust or Jupiter, all matter takes up space.

Measuring the volume of...

Liquids:

- ✓ Graduated cylinder
- ✓ Displacement method
- ✓ Measured in liters (L) & milliliters (mL)



Solids:

- ✓ Length x width x height



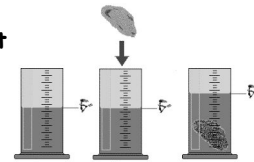
Gases:

- ✓ Since a gas expands to fill its container, if you know the volume of the container, you know the volume of the gas.



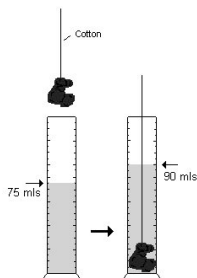
- ✓ Density - The mass of a substance divided by its volume

- ✓ Density is an important physical property. Density is the mass of a substance per unit volume.



- ✓ Volume is the amount of space an object occupies.

Extensive - Properties that do depend on the amount of matter present.



- ✓ Volume - A measurement of the amount of space a substance occupies.

- ✓ *Length

You try it!



Sack Secrets

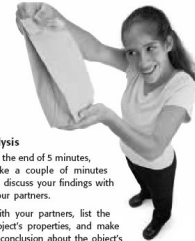
In this activity, you will test your skills in determining the identity of an object based on its properties.

Procedure

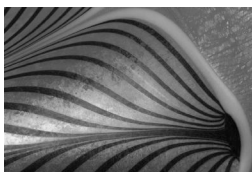
1. You and two or three of your classmates will receive a **sealed paper sack** with a number on it. Write the number in your ScienceLog. Inside the sack is a **mystery object**. Do not open the sack!
2. For 5 minutes, make as many observations as you can about the object. You may shake the sack, touch the object through the sack, listen to the object in the sack, smell the object through the sack, and so on. Be sure to write down your observations.

Analysis

3. At the end of 5 minutes, take a couple of minutes to discuss your findings with your partners.
4. With your partners, list the object's properties, and make a conclusion about the object's identity. Write your conclusion in your ScienceLog.
5. Share your observations, list of properties, and conclusion with the class. Now you are ready to open the sack.
6. Did you properly identify the object? If so, how? If not, why not? Write your answers in your ScienceLog, and share them with the class.



How can you describe them if you didn't know what they were?



- ∨ Describing objects by using
- ∨ size
- ∨ shape
- ∨ color
- ∨ texture
- ∨ uses an object's properties.

Properties

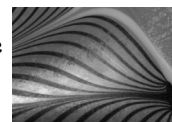
- ∨ It doesn't matter what your object was, everyone used similar descriptions. What were some of the properties you listed about your object?
- ∨ Size, Weight & Mass, Shape, Odor, Sound, etc.
- ∨ After opening your bag, you were able to list even more properties such as color, texture, etc.

Common Physical properties

- ∨ Physical properties can be observed or measured without changing the identity of the matter.
- ∨ Basically, properties you notice when using one of your five senses:
 - ∨ Feel - mass, volume, texture
 - ∨ Sight - color
 - ∨ Hear
 - ∨ Smell
 - ∨ Taste

Physical properties of matter are categorized as either:
Intensive or Extensive:

- Intensive - Properties that do not depend on the amount of the matter present.
- Color & Odor
- Luster: How shiny a substance is.
- Malleability - The ability of a substance to be beaten into thin sheets.
- Ductility - The ability of a substance to be drawn into thin wires.



- Conductivity - The ability of a substance to allow the flow of energy or electricity.
- Hardness - How easily a substance can be scratched.
- Melting/Freezing Point The temperature at which the solid and liquid phases of a substance are in equilibrium at atmospheric pressure.
- Boiling Point - The temperature at which the vapor pressure of a liquid is equal to the pressure on the liquid (generally atmospheric pressure).



More Physical Properties

Density is a very important property.

- ∨ It is the amount of matter in a given volume.
- ∨ Density = Mass / Volume



$$D = \frac{m}{V}$$

More Physical Properties		
Physical property	Definition	Example
Thermal conductivity	The ability to transfer thermal energy from one area to another	Plastic foam is a poor conductor, so hot chocolate in a plastic-foam cup will not burn your hand.
State	The physical form in which a substance exists, such as a solid, liquid, or gas	Ice is water in its solid state.
Malleability (MAL ee uh BIL uh tee)	The ability to be pounded into thin sheets	Aluminum can be rolled or pounded into sheets to make foil.
Ductility (duhk TIL uh tee)	The ability to be drawn or pulled into a wire	Copper is often used to make wiring.
Solubility (SAHL yoo BIL uh tee)	The ability to dissolve in another substance	Sugar dissolves in water.
Density	Mass per unit volume	Lead is used to make sinkers for fishing line because lead is more dense than water.

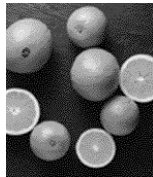
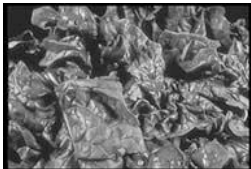
Properties of all objects



- v **Objects take up space.**
- v **All objects take up space.**
- v **Your computer is taking up space on the desk.**
- v **You are taking up space on the chair.**

Properties of Matter

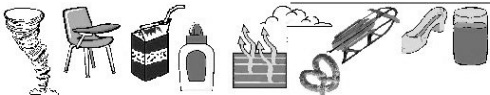
- v **Remember all objects take up space and have mass.**
- v **You use your sense of taste and smell to tell the difference between spinach and an orange.**



Physical properties-

- The measurement of mass and other characteristics that can be seen without changing how that object looks are its physical properties.
- When you look at oranges, you know that they are oranges because of their color, shape, and smell.
- **Mass, color, shape, volume, and density are some physical properties.**
- The answers to the question about the present are physical properties.

A property describes how an object **looks, feels, or acts.**



Properties are constantly changing...



- **Matter is constantly changing.**
Ice in your soda melts, glass breaks, paper is ripped.
- **When ice in your soda melts where does it go?**
- **What does it become?**

Physical vs. Chemical Properties

- ✓ **Physical properties:** observe without changing the identity of the substance
- ✓ **Chemical properties:** observe only when the identity changes
- ✓ How do you know if it is chemical or physical?
 - ✓ If it **CH**anges, it's **CH**emical

Chemical properties

- ✓ A common chemical property is **reactivity**.
 - ✓ Reactive to oxygen
 - ✓ Reactive to air
 - ✓ Reactive to water...
- ✓ Notice that chemical properties aren't EASY to observe, unlike physical properties.

Comparing Physical and Chemical Properties

Substance	Physical property	Chemical property
Helium	less dense than air	nonflammable
Wood	grainy texture	flammable
Baking soda	white powder	reacts with vinegar to produce bubbles
Powdered sugar	white powder	does not react with vinegar
Rubbing alcohol	clear liquid	flammable
Red food coloring	red color	reacts with bleach and loses color
Iron	malleable	reacts with oxygen
Tin	malleable	reacts with oxygen

Physical Changes:



- ✓ Changes in matter that do not alter the identity of the matter itself. Changes that **do NOT change** the identity of the substance.

More Examples of Physical Changes

- Freezing water for ice cubes
- Sanding a piece of wood
- Cutting your hair
- Crushing an aluminum can
- Bending a paper clip
- Mixing oil and vinegar

Physical Changes:

You may or may not be able to undo a physical change.



Figure 5 The mass of the bowling ball does not change. The mass of the puppy increases as more matter is added—that is, as the puppy grows.

- For example:
 1. Size
 2. Shape
 3. State
 - solid liquid gas
 4. Dilutions
- The water doesn't turn into soil or macaroni.
- It remains water.
- If it did change into soil or macaroni, your drink would taste terrible and you would have an example of a chemical change

- ✓ If you remember, ice is water in the solid state.
- ✓ When you drop the ice cube into the liquid, it begins to melt because the temperature is higher than that of the ice cube.
- ✓ It's like putting a snowman on your front lawn in July.
- ✓ The ice cube becomes liquid water.
- ✓ This is an example of a physical change.
- ✓ The solid water turned to liquid water.

Chemical Changes

- v Chemical changes *do* alter the identity of a substance
- v In other words, a chemical change is when something changes into an **entirely different substance**
- v For example:
 - v Iron rusting
 - v Wood burning
 - v Copper turning to brass
 - v Baking a cake
 - v spoiled milk



THESE PIPES ARE IN THE MIDDLE OF CHEMICAL CHANGES AS THEY RUST.

Chemical properties-

- v These are properties that can only be observed by changing the identity of the substance.
- v A piece of paper burns and turns to a black substance.
- v After the flame goes out you can no longer burn the new substance.
- v The chemical properties have been changed.



- v Milk needs to be in the refrigerator or else it will go bad.
- v If you've ever seen or smelled spoiled milk, it is not a pretty sight.
- v The milk gets a sour odor and becomes lumpy.
- v Unlike physical changes, you cannot reverse chemical changes.
- v You can melt ice to get water and freeze that water to get ice again.
- v You cannot make milk unspoiled.



Examples of Chemical Changes

Soured milk smells bad because bacteria have formed new substances in the milk.



Effervescent tablets bubble when the citric acid and baking soda in them react in water.



The hot gas formed when hydrogen and oxygen join to make water helps blast the space shuttle into orbit.



The Statue of Liberty is made of shiny, orange-brown copper. But the metal's interaction with carbon dioxide and water has formed a new substance, copper carbonate, and made this landmark lady green over time.

Brainpop

- v Property changes!

PROPERTY CHANGES

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elaine

SCORE: 10/10

- 1 **When water changes to ice, what kind of change has occurred?**
 - A) A chemical change
 - B) A physical change
 - C) A state change
- 2 **What type of change has occurred when a solid melts?**
 - A) A nuclear change
 - B) A physical change
 - C) A chemical change
- 3 **What does it mean when there is a physical change?**
 - A) Matter has changed from one substance into another.
 - B) Matter has changed into, shape or form.
 - C) Matter has new particles with matter.
- 4 **What does it mean when there is a chemical change?**
 - A) There is a change in the color or shape of an object.
 - B) One substance has changed into another.
 - C) A solid changes into a chemical.
- 5 **What is an example of a chemical change that happens inside your body?**
 - A) Food being broken down by enzymes in your stomach.
 - B) Food being broken into small pieces by your teeth.
 - C) Your heart beating.
- 6 **What is an example of a physical change that happens inside your body?**
 - A) Food being broken down by enzymes in your stomach.
 - B) Food being broken into small pieces by your teeth.
 - C) Your heart beating.
- 7 **What type of change is washing?**
 - A) A chemical change
 - B) A physical change
 - C) A nuclear change
- 8 **What chemical change produces table salt?**
 - A) Sodium and chlorine react with one another.
 - B) Paper and sugar are mixed together.
 - C) A piece of salt cane is crushed into tiny pieces.
- 9 **Which of these is a chemical change that occurs over a long period of time?**
 - A) Adding chlorine to the pool.
 - B) Ice cream melting.
 - C) Metal rusting.
- 10 **What type of change has occurred when a glass breaks?**
 - A) A chemical change
 - B) A physical change
 - C) A psychological change

✓ **Common Errors**

- ✓ *Ice melting, water freezing, water evaporating, and steam condensing are all examples of a state change.
- ✓ *These are physical changes, not chemical.
- ✓ *Diluting a solution is a physical change, even if the color becomes more faint.

Melting is a
physical change.

The Take Home Message



- State changes, like melting, freezing, boiling, are all **PHYSICAL** changes.
- The substance remains the same substance, it just changes what **STATE** it is in.
- We'll talk about this next time.