

## Grade 7 Science

Week of November 9 – November 13

### Physical Properties of Pure Substances

#### Introduction to Physical Properties

This section explores properties of matter. Consider for a moment why this might be important.

When engineers design and build airplanes and space shuttles, they need to know everything about the materials they use. For example, the space shuttle needs to be heat resistant because it will heat up as it re-enters the earth's atmosphere. Bridges need to be able to withstand earthquakes and all types of weather. It is essential to know if these materials will change when exposed to heat or cold temperatures. You don't want the materials to rust and fall apart!

An important part of chemistry is making observations and interpreting results. What do you see when ice melts, paper burns, or metal rusts? Are there any similarities? Or differences? When matter changes, can it be changed back? Or is the change irreversible?

Why are the domes on top of the BC Legislature buildings green? By the end of this section, you'll know the answer to this and other matter-related questions.

Dome on the BC Legislature Building  
Reprinted with permission from Daljinder Kang.



As you know from past science lessons, everything around you is made up of matter. Matter is anything that has mass and volume. You, the chair you're sitting on, and the sandwich you're going to eat for lunch are all made up of matter.

If everything is made up of matter, how do we tell the difference between different types of matter? How would you tell the difference between gold and pyrite (fool's gold)? When you observe elements and substances, you can see certain differences in their physical appearance. You can also do tests to find some of their chemical properties. The periodic table classifies elements according to physical and chemical properties.

## Physical Properties of Pure Substances

Think of the last liquid you drank. Maybe it was water, orange juice, hot chocolate, or something else? What colour was it? Did it have a smell? These are properties of matter. A **physical property** is a characteristic of matter that can be observed or measured. Some examples of physical properties are:

- state (solid, liquid, or gas)
- colour
- lustre (a description of how the substance reflects light, using words such as shiny, dull, pearly, glassy, oily, and so on)
- density (mass per given volume)
- hardness (ability of a solid to resist scratching)
- melting or boiling point
- viscosity (a fluid's resistance to flow)
- malleability (a solid's ability to be flattened into thin sheets)
- ductility (a solid's ability to be stretched into thin strands or wires)
- magnetism (ability to exert a magnetic force)
- conductivity (ability of electricity to flow through the material)

For example, here is a partial list of some properties of hydrogen and gold:

Property	Hydrogen	Gold
colour	clear	yellow
density	0.09 g/L	19.3 g/cm <sup>3</sup>
boiling point	-252.87 <sup>0</sup> C	2 807 <sup>0</sup> C
conductivity	does not conduct	conducts

Everything around you is considered **matter**. What type of matter you choose for your purpose depends on the **properties** of that matter.

Part of the properties of matter include the **state** (solid, liquid, or gas) that the matter can be found in at particular temperatures. Solid matter has a fixed shape, liquid matter is a fluid and takes the shape of the container it is in, and gas has no fixed shape but will fill the container it is in. Different types of matter have different states at different temperatures. Gold will become a liquid at a different temperature than water.

## Physical Properties of Matter Movie

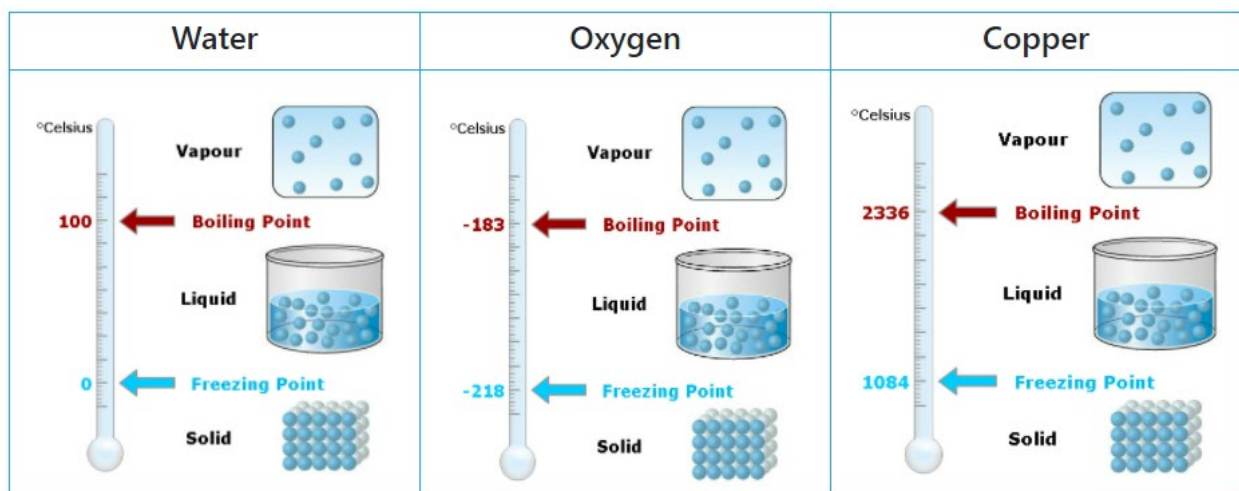


Check out this video about the physical properties of Matter: <https://youtu.be/ougNDSht5dU>

## Comparison

Water, copper, and oxygen are three types of matter with very different properties.

Examine the images below to get an idea of how states change at very different temperatures.



The freezing point of matter is the temperature where a solid becomes a liquid; this is the same as its melting point. The boiling point is the temperature where a liquid becomes a gas.

The freezing and boiling points of matter are properties that can be observed and measured *quantitatively*. There are also many *qualitative* properties that can be observed with your senses, such as colour, odour and shape.

Properties might include:

blue - the colour

salty - the taste

rough - the texture

spicy - the smell

shiny - the lustre

liquid - the state

200 mL - the volume

Can you tell which of these are quantitative and which are qualitative? We'll be exploring more properties of matter in this unit.

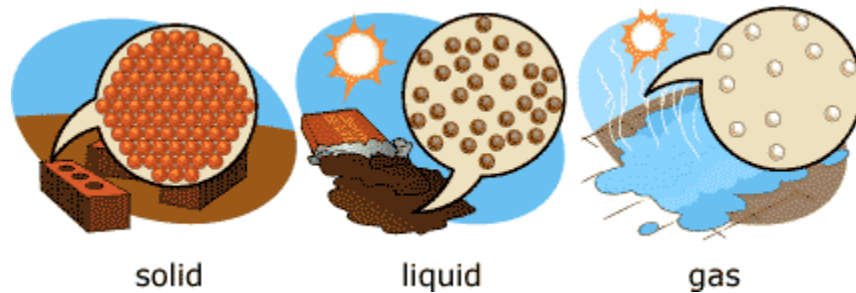
## States of Matter

As you've learned in previous science courses, there are three **states** that material is commonly found in: solid, liquid, and gas.



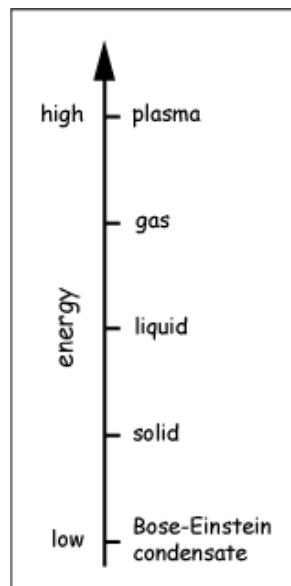
Matter and its Physical Properties <https://youtu.be/g0sanYvDGvk>

- **Solid** – has a fixed shape and volume. Its shape remains the same no matter what shape the container is that it's in.
- **Liquid** – has a fixed volume, but not shape. Its shape changes, it takes the shape of the container that it is in.
- **Gas** – has neither a fixed shape or volume. It takes the shape of the container that it is in, and it can be compressed or decompressed.



### Did You Know...?

Scientists have been able to identify five states of matter: solid, liquid, gas, plasma, and Bose-Einstein condensates. There is still discussion on these in the scientific community and for our practical purposes we will stick to the basic three states—solid, liquid, gas. If you are interested in learning more about the subject, you can do an Internet search for states of matter.



## Melting and Boiling Points

The **melting point** of a substance is the temperature at which a solid becomes a liquid. Ice melts at 0°C to become water. Every substance has a different melting or boiling point.

The **boiling point** of a substance is the temperature at which a liquid changes to gas. Water boils at 100°C.



Melting and Boiling Points <https://youtu.be/-dgxE8vUGAk>

## Conductivity

**Conductivity** is the ability of substances to conduct heat or electricity. For example, the electrical wires in your house contain material that allows electricity to flow through it. The plastic coating on the electrical cords contain materials that don't allow electrical flow; this is an example of non-conductivity. Can you see why both qualities are important?



Electrical Conductivity of Solutions <https://youtu.be/ABAqtFPfVos>

## Density

**Density** measures how close the particles of a substance are packed together. Density is **mass** per unit **volume**. The density of water is 1 g/cm<sup>3</sup> or 1 g/mL . This means mass divided by volume.

You will learn more about density in the next section.

## Fool's Gold

Do an online search to complete the table for pyrite. Even though gold and pyrite may be similar in appearance, how similar, or different, are their other properties?

Property	Gold	Pyrite
colour	yellow	
density	19.3 g/cm <sup>3</sup>	
boiling point	2807 °C	
conductivity	conducts	

### *Physical Properties of Pure Substances*

1. List five physical properties that can be used to identify pure substances.

2. Write a definition for melting point and boiling point and conductivity.

Melting point –

Boiling point –

Conductivity –

3. Find a household item that is a pure substance and describe it using physical properties in the space below – include the item name. Show your description to someone and see if they can identify the substance.

4. Fill in the table below by adding a physical property and use for each substance. Think about what they are used for and start from there.

<b>Substance</b>	<b>Physical Property</b>	<b>Use</b>
Gasoline		
Diamond		
Graphite		
Steel		
Plastic		
Gold		
Glass		

5. Name five other substances not in the table above and identify the physical or chemical property that makes them useful.