## شكراً لتحميلك هذا الملف من موقع المناهج الإماراتية

## تجميعة أسئلة وفق الهيكل الوزاري - انسباير



## التواصل الاجتماعي بحسب الصف السابع

| | | | |
|---|---|---|---|
| | | | |

## روابط مواد الصف السابع على تلغرام

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|---|---|---|---|
| التربية الاسلامية | اللغة العربية | اللغة الانجليزية | الرياضيات |

## المزيد من الملفات بحسب الصف السابع والمادة علوم في الفصل الثاني

| | |
|---|---|
| 1 | أسئلة الامتحان النهائي - بريدج |
| 2 | حل أسئلة الامتحان التعويضي |
| 3 | الأسئلة الكتابية المتوقعة في الاختبار النهائي |
| 4 | حل أسئلة الامتحان النهائي |
| 5 | تجميعة أسئلة وفق الهيكل الوزاري - انسباير |

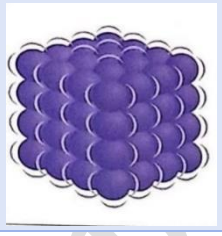
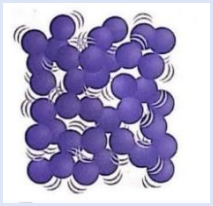
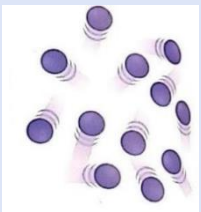
# Inspire Science Grade 7 تجميع هيكل

## Module1: Classification and state of matter

## Lesson 1: Energy and state of matter

**Properties of States of Matter:**

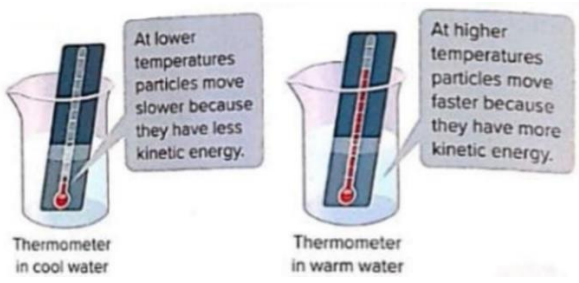
1. A **solid** is a state of matter with a definite shape and volume. Solids are difficult to compress, or squeeze into a smaller volume.
2. A **liquid** is a state of matter with a definite volume but not a definite shape. Liquids are also difficult to compress.
3. A **gas** is a state of matter without a definite shape or a definite volume. Gases are easy to compress.

| Solids | Liquids | Gases |
|---|---|---|
| ▪ Particles are very close to one another in a rigid structure.<br>▪ Particles vibrate in place.<br>  | ▪ Particles are close to each other.<br>▪ Move around randomly.<br>▪ Can collide with each other.<br>  | ▪ Particles are widely spaced<br>▪ Move around randomly at high speeds.<br>  |

***Energy and Temperature***

**Kinetic energy** is the energy an object has due to its motion. The faster particles move, the more kinetic energy they have.

The measure of the average kinetic energy of the particles in a material is **temperature. The higher the kinetic energy** of the particles, **the higher the temperature of the substance.**



**Thermometers** To measure the average kinetic energy or speed of the particles in a material a thermometer is used.

**Temperature scales** include **Celsius**, **Fahrenheit**, and **Kelvin**. The **Celsius** scale is used by scientists worldwide.

**The Kelvin scale** was developed to predict at what temperature particles would stop all motion. This temperature, known as **absolute zero**, would be recorded at **0 K**, if a substance reached 0 K, the particles would have no movement or kinetic energy. Scientists have not been able to cool any material to 0 K.

- **Circle the example in each pair that contains the greatest amount of energy. Explain your choice.**

1. **A glass of water at 20°C or a glass of water at 80°C**

The higher the temperature, the higher the kinetic energy.

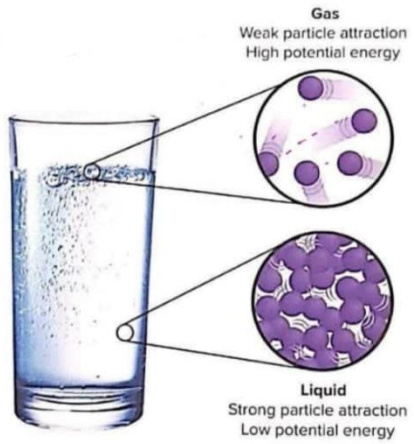
2. **An aluminium can at 30°C or an aluminium can at 20°C**

The higher the temperature, the higher the kinetic energy.

## *Potential energy*

Is stored energy due to the interactions between particles or objects.

**Attraction and Energy:** Particles of matter that are close together exert an attractive force on each other. **Solid particles** are very close to each other and have the greatest force of attraction between particles. **Gas particles** are far apart and have the smallest force of attraction between particles.




The potential energy of particles is due to the position of the particles relative to other particles. **As particles move farther apart**. the attractive forces between the particles decrease, **and as particles move closer** together, the attractive forces between the particles increase. The particles that are farther apart have greater potential energy. Gases have more potential energy than liquids or solids.

**Ex: The bubbles** in this carbonated water have **more potential energy** than the liquid water particles because they are farther apart from one another. **The liquid water** particles have **less potential energy** than the gas in the bubbles because they are closer to each other. *The state of matter* determines the amount of potential energy contained in a substance.

**Circle the example in each pair that has the greatest amount of energy. Explain your choice.**

1. **An ice cube at 0°C or a recently melted ice cube at 0°C.**

Because the attraction between particles of melted ice cube is less than the attraction between the particles of an ice cube.

2. **A puddle of isopropyl alcohol or evaporated isopropyl alcohol.**

Because when isopropyl alcohol evaporated it transformed into gas, and the gas has more potential energy than liquid.

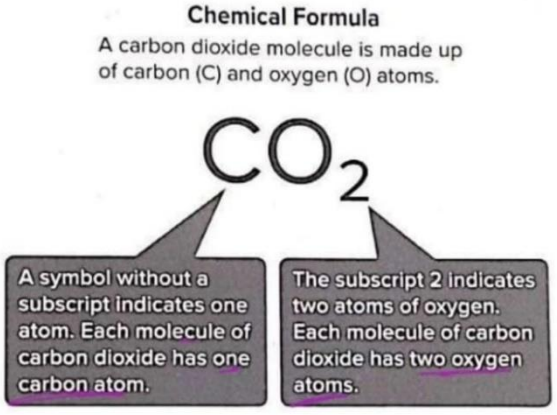
## *Thermal Energy*

The result of the motion of all the particles, and the distance and attractions between those particles in the system, is known as **thermal energy**

**Thermal energy of a substance depends on:**

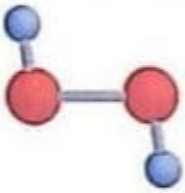
1- Temperature
2- the state of a substance. (It includes both kinetic and potential energies of substance)
3- the larger the sample of matter you have, the more thermal energy it contains. This is why a bathtub full of water contains more energy than a glass of water at the same temperature. The bathtub contains more particles of water than the glass.

| Element Symbols | Chemical Formulas |
|---|---|
| Element symbols are found on the periodic table of elements. The symbols for the known elements are one or two letters often taken from the name of the element. | compounds have chemical formulas. A **chemical formula** is a group of chemical symbols and numbers that represent the elements and the number of atoms of each element that make up a compound.<br>1. A chemical formula includes the symbols of each element in the compound.<br>2. It also includes numbers, called subscripts, that show the ratio of the elements in the compound. |



**Write the chemical formula for each compound model.**

Key
=N =H =O

| Compound Model |  |  |  |
|---|---|---|---|
| Formula | $NH_3$ | $H_2O_2$ | $HNO_2$ |

## Lesson 2: Changes in temperature

Lab: growing air https://youtu.be/LHptnVzkaml

***History*** *Jacques Charles (1745-1823) was a French scientist who described the relationship between temperature and volume of a pes. The change in volume car be measured by using a flexible container such as a balloon.*

### *Volume-Temperature Law*

**Charles's law** that the volume of ages Increases with increasing temperature, the pressure is constant.

**When the balloon is in cold air, the temperature of gas inside the *balloon* decreases.**

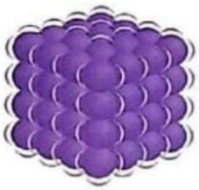
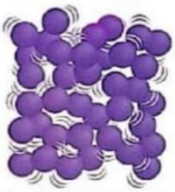
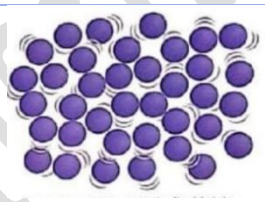
1. Decrease in temperature.
2. Decrease in the average kinetic energy of particles.
3. Result, the gas particles slow down.
4. They have less energy to overcome the attractive forces between them and begin to get closer together.
5. Fewer particles hit the inside surface of the balloon.
6. The balloon appears partially deflated, like the gas has escaped


- **Thermal contraction:** Is a decrease in a volume as its temperature decreases, increase in volume as the temperature increases.
- **Thermal expansion:** The number of particles does not change during expansion and contraction.

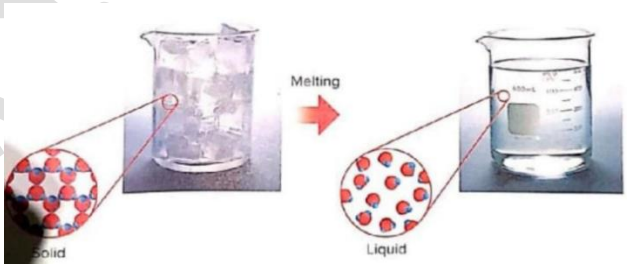
Particle size remains the same during expansion and contraction. The volume that the particles take up changes.

## What happen to state of matter as Temperature changes?

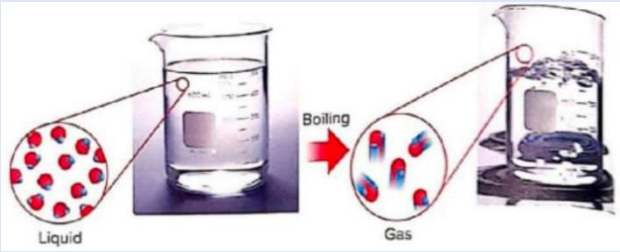
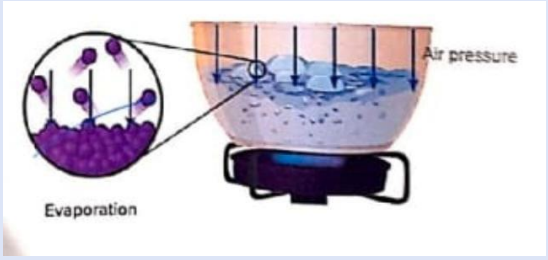
**Melting** Matter can change state when it gains or loses enough thermal energy, when particles speed up, they start to move farther away from each other. Recall that particles in a solid are also held together by strong attractive forces. As the particles gain more and more thermal energy, they gain enough energy to start to break away from the other particles. This is the **melting point** of a substance.

| | | |
|---|---|---|
|  As energy is added, solid particles vibrate faster and temperature increases. |  As particles move farther apart. the solid becomes a liquid. Temperature remains constant at the matting point. |  Once all particles are in the Equid state, any additional energy increases the speed of the particles. Temperature increases. |

Take a look at the figure below. At first, both the thermal energy and the temperature increase. The temperature **stops increasing when it reaches the melting point** of the water, the temperature at which the solid state changes to the liquid state. The energy supplied to the ice goes to breaking the attractive forces until all of the ice has melted. Once all the ice is melted, any additional energy supplied to the substance goes to speeding up the particles again as shown by a temperature increase of the water.




| Vaporization | Evaporation |
|---|---|
| When you heat water, *do you ever notice how bubbles begin to form at the bottom and rise to the surface?* The bubbles contain water vapor, a gas. The change in state from a liquid to a gas is **vaporization**. Vaporization that occurs throughout a liquid is called **Bolling**, Bolling is similar to melting.<br>As thermal energy is added to a liquid, the particles move faster and faster Once they are moving fast | You might have seen a puddle of water disappear over the course of a day. The temperature outside never reached Bolling, so *what caused the liquid water in the puddle to vaporize?* The water evaporated. Unlike Bolling, evaporation is vaporization that occurs **only at the surface** of a liquid. When the particles at the surface of the puddle gained enough energy from the Sun to |

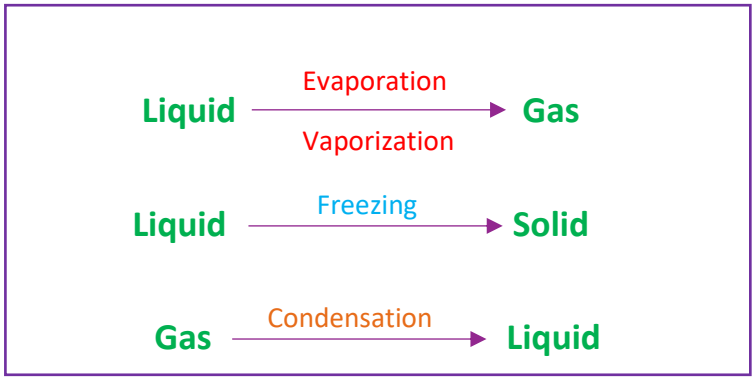
| Vaporization | Evaporation |
|---|---|
| enough, they overcome the attractive forces holding them in a liquid state and become gas particles.<br>The temperature needed for a substance to boll is called the **boiling point**. A substance's **temperature will remain** at its boiling point until all of the particles have changed from liquid to gas. Once all the particles are a gas. any additional energy will increase the speed of the gas particles as indicated by an increase in temperature.<br>  | overcome the attractive forces holding them to the rest of the particles in the puddle, they broke away as a gas.<br>**Pressure and Evaporation** Pressure also plays a role in evaporation.<br>Not only do the particles need to overcome the attractive forces between the particles they must also overcome the force of air pressure.<br>  |

## *Freezing*

The opposite of melting is freezing, the change of state from a liquid to a solid.
*Freezing requires the removal of thermal energy*. As energy is removed from liquid particles, they slow down. As they slow down, they have less energy to overcome the attractive forces between particles and will start to form an organized structure.
Once all of the particles have formed a solid. they will start to slow down even more, which is indicated by a decrease in temperature.

## *Condensation*

If you remove thermal energy from a gas, it will condense and a liquid will form.
As energy is removed, the particles in the gas move slower and slower, Because the particles are moving slower, they cannot overcome the attractions between each particle. As the particles move closer together, a liquid condenses.



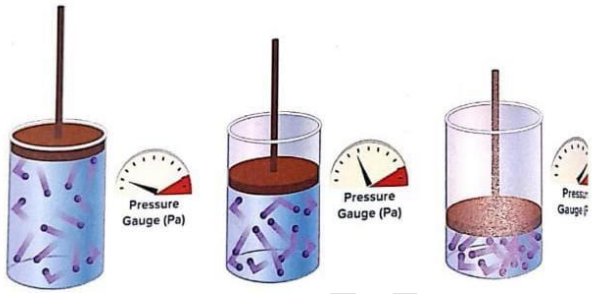
# Lesson 3: Changes in Pressure

## *Pressure and Volume*

Look at the figure below, When the plunger is pushed down, it **compresses the gas** in the cylinder and **decreases the volume**. With less space to move around, the particles that make up the gas collide with each other and the container more frequently. This causes an increase in pressure as shown on the pressure gauge(مؤشر الضغط) .

**The more the particles are compressed** ⟶ **The more often they collide** ⟶ **The more the pressure increases**

When the volume is greater the particles have more room to move ⟶ This additional space results in fewer particle collisions and a decrease in pressure.



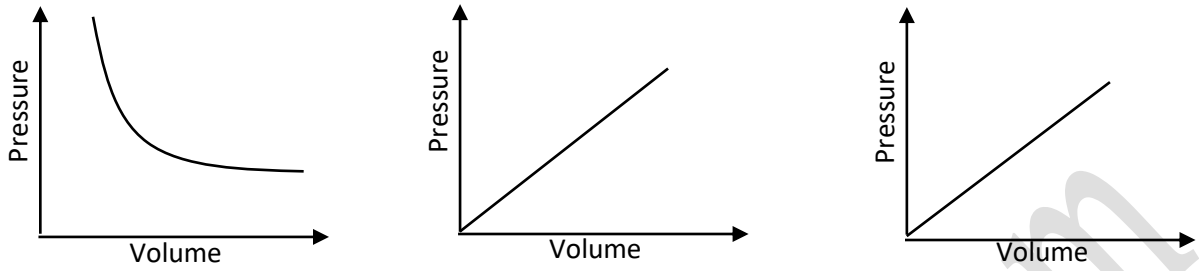

***History*** *Robert Boyle, a British scientist, noticed the relationship between volume and pressure of gases. He measured the pressure of a gas in different volumes. Using this data, he graphed the two variables. No matter what gas or volume was used, he always saw the same result. Because the relationship between pressure and volume is a repeatable pattern, it is now defined as a scientific law.*

## *Types of Relationships*

When one variable changes and the other variable changes in the same way, this is known as a **proportional relationship**.
For example: When pressure decreases, temperature will decrease.

When one variable changes and the other variable changes in the opposite way, this is known as **an inversely proportional relationship**.
An example: When pressure decreases and volume increases.

- **Using your understanding of cause and effect, analyze and interpret the graphs. Then indicate how each variable changes by writing increases, decreases, or doesn't change on the lines below.**




- When pressure increases, volume decrease
- When the number of particles increases, the pressure is increase
- When the pressure increases, the temperature increase
- When the volume decreases, pressure increase
- When the pressure decreases, the number of particles decrease
- When the temperature decreases, the pressure decrease

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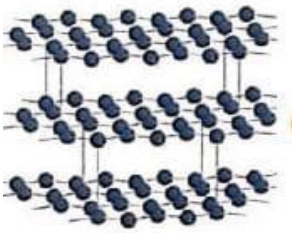
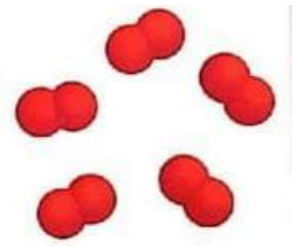
# Lesson 4: Molecular structure

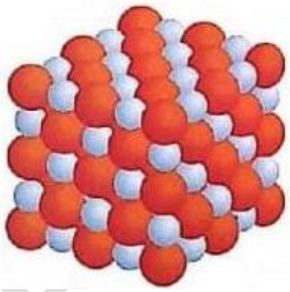
| Ionic Compounds | Covalent Compounds |
|---|---|
| Ionic compounds form between atoms of opposite charges. The oppositely charged atoms have a strong attraction to each other, These extended structures can form crystals. The strong attractive forces between the atoms give ionic compounds their many properties:<br>1- High melting and boiling points.<br>2- Brittleness.<br>3- Many ionic compounds will dissolve in water.<br>4- good conductor of electricity because the charged atoms can move and conduct electric current. | 1- Covalent compounds form molecules. molecule is a group of atoms that are held together by bonds and act as a unit.<br>2- Covalent compounds usually have low melting and boiling points.<br>3- they are usually gases or liquids at room temperature.<br>4- poor conductors of electricity and thermal energy. |

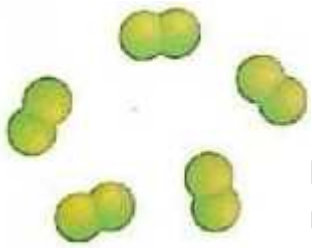
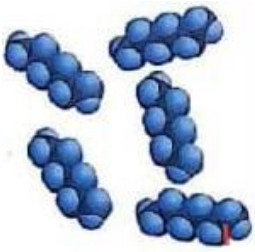
***To Dissolve or Not to Dissolve***

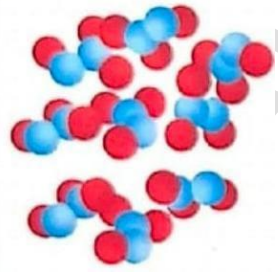
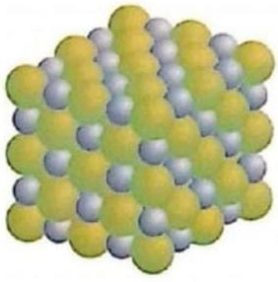
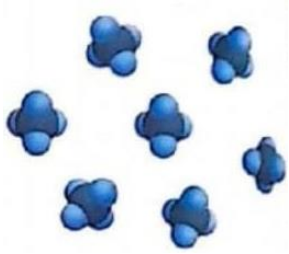
**"Like dissolves like"** This means that polar covalent compounds can dissolve in other polar compounds. Similarly nonpolar compounds can dissolve in other nonpolar compounds.

+201145595274
+201277325227

| | | |
|---|---|---|
|  |  |  |
| **Nonmetal solid** | **Metal** | **Nonmetal gas "molecules"** |

| | |
|---|---|
|  |  |
| **Element "molecule"** | **Compound "molecule "** |

| | |
|---|---|
|  |  |
| **Element molecule** | **Compound molecule** |

| | | |
|---|---|---|
|  |  |  |
| **Polar covalent compound** | **Ionic compound** | **Compound molecule** |

# Module: Matter; Properties and changes

## Lesson 1: Properties of matter

Lab: Big enough https://youtu.be/NydouLupr5o

**How can a substance's properties be measured?**

Characteristics that you can observe (qualitative) or measure (quantitative) without changing the identity of the matter are **physical properties** of substances. These properties can be used to help identify a substance.

### *1) Mass*

**Mass** is the amount of matter in a substance. If you pick up a small rock in one hand and a larger rock in the other hand, you can tell the larger rock is heavier and so it must have more mass. Because mass changes with the size of the object, mass is **a size-dependent property** (تعتمد على الحجم).

mass can be measured, so it is a quantitative property. Mass is measured in **kilograms (kg)** or grams (g). ***The instrument*** used to measure mass is called a **balance**. Types of balances can include the following.

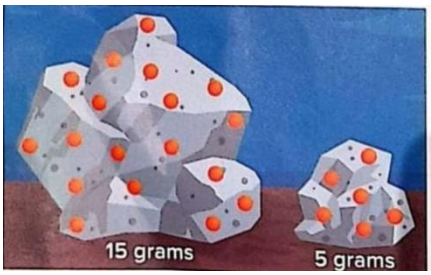
| Double pan balance | Triple beam balance | Digital balance |
|---|---|---|
|  |  |  |

**Mass is not the same as weight**

| Mass | Weight |
|---|---|
| Mass is the amount of matter, or particles, in a substance, but mass does not change with location. | Weight, measured by a scale, is the gravity on matter. Weight changes with location |

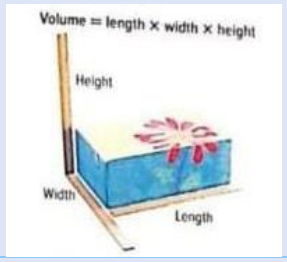
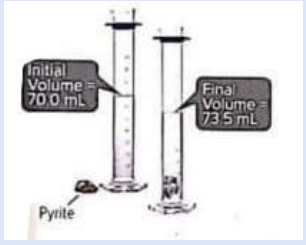
If the objects were on the Moon, a balance would read the same as it does here on Earth. A scale would give a different weight, because the pull of gravity is different on Earth than it is on the Moon.

***Modelling Mass***



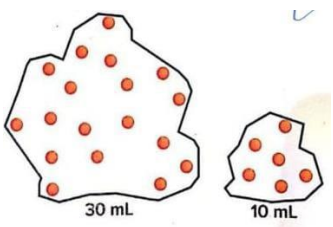

## *2) Volume*

Another physical property Enough is volume, **Volume** is the amount of space a substance takes up. It is also **size-dependent** (تعتمد على الحجم). The larger rock takes up more space, so not only does it have more mass, it has a larger volume. There are three ways to measure an object's volume.

| Object Shape | Measuring Method |
|---|---|
| **Regular-shaped object**   | Dimensions such as length, width, and height are measured using a ruler or tape measure. Those values are used in a volume equation to determine volume. |
| **Liquid**  | Measured by graduated cylinders, pipettes, beakers, and flasks. The more divisions on the instrument, the more accurate the measurement. |
| **Irregularly shaped object**   | Measured by the displacement method. A graduated cylinder is filled part way with water. The initial volume is noted. The object is placed in the cylinder. The final volume is noted. The volume of the object is the difference between the water level before and the water level after placing the object. |

Units for volume include cubic **centimetres ($cm^3$), liters (L),** and **milliliters (mL).**

***Modelling Mass***



# Chemical Properties

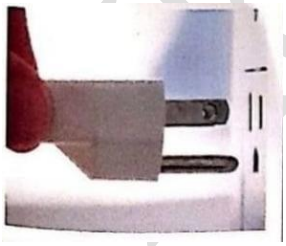
**Chemical property** is a characteristic of matter that can be observed as it changes to a different type of matter.

| Flammability | Oxidation | Reaction to Acid |
|---|---|---|
| **Flammability** is the ability of a type of matter to burn easily. Materials are often chosen for certain uses based on flammability. For example, propane is used as a grill fuel. because it burns easily. Materials used to make cooking pans must not be flammable. because they should not catch on fire. | **Oxidation** occurs when-substances react with oxidizing agents, changing it to a new substance. Rusting is a type of oxidation. Some examples of oxidizing agents include oxygen. bleach, chlorine, and fluorine. Oxidation is often seen as a color change. For instance, when a nail rusts, it changes from silver to a brown-orange color. The rate of oxidation depends on how much of the oxidizing agent is present. | **Reactivity** occurs when a substance reacts with another substance, changing it into a new substance. Many substances react with acid. During this process, a solid may be dissolved. For example, limestone becomes pockmarked when exposed to acid rain. Other substances, like copper, silver, and gold, have almost no reaction to most acids. |

## Identifying a Substance Using Properties

**Physical and chemical properties can be used to classify and identify matter.**

**(Physical Properties)**

| Conductivity | Boiling and Melting Points | Solubility |
|---|---|---|
| The ability of matter to conduct electricity or thermal energy.  | The temperature at which a material changes state.  | The ability of one substance to dissolve in another.  |

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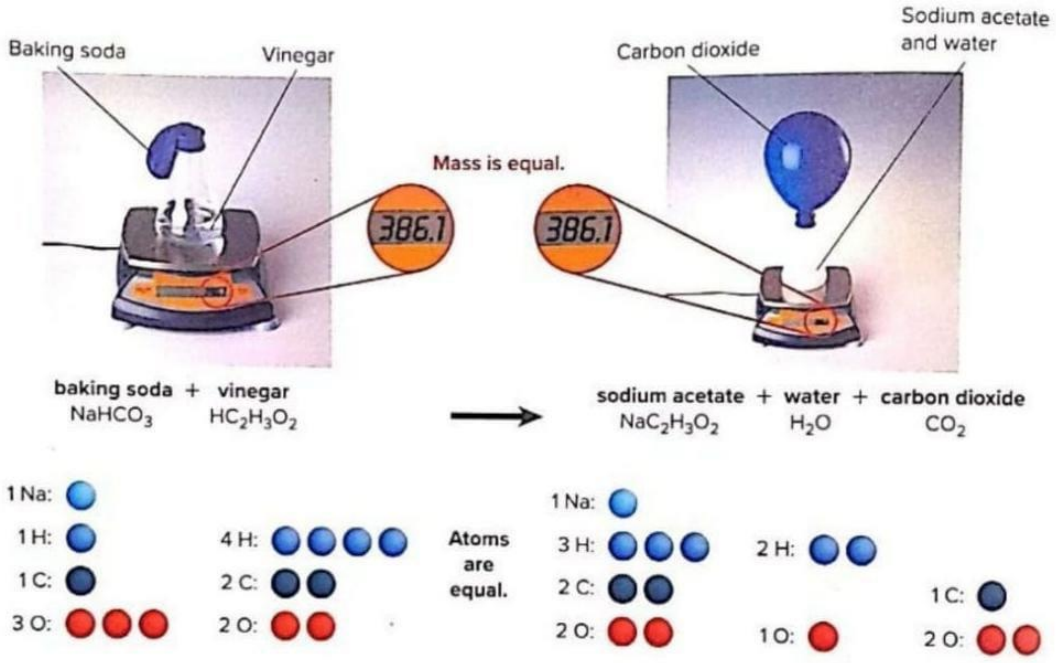
# Lesson 2: Property changes in chemical reactions

## *Atomic Arrangement*

**Atoms are not destroyed, and no new atoms form.** All atoms at the just arranged into new combinations forming new substances.

**For example,** as the reaction between baking soda and vinegar happens, the mass on the balance remains the same, showing that mass is conserved. Atom of elements or compounds rearrange and form different elements or compounds.



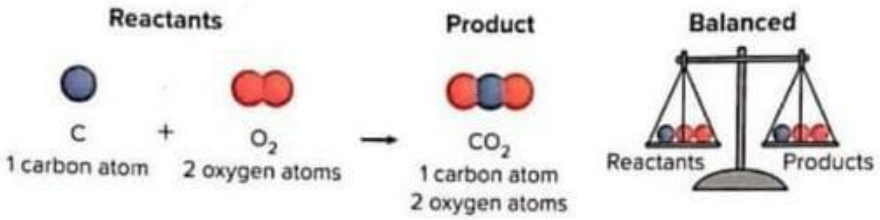

### Chemical Equations

A chemical equation includes both the reactants and the products in a chemical reaction. The general structure for an equation is:

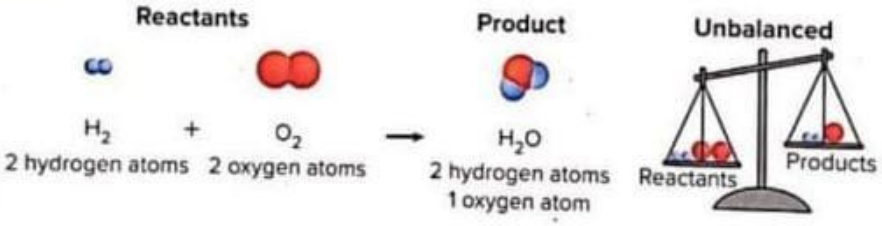
reactant + reactant ⟶ product + product

chemical formulas are used to easily describe the reactants and the products, it's important to use correct chemical formulas. Examine the formation of carbon dioxide below. The product carbon dioxide is written as $CO_2$ and not as CO.CO is the formula for carbon monoxide, which is not the same compound as $CO_2$ .

**A subscript** describes the number of atoms of atoms of an element in a compound.



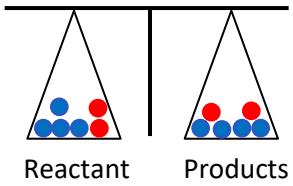

You might think a balanced equation happens automatically when you write the symbols and formulas for reactants and products. However, this usually is not the case. For example, the reaction between hydrogen ($H_2$) and oxygen ($O_2$) that forms water ($H_2O$) is shown below.




Because the numbers of each type of atom are not equal, this equation is not balanced. To accurately represent this reaction, the equation needs to be balanced. When you balance a chemical equation, you count the atoms in the reactants and the products and then add coefficients to balance the number of atoms.

**A coefficient** is a number placed in front of an element symbol or chemical formula in an equation.

$$2H_2 + O_2 \longrightarrow 2H_2O$$




**What conclusion can you draw from the scientist's observations?**

A. A new substance was formed, because the formation of a precipitate is evidence that a chemical reaction took place.
B. A physical reaction took place, because the physical properties of the substances changed.
C. The lead nitrate froze when it was added to the potassium iodide, because solids form as a result of freezing.
D. The potassium iodide crashed out of solution, because the solution became supersaturated, and no reaction occurred.

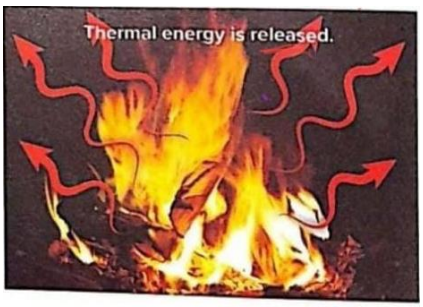
**Which model shows that atoms are conserved in the reaction?**

A. $CH_4 + O_2 \longrightarrow CO_2 + H_2O$
B. $CH_4 + O_2 \longrightarrow CO_2 + 2H_2O$
C. $CH_4 + 2O_2 \longrightarrow CO_2 + 2H_2O$
D. $2CH_4 + O_2 \longrightarrow 2CO_2 + H_2O$

# Lesson 3: Energy changes in chemical reactions

## *Energy in Chemical Reactions*

Not all bonds release and absorb the same amount of energy. Some atoms release a high amount of energy when they form compounds. Other compounds require a lot of energy to break apart.

| endothermic reaction | exothermic reaction |
|---|---|
| ▪ **Energy Absorbed**<br>▪ Chemical reactions where more energy is required to break the bonds of the reactants than is released when products form are endothermic reactions.<br>▪ For an endothermic reaction to continue, energy must be constantly added.<br>**reactants + thermal energy ⟶ products**<br>  | ▪ **Energy Released** Some chemical reactions release energy as opposed to absorbing it.<br>▪ In an exothermic reaction, more energy is released when the products form than is required to break the bonds in the reactants.<br>**reactants + products + thermal energy**<br>  |

| **Reaction** | **Reaction + thermal energy ⟶ products** |
|---|---|
| **Type** | Endothermic reaction |
| **Energy change** | Energy absorbed |
| **Bonds that contain more energy** | Reactants |
| **Reaction** | **Reaction + thermal energy ⟶ products** |
| **Type** | Exothermic reaction |
| **Energy change** | Energy released |
| **Bonds that contain more energy** | products |

## Concentration Revisited

Think of a crowded hallway. Because the concentration of people is higher in the crowded hallway than in an empty hallway, people probably collide more often.

Similarly, increasing the concentration of one or more reactants ⟶ increases collisions between particles ⟶ More collisions result in a faster reaction rate. When particles are closer together, more collisions occur.

## Conserving Energy

**law of conservation of energy** states that even though energy is always transferring, energy is not created and energy is not destroyed. Energy is constantly being reused.

- The laws of conservation of energy and matter apply to both the physical and living environments. Plants store glucose molecules in their tissues ⟶ When plants are eaten by animals, energy and matter transfer to the consumer.
- One way energy can return to the environment is in the form of thermal energy given off by organisms. Another way is when plants and animals die, the energy and matter contained in their tissues is recycled by decomposers.

---

Mayra poured about 10 mL of vinegar into a small plastic cup. Then she recorded the initial temperature of the vinegar as 22°C. While the thermometer was in the cup, she added about teaspoon of baking soda to the cup. Mayra noticed the baking soda dissolved into the vinegar and bubbles started to form. She watched the thermometer for a change in temperature. After the fizzing stopped and the temperature had stopped changing. Mayra recorded the final temperature as 15°C

**Which model most accurately represents the overall change that occurred in the cup?**

A) vinegar + baking soda ⟶ sodium acetate + carbon dioxide + water
B) energy+ vinegar + baking soda ⟶ sodium acetate + carbon dioxide + water
C) vinegar + baking soda ⟶ sodium acetate + carbon dioxide + water + energy
D) energy+ vinegar + baking soda ⟶ sodium acetate + carbon dioxide + water + energy

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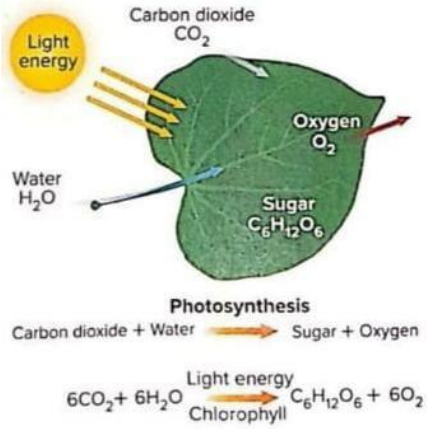
**What happens to the energy form the Sun in the leaf?**

A) The light energy is consumed by the leaf and can no longer be used.
B) The light energy is used to create energy that the plant uses.
C) The light energy is used to break the bonds in the carbon dioxide and water molecules.
D) The light energy is used to break the bonds in the sugar and oxygen molecules.



# Module: Distribution of Earth's Resources

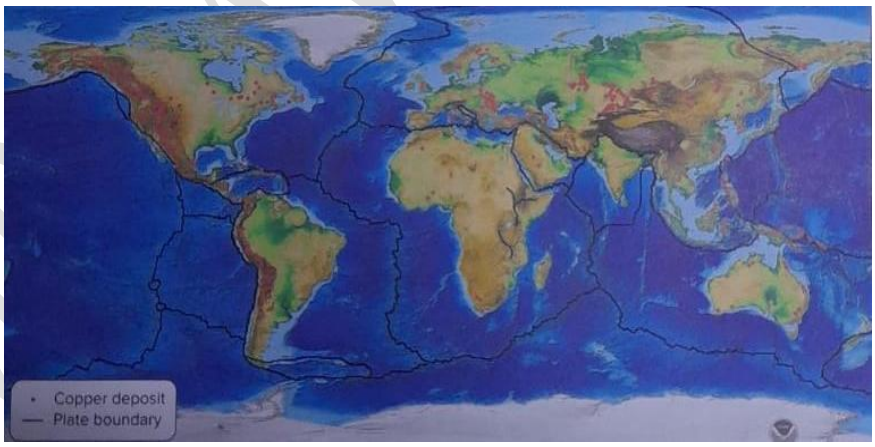
## Different between Ores, Minerals and Metals: -

| Ores | Minerals | Metals |
|---|---|---|
| ▪ Are deposits of minerals that are large enough to be mined for profit. (يتم التنقيب عنها واستخراجها بهدف الربح)<br>▪ All ores are considered to be minerals. | ▪ Refer to all naturally occurring materials found in the crust of the earth. (جميع المواد الموجودة بصورة طبيعية في القشرة الأضية)<br>▪ Not all minerals are considered to be ores. | ▪ Found naturally in the minerals. |

## Where are minerals found on Earth?

- ❖ The basic building blocks for soil, rocks, and metals are minerals.
- ❖ Metal products from airplanes to zippers come from minerals.
- ❖ The salt you put on your eggs at breakfast is a mineral. Even the exterior of the Statue of Liberty is coated in a mineral-copper!

**The map below shows the location of copper deposits that are associated with igneous intrusions.**




## *Dwindling Deposits*

**As with all natural resources, the demand for minerals continues to increase due to:**

1. Population growth.
2. The fact that more countries are becoming industrialized.
3. Developing consumer societies.

Minerals are a nonrenewable resource.

**Study the table below showing worldwide production rates and total reserves for some of the more common mineral resources. Then answer the questions that follow.**

| Mineral | Production (thousands of metric tons) | Reserves (thousands of metric tons) | Estimated Life of Reserves (years) |
|---|---|---|---|
| Iron ore | 3,320,000 | 190,000,000 | 57 |
| Aluminum ore (bauxite) | 274,000 | 28,000,000 | 102 |
| Phosphate rock | 223,000 | 69,000,000 | 309 |
| Chromium | 27,000 | >480,000 | >18 |
| Copper | 18,700 | 720,000 | 39 |
| Manganese | 18,000 | 620,000 | 34 |
| Zinc | 13,400 | 200.000 | 15 |
| Titanium concentrates | 6,090 | 790,000 | 130 |
| Lead | 4,710 | 89,000 | 19 |
| Nickel | 2,530 | 79,000 | 31 |
| Tin | 294 | 4,800 | 16 |
| Cobalt | 124 | 7,100 | 57 |
| Silver | 27 | 570 | 21 |
| Gold | 3.0 | 56 | 19 |

## *Mineral Supplies*

For years scientists have warned about the prospect of important mineral reserves being depleted due to the exponential growth of demand. However, depletion has not occurred because total reserves have kept increasing.

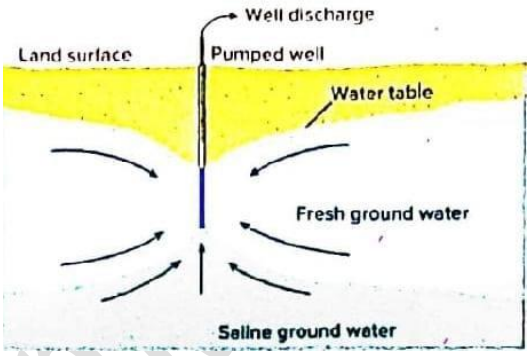
1- One reason for this is that geologists have improved their ability to locate new reserves through more sophisticated exploration techniques.
2- Another factor is that technological advances in mining have allowed many low-grade deposits to become economical to extract.

The minerals will not be available to future generations if rates of consumption are not decreased.

## *Groundwater Depletion*

In many areas of the world, groundwater is being withdrawn from aquifers faster than natural recharge can replace it, this is called **groundwater overdraft.**

the extraction of groundwater can deplete this important resource, but **did you know that overpumping wells can also cause water quality issues?**




The quality, quantity, and reliability of groundwater resources are directly affected by the health of the aquifers.

When wells are overdrawn, underlying salt water can rise into the wells and contaminate freshwater aquifers.

## *From Reactants to Products*

All synthetic materials are the result of chemical reactions. Substances react chemically in characteristic ways. You may recall that in a chemical reaction, the bonds between atoms in the reactants are broken. The atoms rearrange and make new bonds to form the products.

The products have different properties than the reactants, the reactants underwent a chemical reaction called polymerization.

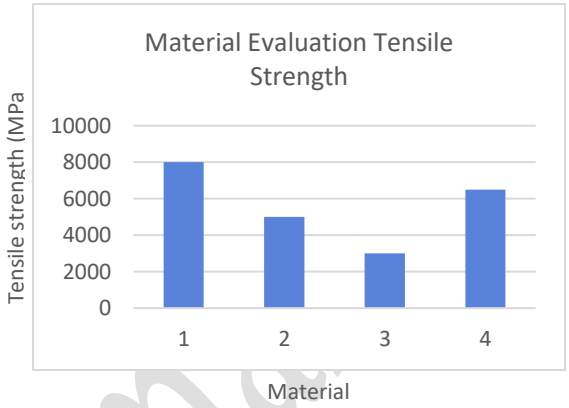
**Polymerization** is the chemical process in which small organic molecules, or monomers, bond together to form a chain.

**A monomer** is one of the small organic molecules that make up the long chain of a polymer. Polymer chains can be very long.

**Polypropylene**, which is used to make drinking straws, can have **50,000 to 200,000** monomers in its chain.

Tensile strength is a measure of the amount of "pulling" stress an object ca withstand before it breaks or becomes damaged. The graph below shows the tensile strength for four materials being considered for a new product.

- **Which material should be considered if the product must be tear-resistant?**
  - A) 1
  - B) 2
  - C) 3
  - D) 4




As an engineer working on the design of a new car, you need to select the right ceramic material to build parts of the car's engine and its onboard computer. The table below shows the materials you have to choose from.

| Material | Wear Resistant | Conducts Electricity | Reacts with Chemical | Melting Point (C°) |
|---|---|---|---|---|
| 1 | Highly | No | No | 3,000 |
| 2 | Not at all | No | Yes | 100 |
| 3 | Moderately | Yes | No | 1,500 |
| 4 | resistant | Yes | No | 500 |

- **Which of the above materials would you use when you build the engine?**
  - A) 1
  - B) 2
  - C) 3
  - D) 4

## What limits the production and use of synthetic materials?

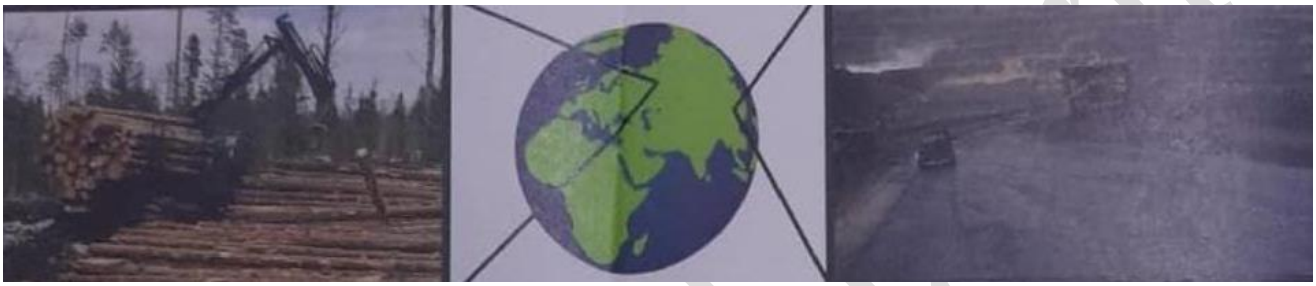
Humans depend on **Earth's land**, **oceans**, **atmosphere**, **and biosphere** for different natural resources!
Many of the resources, including **minerals**, **water**, and **biosphere resources**, are limited. In addition, many of these resources are not renewable or replaceable over human lifetimes.

### *Natural Resource Availability*

Natural resources are distributed unevenly around Earth.

**For example:**

- iron ore is found near the surface of Earth and is mined easily in some regions in China ⟶ Large amounts of iron ore are used in the production of steel, a synthetic material, in other countries, iron ore is rare and steel must be imported, or brought into, the country.
- Climate also plays a role in natural resource availability ⟶ One of Russia's resources is timber, because its climate is favorable for growing large forests.



### *Synthetic Material Production*

In Russia, it is easy to make synthetic materials from timber because it is readily available. The production and use of technology, such as synthetic materials, varies from region to region due to **differences in climate** and **natural resource availability**.

**Economic conditions** of a region also determine the production and uses of synthetic materials. During favorable economic conditions, less effort is spent on synthetic materials that provide for basic living needs, because those needs are taken care of. More effort can be put into synthetic materials that improve a specific aspect of living, such as entertainment.