Workbook Preview

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Grade 7 Science – 2022 Curriculum

Pure Substances and Mixtures

	Curriculum Expectations	Pages
C1.1	analyse the social and environment impacts of the use and disposal of pure substances found in technological devices, considering local and global perspectives	112-117
C1.2	assess environmental and social impacts of different industrial methods used to separate mixtures	118-119, 123-125
C2.1	demonstrate an understanding of the particle theory of matter	8-10, 85-90
C2.2		-90, 11
C2.3		-52, -90
C2.4	use the particle theory to describe how different factors affect the solubility of a substance and the rate at which it dissolves	53-56, 60-61, 64-65, 70, 94
C2.5	describe the concentration of a saturated solution in both qualitative and quantitative terms, and differentiate between saturated and unsaturated solutions	62-65, 73-75, 91-97
C2.6	explain why water is referred to as the universal solvent	53-54, 57-59
C2.7	explain various processes used to separate mixtures, including solutions, into their components, and identify some applications of these processes	85-90, 101-102, 105-108
C2.8	describe pure substances as elements and compounds consisting of atoms and combinations of atoms	11-38, 85-90, 109-111

Preview of 100 pages from this product that contains 208 pages total.

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Grade 7 Science Unit

Strand A - STEM Investigation and Communication Skills

	Curriculum Expectations	Pages
A1.1	use a scientific research process and associated skills to conduct investigations	121-122, 126-128
A1.2	use a scientific experimentation process and associated skills to conduct investigations	68-69, 71-72, 98-100, 121-122
A1.3	use the design process and associated skills to design, build, and test devices, models, structures, and/or systems	66-67, 83-84, 103-104
A1.4	follow established health and safety procedures during science and technology investigations, including wearing appropriate protective equipment, handling and safely using tools, instruments, and materials	66-69, 71-72, 83-84, 98-100, 103-104
A1.5	communicate their findings, using science and technology vocabulary and formats that are appropriate for specific audiences and purposes	66-69, 71-72, 83-84, 98-100, 103-104
A2.1	write and execute code in investigations and when modelling concepts, with a focus on planning and debugging programs	120, 127-129,
A2.2	identify and describe impacts of coding and of emerging technologies, such as artificial intelligence systems, on everyday life, including skilled trades	, 126-131
A3.1	describe practical applications of science and technology concepts in various occupations, including skilled trades, and how these applications address real-world problems	126-131
A3.2	investigate how science and technology can be used with other subject areas to address real-world problems	126-131
A3.3	analyse contributions to science and technology from various communities	126-130

PREVIEW

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SUBSTANCES AND MIXTURES



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Curriculum Connection
C2.1

The Particle Theory of Matter

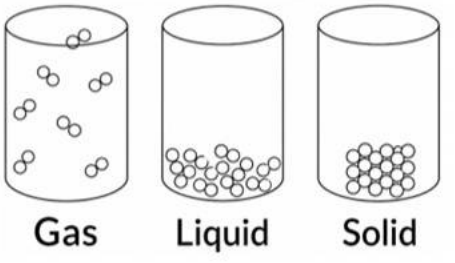
Matter

Matter is anything that has mass and takes up space. All matter can be classified as either a pure substance or a mixture. All matter is made up of tiny particles. The study of matter and its changes is called chemistry.

The Particle Theory

Matter can be classified according to its physical characteristics. The particle theory of matter helps to explain the physical characteristics of matter.

1. Everything is made of particles.
2. There are spaces between the particles.
3. Particles are attracted to each other.
4. Temperature affects the speed at which particles move.
5. Particles are always moving because they have kinetic energy.
6. There are different kinds of particles, but all particles of a substance are identical.



PREVIEW

Solids

In solid form particles are close together. The particles are strongly attracted to each other. They are locked in a pattern and vibrate in place. Solids have a shape and volume. The spaces between the particles are small.



Liquids

In liquid form, particles are slightly farther apart. Particles are less attracted to each other and are able to slide past each other. The spaces between the particles are larger than in a solid.

Gas

In gas form, particles are far apart and can move in any direction because the attraction forces between them are weak. Gases have no fixed shape and no fixed volume. They expand to fill their container.

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Curriculum Connection
C2.1

True or False

Circle whether the statement is true or false.

1) All matter is made of particles.	True	False
2) Temperature affects how fast particles move.	True	False
3) In solid matter, particles are further apart.	True	False
4) When matter heats up, the atoms move slower.	True	False
5) In gases, particles expand and fill their container.	True	False

Question

What questions do you have after reading the information?

1)	
2)	
3)	

Explain

List the properties of each state of matter.

State of Matter	Properties of the State of Matter
Solid	
Liquid	
Gas	

PREVIEW

Name: _____ 10

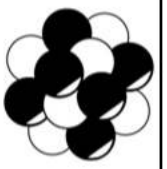
Curriculum Connection
C2.1

Particle Theory

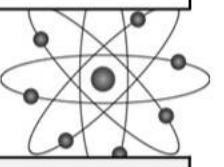
Particle Theory
The **particle theory** states that all matter is made up of tiny particles that are constantly moving. The speed the particles move depends on which state of matter they are in.

Solids
Particles in solids are held tightly together. They are strongly attracted to each other, meaning they move slowly. These particles vibrate instead of move, but they are not still.

Liquids
Particles i[illegible]ds are fairly close together with some attraction between them. They mov[illegible]n all directions, but they can't move too far because they are attracte[illegible] near them.



Gase[illegible]
Particle[illegible] gases [illegible] any attraction between them. They move rapidly in all directions. The[illegible] eac[illegible]er and the walls of the container they are in.



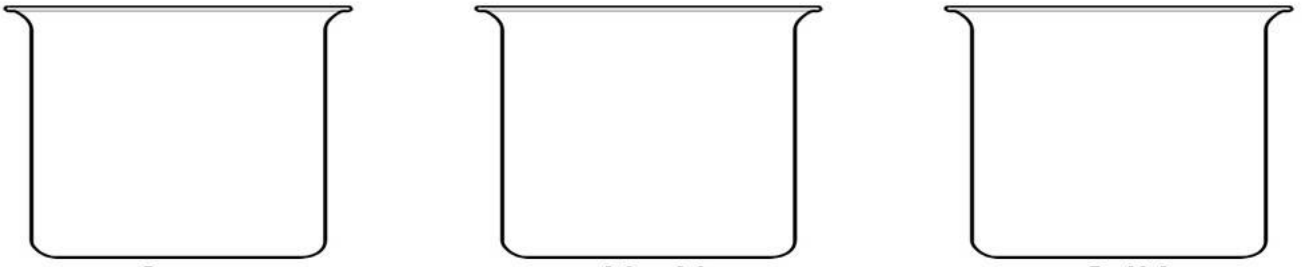
PREVIEW

Part 1 Fill in th[illegible]ank[illegible] [illegible]m the word bank.

Small	Particles	[illegible]e	Moving	Matter
Gas	Solid	Liquid	S[illegible]	Weakest

All things we can touch are made up of _____. Particles _____ compounds that make up _____. The particle the[illegible]tes [illegible]icles are _____ constantly. They move faster based on which _____ matter they are in. Particles in _____ have the strongest attracti[illegible] particles in _____ have the _____. Particles in _____ are fairly close together. The _____ the attraction, the less the particles will move, like in solids.

Part 2 Add particles (dots) to the beakers to represent which state of matter it is.



Gas **Liquid** **Solid**

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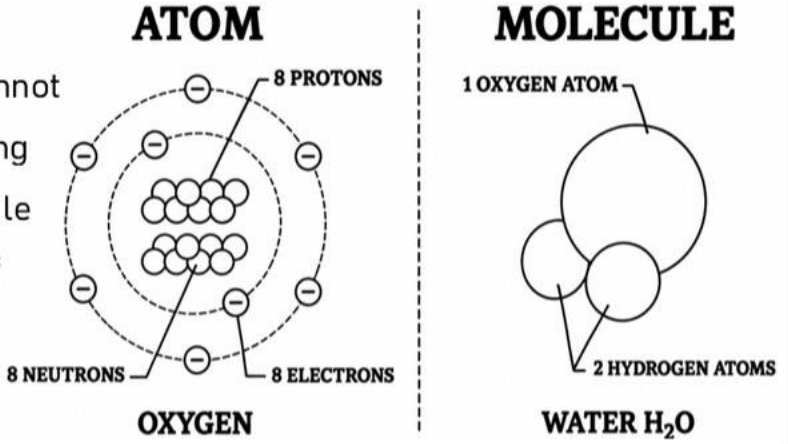
Curriculum Connection
C2.2, C2.8

Atoms, Molecules and Pure Substances

Atoms vs Molecules



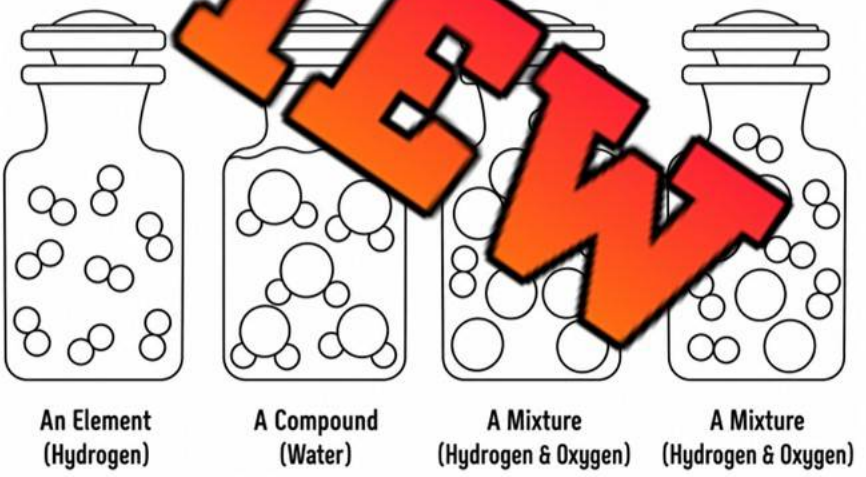
Atoms are the smallest particles. They cannot be divided further, and they are the building blocks of matter. **Elements** are either single atoms or t… more of the same type of atoms bon… ther. For example, hydro… …t is made of two hy… …n ato…

A **molec**… …a… …p of … …bonded together. Therefore, hydrogen is a molecule because it is made … hydr… …a… …n fact, hydrogen is the smallest molecule!

A compound is a m… …a well b… …compounds have more than two atoms bonded together. However, the …ffer… …n element and a compound is that **compounds** are made of two or more different elements that are combined. Water is a compound because it is made of two different elements (hydrogen and oxygen) that are bonded together. Water has two hydrogen atoms combined with one oxygen atom.

PREVIEW

…ement… …nds and Mixtures



Pure Substances

All matter is either a pure substance or a mixture. A **pure substance** is made of just one element or one compound, while a **mixture** has more than one element or compound. Hydrogen is a molecule that is a pure substance because it is made of just one element. Water is a pure substance because it is made of just one compound. Other examples of pure substances are sugar, table salt, baking soda, aluminum and gold.

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Curriculum Connection
C2.2, C2.8

Define What do the terms below mean? Give an example of each.

	Definitions	Example
Atom		
Molecule		
Element		
Compound		
Pure Substance		
Mixture		

PREVIEW

Draw Draw a diagram of each of the terms below.

Atom	Molecule	Element	Compound	Pure Substance	Mixture

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Curriculum Connection
C2.2, C2.8

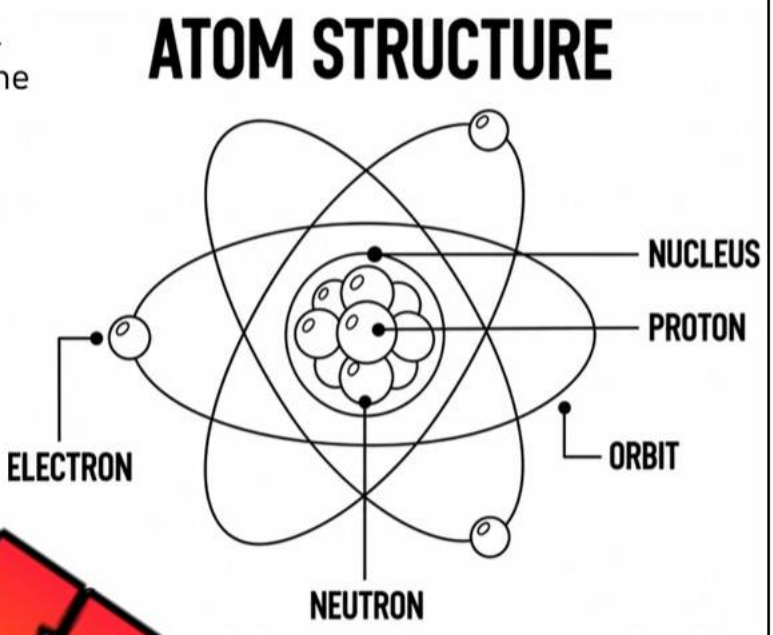
What are Atoms?

What are Atoms?

Atoms are the basic building blocks of all matter. Everything around us, including the air we breathe, the food we eat, and the clothes we wear, is made up of atoms.

Atoms are very small particles that are too small to see with the naked eye. They are so small that it takes billions of them to cover the tip of a tiny grain of sand. Despite their small size, atoms are very important because they determine the properties of the materials they make up.

Each atom is made up of three types of subatomic particles, protons, neutrons, and electrons.



PREVIEW

Protons

Protons are found in the center of the atom, in a region called the nucleus. They are positive charges, which means that they have a positive electrical charge. The number of protons in the nucleus of an atom determines what element the atom is. For example, if an atom has six protons in its nucleus, it is a carbon atom. If an atom has eight protons, it is an oxygen atom.

Neutrons

Neutrons are also found in the nucleus of an atom. They have no electrical charge, which means that they are neutral. The number of neutrons in an atom can vary, but the number of protons is always the same for a given element.

Electrons

Electrons are much smaller than protons and are found orbiting the nucleus. They have a negative electrical charge, which means that they have the opposite charge as protons. Electrons are very important because they determine the chemical properties of atoms and how they can react with other atoms.

What is the Nucleus?

The nucleus of an atom is the central region of the atom that contains protons and neutrons. It is located in the center of the atom and is surrounded by a cloud of electrons orbiting the nucleus.

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Name: _____ 15

Curriculum Connection
C2.2, C2.8

Questions

Answer the questions below using evidence from the text.

1) What three subatomic particles do atoms have?

2) What is ucleus of an atom?

PREVIEW

Define

What do particles do?

Protons	
Neutrons	
Electrons	

True or False

Is the statement true or false?

1) Electrons are positively charged.	True	False
2) Protons have a positive charge.	True	False
3) Oxygen atoms always have 8 protons.	True	False
4) Carbon atoms always have the same number of neutrons.	True	False
5) Electrons are located in the nucleus.	True	False

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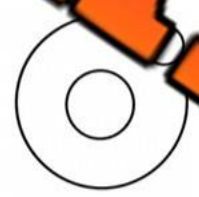
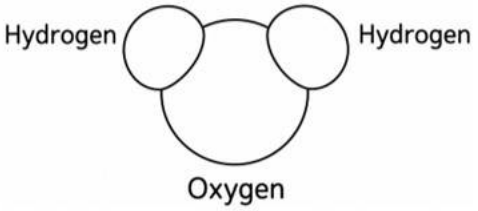
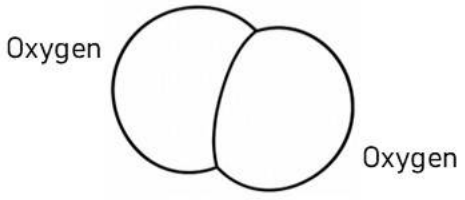
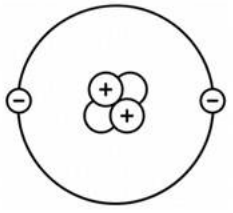
Curriculum Connection
C2.2, C2.8

Atom or Molecule

Classify Is the description an atom or molecule? Also, is it an element or compound?

1)	One chlorine atom	Atom	Molecule	Element	Compound
2)	Two atoms bonded together	Atom	Molecule	Element	Compound
3)	Five [illegible] bonded together	Atom	Molecule	Element	Compound
4)	Wa[illegible]ogen, 1 oxygen	Atom	Molecule	Element	Compound
5)	[illegible]ment w[illegible]e atom	Atom	Molecule	Element	Compound
6)	One sulf[illegible]	Atom	Molecule	Element	Compound
7)	 Hydrogen	Atom	[illegible]olecule	Element	Compound
8)		Atom	Mo[illegible]	Ele[illegible]	Compound
9)		Atom	Molecule	Element	Compound
10)	 Helium	Atom	Molecule	Element	Compound

PREVIEW

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Name: _____ 17

Curriculum Connection
C2.2, C2.8

Models Used To Draw Atoms

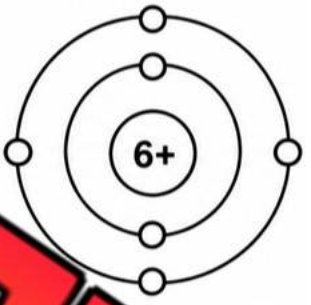
The Rutherford-Bohr model shows the number of electrons in each shell as well as the number of protons in the nucleus.

Directions Identify the name of the element by looking at the model.

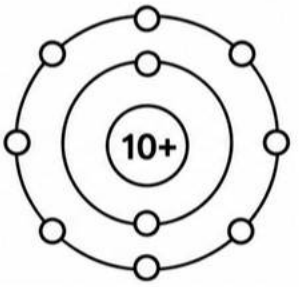
1)



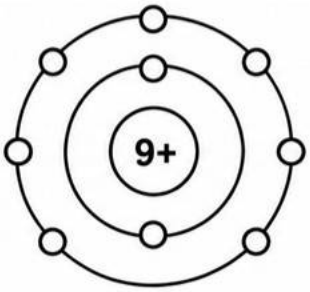
2)



3)



4)



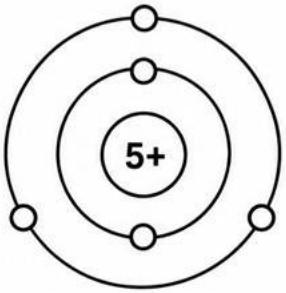
5)



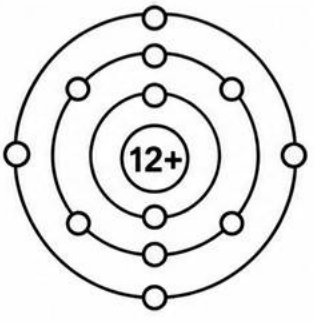
6)



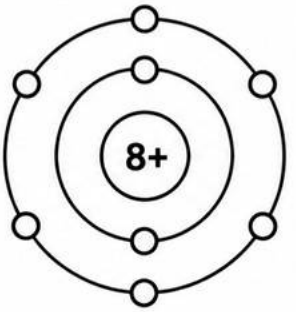
7)



8)



9)



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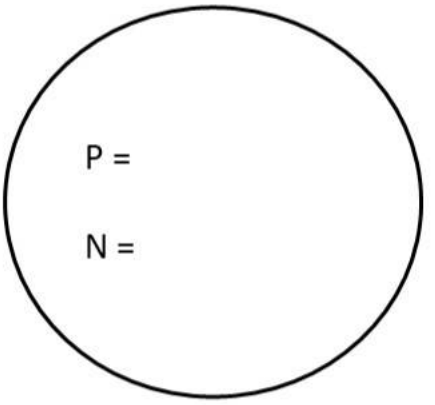
Curriculum Connection
C2.2, C2.8

Models Used To Draw Atoms

Directions Complete the Bohr Models and fill in the blanks.

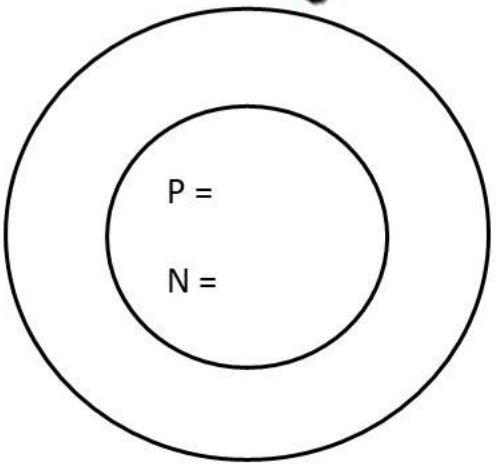
Hydrogen	
Symbol	
# of Ne	
# of P	
# of E trons	
Atomic Numb	



Carbon	
Symbol	
# of Neutrons	
# of Protons	
# of Electrons	
Atomic Number	



Oxygen	
Symbol	
# of Neutrons	
# of Protons	
# of Electrons	
Atomic Number	



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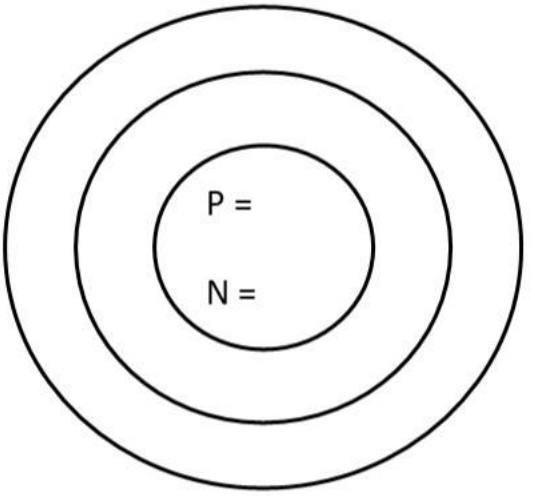
Name: _____ 19

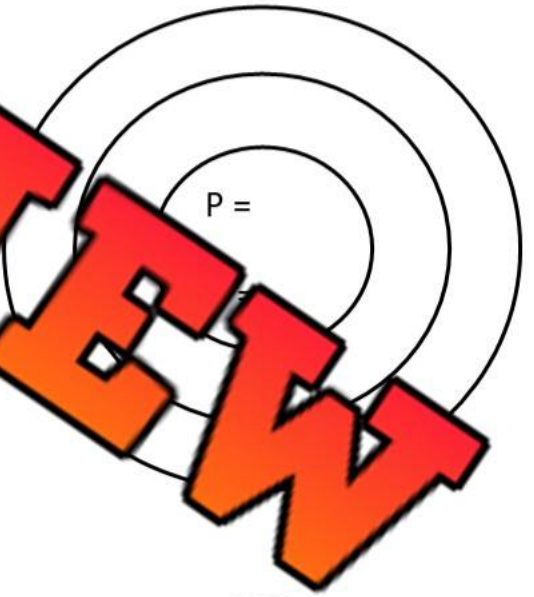
Curriculum Connection
C2.2, C2.8

Directions Complete the Bohr Models and fill in the blanks.

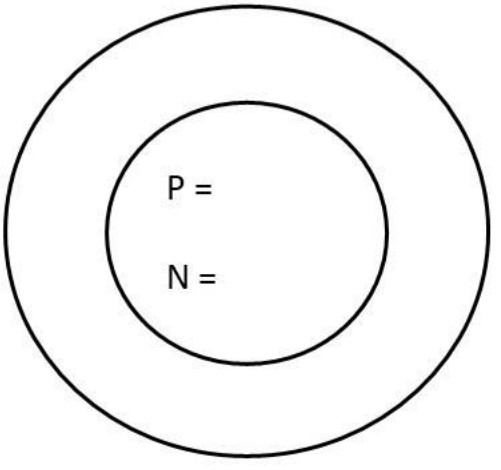
Chlorine	
Symbol	
# of Neutrons	
# of Pro	
# of E	
Atom umber	



Sodi	
Symbol	
# of Neutrons	
# of Protons	
# of Electrons	
Atomic Number	



Nitrogen	
Symbol	
# of Neutrons	
# of Protons	
# of Electrons	
Atomic Number	



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Curriculum Connection
C2.2, C2.8

Exit Cards

Cut Out Cut out the exit cards below and have students complete them at the end of class.

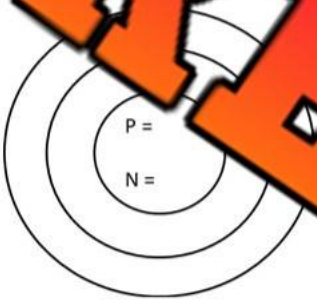
Name: _____

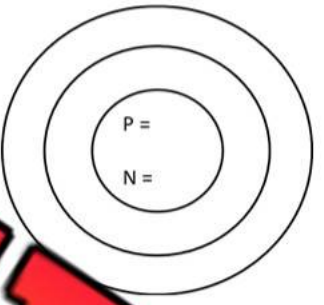
Mark
/2

Complete the Bohr Models and fill in the blanks.

Phosphorus	
Symbol	
# of Neutrons	
# of Protons	
# of Electrons	
Atomic Number	

Magnesium	
Symbol	
# of Neutrons	
# of Protons	
# of Electrons	
Atomic Number	





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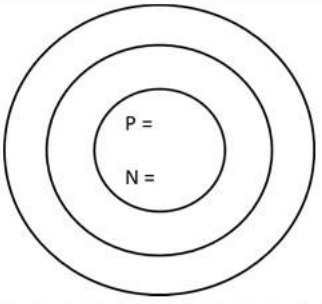
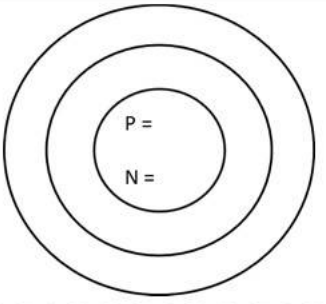
Name: _____

Complete the Bohr Models and fill in the blanks.

Phosphorus	
Symbol	
# of Neutrons	
# of Protons	
# of Electrons	
Atomic Number	

Magnesium	
Symbol	
# of Neutrons	
# of Protons	
# of Electrons	
Atomic Number	





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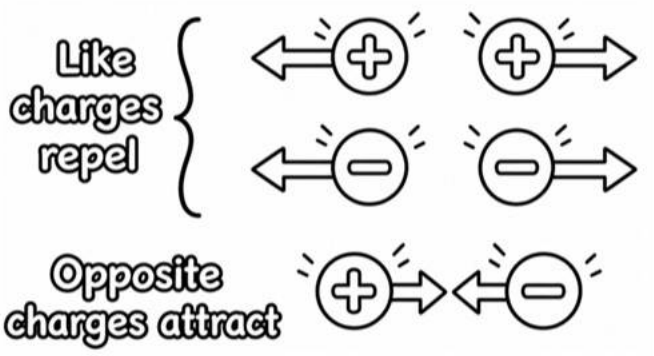
Curriculum Connection
C2.2, C2.8

Blog Post - What's the Charge?

What's the Charge? How Tiny Particles Make Big Reactions

Date: April 3, 2026 Author By: Alex Dwayne *3-minute read*

Ever wonder how elements "know" which other elements to bond with? It all comes down to charge—po…ve, negative, or neutral. These tiny electri…es determine whether atoms attract, r… st stay neutral. Let's break it down…



1) **The B…cs of …** …oms are made of protons (po… …ons …tive), and neutrons (neu… …otons …ns live in the nucleus, wi… …lect… …d. A neutral atom has the s… …mber of … and electrons. If an atom gains or loses electrons, it becomes an … this … erything!
   - Lose an electron? The …m b… …(a cation).
   - Gain an electron? The atom b… negat… anion).
   - Stay neutral? It doesn't attract … repel.

2) **Opposites Attract** –Atoms with opposite ch… are d… t… other, like magnets. This is the foundation of ionic bonding. F… …e, so… …la) loses one electron to become Na^+, while chlorine (Cl) gains o… …me… …gether, they form NaCl—table salt!

3) **Charge Rules the Periodic Table** –Groups on the periodic table … …harge.
   - Group 1 elements usually form +1 charges.
   - Group 17 elements (halogens) usually form –1 charges.
   - Group 18? No charge! They're noble gases and don't react easily.

Understanding charge helps scientists predict how elements form compounds in chemical reactions.

4) **Charge in Real Life** –Charged particles aren't just in chemistry labs—they're everywhere! From batteries and electricity to how your body sends signals through nerves, it all depends on the movement of charged ions. Even water becomes a better conductor when ions are added!

Understanding charge isn't just science—it's the key to every chemical reaction!

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Curriculum Connection
C2.2, C2.8

True or False

Is the statement true or false?

1) Gaining electrons creates a positive ion.	True	False
2) Ions are atoms with a charge.	True	False
3) Ionic bonds form between like charges.	True	False
4) Opposite charges attract in ionic bonding.	True	False
5) Group 1 elements often lose electrons.	True	False

Questions

Answer the questions below using evidence from the text.

1) What is an ion? How is it formed?

2) What is the difference between a cation and an anion?

PREVIEW

Matching

Draw a line from each question on the left to the correct answer on the right.

Positive ion	❑ Atom with no overall charge
Opposite charges	❑ Gains an electron
Negative ion	❑ Create ionic bonds
Neutral atom	❑ Has more protons than electrons
Sodium and chlorine	❑ Example of ionic compound

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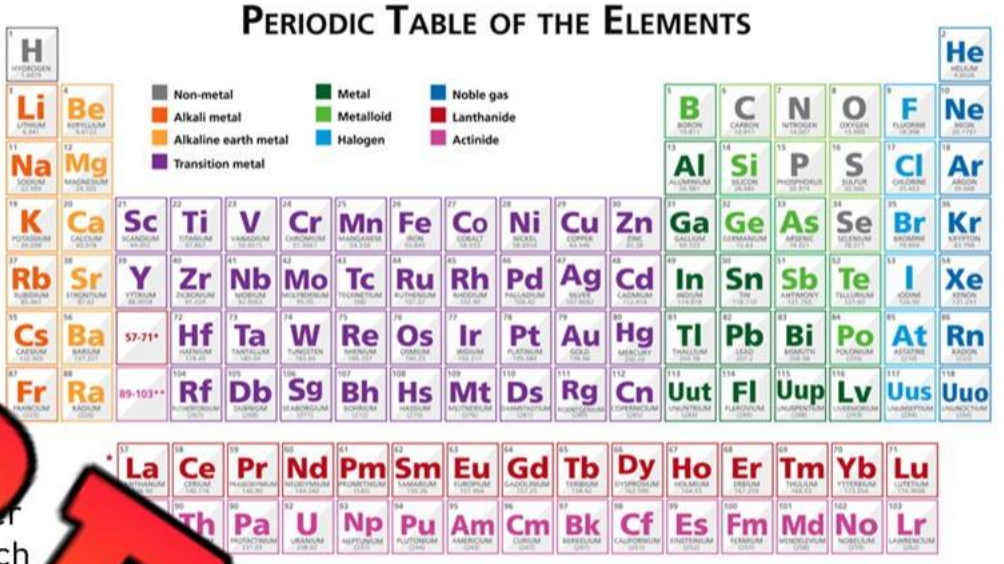
Curriculum Connection
C2.2, C2.8

What are Elements?

What are Elements?
In chemistry, elements are the simplest types of chemical substances that cannot be broken down into simpler substances by chemical means. The[re] currently [kn]own elem[ents] listed [on the] periodi[c] table. Ea[ch] eleme[nt] characterized [by] [the] of protons in its a[tom]ic nucleus, which is also known as its a[tom]ic n[umber]. For example, the element with the atomic number 1 is hydrogen, the element wit[h] [a]tomic nu[mber] 2 is helium, and so on.

Elements are the build[ing] [blo]cks o[f] [ma]tter and they are combined in various ways to form the compounds tha[t] make [up] [the] world around us. Elements can be found in nature as pure substances, or they can be extracted f[rom] compounds through chemical processes.



PREVIEW

Pure Substances – Elements
Elements are considered to be pure substances bec[ause] [they] [can]not be broken down into simpler substances by chemical means. Pure substances [have] a fixed [com]position, meaning that they always contain the same types and proportions of [ato]ms or molecules. Elements are the simplest and most basic types of pure substances, [as] they are made up of only one type of atom.

Why We Need Elements
Elements are the building blocks of all matter, and they are essential for the existence and functioning of the world around us. Elements are used in a wide variety of applications, including:

- ☑ Building Materials – Iron and aluminum are used to build frameworks of structures
- ☑ Energy Production - Carbon and hydrogen are used as fuel sources
- ☑ Medical Treatment - Iodine and fluorine are used to treat various medical conditions.
- ☑ Manufacturing - Elements are used to make metals, plastics, glass, and ceramics.
- ☑ Electronics - Elements like silicon and copper are used to make electronic devices and components, such as computers, smartphones, and other electronic gadgets.

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C2.2, C2.8

Questions

Answer the questions below using evidence from the text.

1) What are elements?

2) Why do[illegible]ed elements? How are they useful to us?

Connect

What d[illegible]ding [illegible]d you of in your life?

PREVIEW

True or False

Circle whether the statement is true or false.

1) Elements are mixtures, not pure substances.	True	False
2) Elements are the building blocks of matter.	True	False
3) There are 78 different elements.	True	False
4) Elements can be divided into two or more substances.	True	False
5) Elements are made of different atoms bonded together.	True	False

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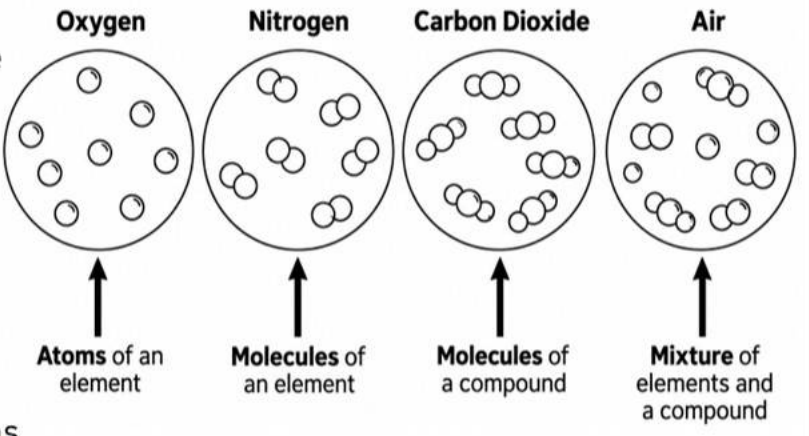
C2.2, C2.8

What are Compounds?

What are Compounds?

Compounds are special kinds of substances that are made up of two or more elements combined. Elements are the basic building blocks of all matter, and they are made up of just one kind of atom. Th[illegible]are many different elements i[illegible]rld, and each one has its o[illegible]perties.

[illegible]lements comb[illegible]ey can f[illegible]mpound. Each compound i[illegible]f a[illegible]ed ratio of the dif[illegible]ents, a[illegible]as its own unique pr[illegible]s that[illegible]t from the properties of the individual elements.



Compounds We Use Ev[illegible]

There are many compounds[illegible]se [illegible]nd each one is made up of a specific combination of elements. Here[illegible] few

- Water (H2O): Water is a compound [illegible]made u[illegible]o hydrogen atoms bonded to one oxygen atom. It is essential for t[illegible]and is u[illegible]r a[illegible]ty of purposes, including drinking, cooking, and cleaning.
- Table salt (sodium chloride, NaCl): Table salt [illegible]om[illegible]de up of one sodium atom bonded to one chlorine atom. It is us[illegible]flavor[illegible]and is also used in the production of a variety of products, includ[illegible]an[illegible]
- Carbon dioxide (CO2): Carbon dioxide is a compound that is mad[illegible] atom bonded to two oxygen atoms. It is a gas that is found in th[illegible]sphere and is used in the production of a variety of products, including soda[illegible] extinguishers.
- Hydrochloric acid (HCl): Hydrochloric acid is a compound that is made up of one hydrogen atom bonded to one chlorine atom. It is a strong acid that is used to make a variety of chemicals and is also found in our stomach to help digest food.
- Sodium bicarbonate (baking soda, NaHCO3): Sodium bicarbonate is a compound that is made up of one sodium atom bonded to one hydrogen atom, one carbon atom, and three oxygen atoms. It is used in baking as a leavening agent and is also used as a natural cleaning agent.
- Sucrose (table sugar, C12H22O11): Sucrose is a compound that is made up of 12 carbon atoms, 22 hydrogen atoms, and 11 oxygen atoms. It is a sweet-tasting compound that is commonly used as a sweetener in food and beverages.

PREVIEW

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C2.2, C2.8

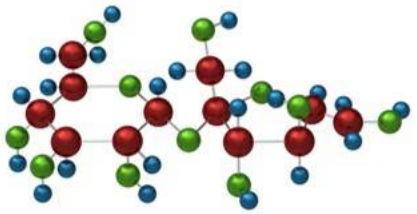
Questions Answer the questions below using evidence from the text.

1) What are compounds? How are they different than elements?

2) What [illegible] you use everyday?

PREVIEW

Draw Draw diagrams of [illegible] The first one is done for you.



Sucrose

Water

[illegible]

Hydrochloric Acid

Sodium Bicarbonate

Carbon Dioxide

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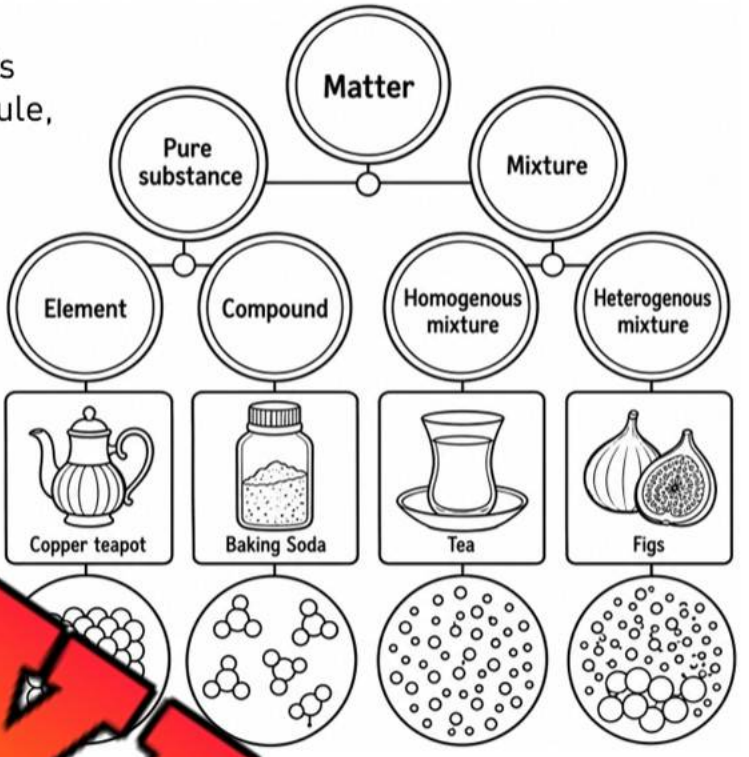
C2.2, C2.8

What are Pure Substances?

What are Pure Substances?

A pure substance is a type of matter that is composed of a single type of atom, molecule, or ion. There are two main types of pure substances: elements and compounds. An element is a pure substance that is made up o[illegible]ingle type of atom, such as hydrog[illegible]en, or gold. A compou[illegible]e substance that is made [illegible]ements that are che[illegible]ally co[illegible]ch as water (H2O), salt (Na[illegible]ne[illegible]).



Mixtures Versus P[illegible]bsta[illegible]

A mixture is a type of [illegible]at[illegible]s made up of two or more p[illegible] substances that are physically combined, but not chemically combine[illegible] Mixtures can be either homogeneous, [illegible]e the c[illegible]ner[illegible]are evenly distributed throughout the mixture, or heterogeneous, wh[illegible] com[illegible]s are not evenly distributed.

An important difference between pure subs[illegible]mixtur[illegible]hat pure substances have a fixed composition, meaning that th[illegible]s hav[illegible]same proportions of their constituent elements or compounds. [illegible]res[illegible]hand, can have varying compositions depending on the proportions of t[illegible]es that are combined.

PREVIEW

Examples of Mixtures and Pure Substances

Pure substances:

- Elements: hydrogen, oxygen, gold, carbon, iron
- Compounds: water (H2O), salt (NaCl), methane (CH4), carbon dioxide (CO2)

Mixtures:

- Air: a mixture of gases, including nitrogen, oxygen, and carbon dioxide
- Stainless steel: an alloy made up of iron, chromium, and other elements
- Concrete: a mixture of cement, sand, water, and aggregate (gravel or crushed stone)
- Stainless steel: an alloy (type of mixture) made of iron, chromium, and other elements

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Curriculum Connection
C2.2, C2.8

Questions

Answer the questions below using evidence from the text.

1) What are pure substances? Give examples.

2) What is the difference between pure substances and mixtures?

PREVIEW

Think

Write examples of pure substances and mixtures below.

Pure Substances	**Mixtures**

True or False

Is the statement true or false?

1) A pure substance can be made with two different elements in a molecule.	True	False
2) A mixture can be made with just one element or compound.	True	False
3) Mixtures are made when we combine different elements or compounds.	True	False
4) Water is a mixture of hydrogen and oxygen.	True	False
5) Carbon dioxide is a pure substance of carbon and oxygen.	True	False

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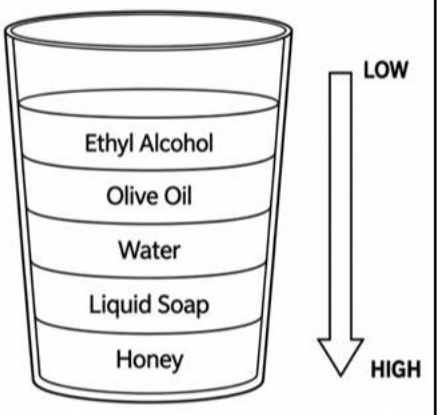
C2.2, C2.8

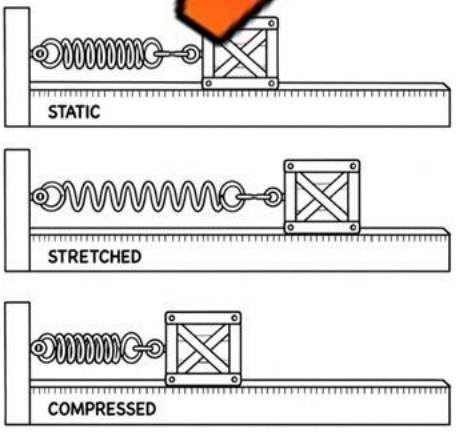
Properties of Pure Substances

What are Properties of Pure Substances?
The properties of a pure substance are characteristics that are unique to that substance and can be used to identify it. These properties are often used to distinguish one pure substance from another and can be used to predict how a substance will behave under different conditions.



List of properties that are used to describe pure substances:

1) **Density**: mass per unit volume of a substance
2) **Melting point**: the temperature at which a solid substance becomes a liquid
3) **Boiling point**: the temperature at which a liquid substance becomes a gas
4) **Solubility**: the ability of a substance to dissolve in a solvent to form a solution
5) **Conductivity**: the ability of a substance to conduct electricity
6) **Magnetic properties**: the ability of a substance to be attracted to a magnet
7) **Chemical reactivity**: the ability of a substance to undergo chemical reactions with other substances
8) **Acidic or basic nature**: acids have a high concentration of hydrogen ions. Bases are the chemical opposites of acids
9) **Transparency**: the ability of a substance to allow light to pass through
10) **Flammability**: the ability of a substance to burn or ignite
11) **Odor**: the smell of a substance
12) **Color**: the visible appearance of a substance
13) **Viscosity**: the thickness or stickiness of a substance
14) **Hardness**: the ability of a substance to resist being scratched or indented
15) **Elasticity**: the ability of a substance to return to its original shape after being deformed



This is not an exhaustive list, and different properties may be more important depending on the specific substance and intended use.

PREVIEW

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Curriculum Connection
C2.2, C2.8

Questions Answer the questions below using evidence from the text.

1) What are properties of pure substances?

2) Why do [illegible]hink it is important to understand the properties of pure substances?

PREVIEW

Think Choose a pure [illegible] using some of the properties from the list.

True or False Is the statement true or false?

1) Copper is a conductive pure substance.	True	False
2) Oxygen is a transparent pure substance.	True	False
3) Gold is a weak pure substance that isn't very hard.	True	False
4) Water is a flammable pure substance.	True	False
5) Baking soda is a soluble pure substance.	True	False

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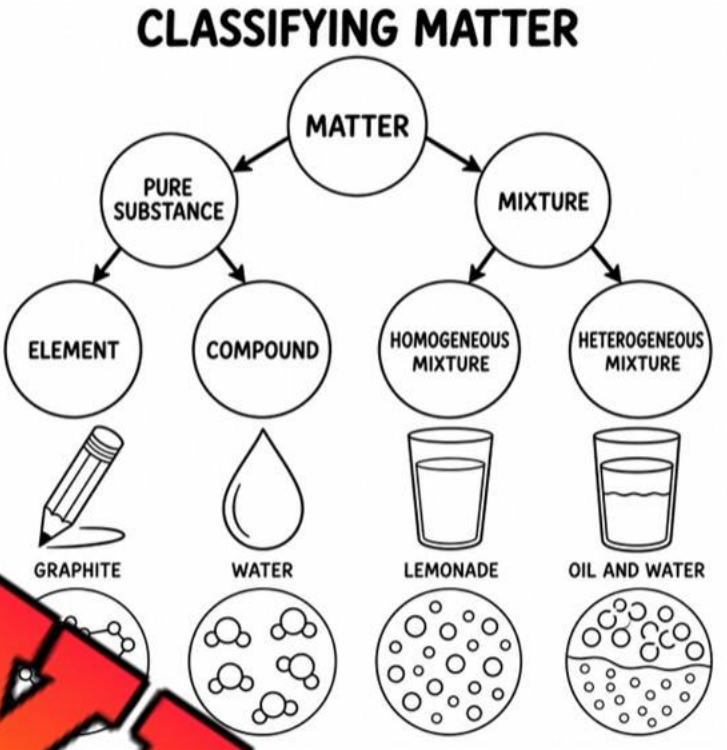
C2.2, C2.3

Mixtures

Mixtures



Matter is most often a mixture. A **mixture** contains two or more types of elements or compounds. In a mixture, no chemical react takes place between the particles. The different e or compounds do not bond to

res com ent proportions an ave d ratio. When you m cerea milk, you are making a you are in control of how mu you add compared to the cereal. The milk and cereal have separate elements compo Mix can be separated by physical means. You can strain the milk from th eas

Mixtures can be homogenous mixtures or hete xtures difference between the two types of mixtures is how well they are co

PREVIEW

Heterogenous Mixtures

Heterogenous mixtures are made up of two or more types of particles. Yo ee or feel the different types of particles. For example, cereal in milk as well as oil and water.

Heterogenous mixtures are not uniform. If you take a sample from different parts of the mixture, the sample will not have the same composition. You can separate components of a heterogenous mixture. For example, you can pick the cereal out of the milk, or you can allow the oil to float to the top of the water and skim it off.

Homogenous Mixtures

Homogenous mixtures are made of two or more types of particles but look like only one type of particle. For example, apple juice, sugar and water, blood, and sports drinks.

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Curriculum Connection
C2.2, C2.3

Questions

Answer the questions below using evidence from the text.

1) What is a mixture? Give two examples of mixtures.

2) What is [illegible]ifference between heterogenous mixtures and homogenous mixtures?

PREVIEW

Making Connections

Give [illegible] of ho[illegible]ous and heterogenous mixtures you know.

Homogenous Mixtures	
Heterogenous Mixtures	

True or False

Is the statement true or false?

1) A mixture cannot be separated as the particles are chemically bonded.	True	False
2) Cereal and milk is a homogenous mixture.	True	False
3) A salad with different vegetables is a heterogenous mixture.	True	False
4) Lemonade is a homogenous mixture.	True	False
5) Water is a mixture of hydrogen and oxygen.	True	False

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Curriculum Connection
C2.2

Classification of Matter by Composition

Matter can be classified by its state: solid, liquid or gas. Matter can also be classified into two categories: pure substances or mixtures. When you look at a teaspoon full of sugar you can see that all the parts are the same. Sugar is a pure substance. In pure substances there is only one kind of particle (one kind of element or compound). Every part of the substance has the same composition as every other part.

Mixtures are made of two or more substances. In some mixtures like pizza, we can see the different ingredients and easily separate the pepperoni from the pizza. In other mixtures, such as soft drinks, you cannot see the individual parts. You can taste the sugar, but you cannot separate it separately as it is a homogenous mixture.

Infer | Was your prediction?

Can you separate sugar from the ingredients in a soft drink? Explain.

Classify | Are the substances below mixtures or pure substances? Explain.

Substance	Classification	Explanation
Sugar	Pure substance	Sugar has only one particle (one compound)
Air		
Baking Soda		
Table Salt		
Soft Drink		
Mud		
Silver		
Carbon Dioxide		
Coffee		

PREVIEW

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C2.3

Homogenous vs Heterogenous Mixtures

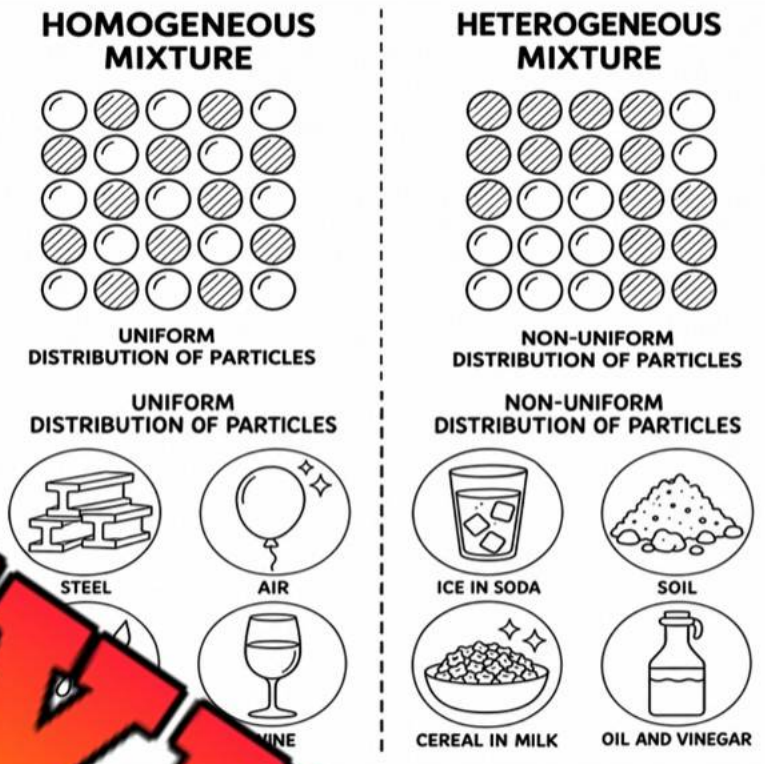
Heterogenous vs Homogenous Mixtures

A homogenous mixture is uniform, meaning the matter looks the same throughout. Steel, air, rain, and wine are all homogenous mixtures because they look the same throughout and they are made of more than one type of particle.

If you took a part of the mixture out, it would be the same as the rest of the mixture. The particles are arranged in a uniform way where they blend together.

A heterogenous mixture is different. It is not uniform, meaning particles are not organized. In fact, particles can be arranged in a random way.

If you took a spoonful of a heterogenous mixture, it will likely be different than the rest of the mixture. Your next spoonful



PREVIEW

Activities Draw a diagram of the mixtures. Then which ture the example is.

Heterogenous Mixture					

Homogenous Mixture					

	Type
Sandwich	
Black Coffee	
Milk	
Pizza	
Ketchup	

Examples Write your own examples of heterogenous and homogenous mixtures.

Homogenous	
Heterogenous	

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C2.3

Exit Cards

Cut Out Cut out the exit cards below and have students complete them at the end of class

Name: _____

What is the main difference between a homogeneous mixture and a heterogeneous mixture?

Name: _____

What is the main difference between a homogeneous mixture and a heterogeneous mixture?

Name: _____

What is the main difference between a homogeneous mixture and a heterogeneous mixture?

Name: _____

What is the main difference between a homogeneous mixture and a heterogeneous mixture?

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C2.3

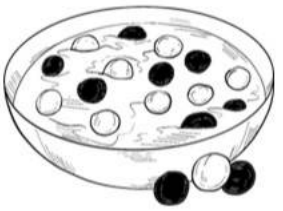
Mixtures | Is the mixture heterogenous or homogenous?

1)



Heterogenous | Homogenous

2)



Heterogenous | Homogenous

3)



Heterogenous | Homogenous

4)



Heterogenous | Homogenous

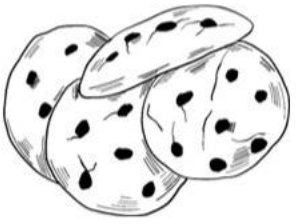
5)

Blood



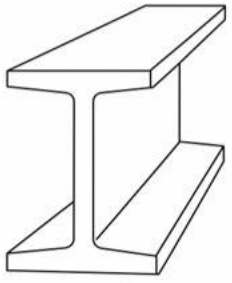
Heterog | Homo

6)



Heterogenous | Homogenous

7)



Heterogenous | Homogenous

8)



Heterogenous | Homogenous



Heterogenous | Homogenous

10)



Heterogenous | Homogenous

11)



Heterogenous | Homogenous

12)

Drink with ice



Heterogenous | Homogenous

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Curriculum Connection
C2.3

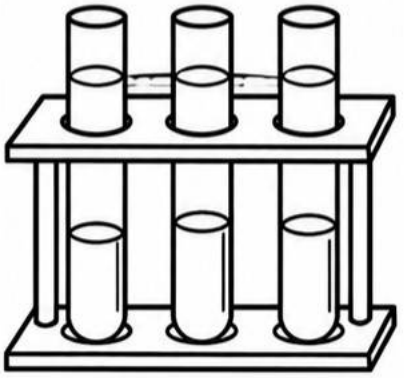
Homogenous and Heterogenous Mixtures

Information — What is this lab about?

Today we will be creating three homogenous and/or heterogenous mixtures using the materials listed below.

Materials — What will you need for the experiment?

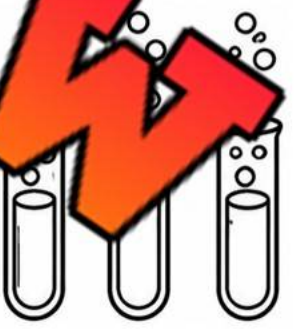
1)
2) 3 test tubes
3) 1 tablespoon
4) 1 tablespoon sugar
5) Vegetable oil
6) Stir stick
7) Food colouring (optional)



PREVIEW

Procedure — How do you perform the experiment?

Experiment 1: Water and Salt
1) Fill the test tube halfway with water
2) Add one tablespoon of salt
3) Stir and wait
4) Answer the questions on the backside of the page



Experiment 2: Water and Sugar
1) Fill the test tube about 1/2 full of water
2) Add one tablespoon of sugar
3) Stir and wait
4) Answer the questions on the backside of the page



Experiment 3: Water and Oil
1) Fill the test tube about 1/3 full of water
2) Add an equal amount of vegetable oil
3) Add one drop of food colouring for colour (optional)
4) Stir the oil and water
5) Answer the questions on the next page.

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Curriculum Connection
C2.3

Hypothesis Circle which type of mixture each experiment will produce.

Experiment	Mixture Type	
Experiment 1	Homogenous	Heterogenous
Experiment 2	Homogenous	Heterogenous
Experiment 3	Homogenous	Heterogenous

Observation What happened during and after each experiment?

Experiment 1	
Experiment 2	
Experiment 3	

PREVIEW

Results Answer the questions below.

1) Was your hypothesis correct? What happened to your mixtures?

2) What is the difference between a homogenous and heterogenous mixture?

3) Do you think the atoms in oil are strongly or weakly attracted to each other? Explain.

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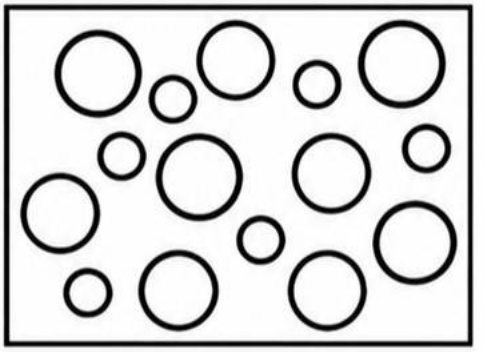
C2.3

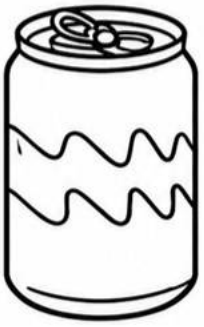
Mechanical Mixtures

Mixtures



Mixtures are made of two or more substances that are not chemically combined. They are combined physically and the substances combined together retain their original chemical identity. Mixtures can be in the form of solids, liquids, and/or gases, in any combination.

For example, a liquid mixture is vinegar and water. These will form a homogenous mixture because you will not be able to see the individual components. Two solids, salt and sand will form a heterogenous mixture. You will be able to see each component even after you mix them together. Brass is also a homogenous mixture of copper and zinc.



Soft drinks are a mixture of all three states of matter. A liquid, water, is mixed with a solid and flavouring that could be solid or liquid. These ingredients are mixed with carbon dioxide, a gas, to give the drink bubbles. Air is a mixture of gases including nitrogen, carbon dioxide and oxygen.



Mechanical Mixtures

Mixtures can be classified as mechanical mixtures or solutions. Mechanical mixtures are heterogenous mixtures. You can see the components after you have combined the components. When you make a salad, you combine the ingredients, but you can still see them separately and they maintain their own properties.

The oil and vinegar salad dressing you use on your salad is also a heterogenous or mechanical mixture because the components don't mix, they maintain their own properties.

Another example of a mechanical mixture is asphalt. The components, gravel, sand and bitumen form together and make a strong solid road surface, however, you can still see the individual components of the asphalt.

PREVIEW

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Curriculum Connection
C2.3

Questions Answer the questions below using evidence from the text.

1) What is the difference between a solution and a mechanical mixture?

2) What ar[illegible]e mixtures that you have made? Were they homogenous or heterogenous mixtures?

PREVIEW

Visualizing Draw what y[illegible]icturi[illegible]you were reading. Explain the picture.

True or False Is the statement true or false?

1) Solutions are mixtures.	True	False
2) Mixtures can be made with different combinations of solids, liquids and gases.	True	False
3) Mechanical mixtures are homogenous mixtures.	True	False
4) Mixtures are made of 2 or more substances that are chemically combined.	True	False
5) Oil and vinegar are a homogenous mixture.	True	False

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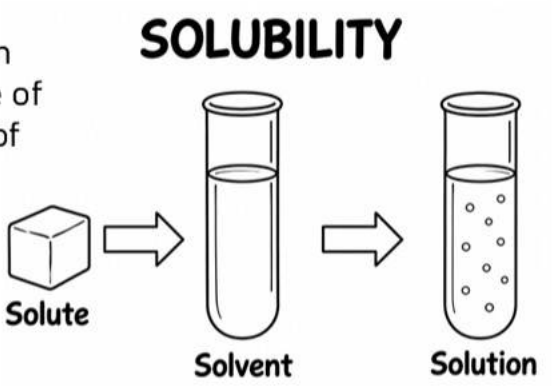
Curriculum Connection
C2.4, C2.6

Solutions

Solutions

A **solution** is a homogenous mixture. Therefore, a solution looks like a single pure substance. It is a uniform mixture of two or more pure substances. There are two main parts of a solution.



1. A **solute** which is the substance that is being dissolv[ed] in the other substance. The solute is the smaller [part] of a solution. Salt is a solute because it dissol[ves] in water.
2. A s[olvent] which [is the] substance that dissolves the other substance. The solvent is the larger part of [the solution] or the part of the solution into which the solute dissolves.

How Do Solutions Form?

When particles of o[ne] substance are attracted to particles of another substance than they are to themselves, the[y] form a s[olution]. Particles on the surface of the solute will break away and begin to fit [in] between solvent particles until all the solute particles are evenly mixed bet[ween] the s[olvent] particles.

The process of a solute mixing wit[h] a solvent is known as **dissolving**. Not all substances dissolve in other substances. For example, sand and water are two separate substances that will not form a solution because the sand will not dissolve in the water.



Water and Water Pollution

Water dissolves more different substances than any other solvent. Because water is the most common solvent in solutions it is called the **universal solvent**. Water does not dissolve fats. Oils and fats are not water soluble.

Our bodies are 70 percent water. The water in our bodies is a solvent that can carry calcium, potassium, oxygen and salt to name a few of the essential nutrients our bodies need to function. Blood is a solution made of the water (solvent), salt (solute), and proteins (solute).

Seventy percent of the earth's surface is covered by water. Solutes in the water can be absorbed by plants and living things. Fertilizer, pesticides, waste from mining, sewage and household products put down the drain are all solutes that can be dissolved in water causing water pollution.

Solid Solutions

Solutions that are solids have both solid solutes and solid solvents. Pure gold is 24 Karat gold. It is a pure substance. 14 Karat gold has 14 parts gold to 10 parts other metals. To make a solution both metals are heated and mixed together into a homogenous mixture. Gold is the solvent and the other metals are the solutes.

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Curriculum Connection
C2.4, C2.6

Define What do the terms below mean? Give an example of each.

	What does it mean?	Example
Solution		
Solutes		
Solvents		

PREVIEW

Summarize What is the m of and supporting details?

True or False Is the statement true or false?

1) Salt is the solvent in a saltwater solution.	True	False
2) Sugar is the solute in a sugar water solution.	True	False
3) A solution is a mixture.	True	False
4) A solution has a solvent and a solute.	True	False
5) The solute mixes with a solvent in a solution.	True	False

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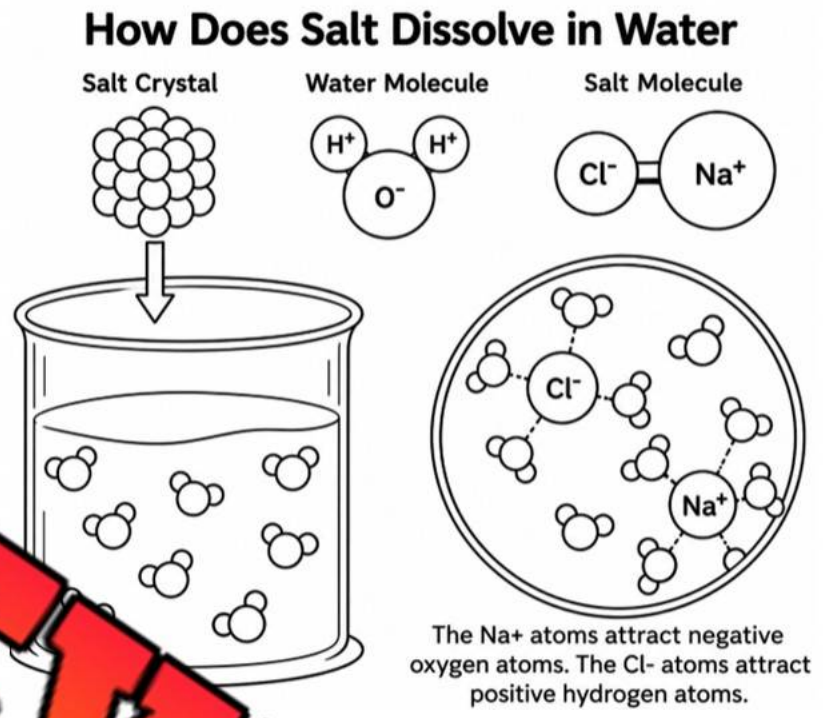
Curriculum Connection
C2.6

Universal Solvent - Water

Universal Solvent – Water

Water is called the **universal solvent** because more substances dissolve in water than in any other substance. This is important because as water moves, it is ...g down and carrying ...als, mine... ...d nutrie...

Water is th... ...t because of its ch... ...mposi... Water molecules are e... ...m... two hydrogen atoms and on... atom. This gives them a positive el...trical ...ydrogen side and a negative electrical charge on their oxygen side. S... ...pposite ...s attract, water molecules can attract many other different types of molecules a... both ...



PREVIEW

Saltwater – Dissolving Salt in Water

Water is so heavily attracted to other substances, like salt, ...ll br... ...own and dissolve the other substance, changing its chemical composition. When ...ter, the salt molecule made of one sodium and one chlorine atom are sepa...d. ...ans the single atoms are floating by themselves in the water.

The positive sodium atoms from the salt attracts the negative oxygen atoms from the water and the negative chlorine atoms from the salt attract the positive hydrogen atoms in the water. The attraction is strong, creating new saltwater molecules that are bonded together, forming a homogenous solution.

Insoluble Substances

Some substances, like oil, will not dissolve in water. These insoluble substances have atoms that are very strongly attracted or bonded to each other. Therefore, the water molecules cannot separate them, so we will see both the water and oil molecules.

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Curriculum Connection
C2.6

Questions

Answer the questions below using evidence from the text.

1) Why is water considered the universal solvent?

2) Why do[illegible]t dissolve into water?

PREVIEW

Diagram

Draw di[illegible] ach[illegible] descriptions below.

Water Molecule	**Salt Molecule**	**S[illegible]ule**

True or False

Circle whether the statement is true or false.

1) Positively charged atoms attract other positively charged atoms.	True	False
2) Hydrogen is a positively charged atom.	True	False
3) Chlorine is attracted to hydrogen which bonds them together.	True	False
4) Oil molecules and water molecules bond together to form a solution.	True	False
5) Salt molecules separate into individual atoms when put in water.	True	False

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Curriculum Connection
C2.4

Factors Affecting Solubility

Factors Affecting Solubility

Solubility is a term used to describe how well a solute will dissolve into a solvent. Sand has no solubility in water but salt is soluble in water. There are a few factors that impact the solubility of a solute.



1) Concentration

The **concentration** of a solution is how much solute there is compared to the amount of solvent. When we mix hot chocolate powder with water, the more solute (chocolate powder) we add to the solvent (water or milk), the stronger the concentration. You can **dilute** a solution by adding more solvent.

The higher the concentration, the less soluble the solute becomes. This is because there is a limit to how much solute can be dissolved into the solvent. Picture trying to dissolve a large amount of hot chocolate powder into a small amount of water. You will likely see clumps as the powder has no place to go to make the solution.

2) Temperature

The **temperature** of the solvent affects how solubility. Generally, when we heat up a solvent, it can dissolve more solid materials (sugar, salt) and less gas (carbon dioxide). The higher the temperature of the solvent, the faster the particles of the solvent move. More movement of the solvent particles causes more collisions between particles, causing the solute to break down faster.



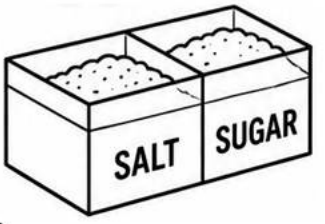
When the temperature of the solvent increases, the spaces between the solvent particles get bigger. This leaves more room for solute particles.

3) Pressure

Pressure can also affect solutions. We see this with soda as we can dissolve more gas under higher pressure. A can of soda has water (solvent) and carbon dioxide (solute) in a pressurized can to allow more carbon dioxide to dissolve into the solvent. This gives our soda more fizz.

4) Size

The **size** of the solute particles affects the dissolving process. If you take a teaspoon of sugar and stir it into water, it will dissolve quickly. If you take a sugar cube and stir it into water, it will take longer to dissolve.



This is because the solvent can only dissolve the outside surface of the solute. In the sugar cube, the outside surface protects the sugar inside from being dissolved. With a powder, the solvent can dissolve each individual grain of sugar all at once.

PREVIEW

Name: _____ 61

Curriculum Connection
C2.4

Questions

Answer the questions below using evidence from the text.

1) How does temperature affect the solubility of a solute?

2) Give an example of when you've made a solution with a weak or strong concentration.

True or False

Circle whether each statement is true or false.

1) You can dilute a solution by adding more solvent.	True	False
2) You can increase the concentration of a solution by adding more solvent.	True	False
3) A cold liquid solvent can dissolve the solute faster.	True	False
4) The concentration of a solution affects how fast solutes dissolve.	True	False
5) If the solute dissolves completely, we get a homogeneous solution.	True	False

Matching

Match the definition with the word being defined. Use the word bank.

Word Bank				
Solute	Solvent	Dissolve	Dilute	Mechanical Mixture

The act of a solute completely combining with a solvent to become a solution.	
To weaken the strength of a solution by increasing the amount of solvent	
A material made up of at least two different pure substances, each material maintains its own properties.	
A substance that can be dissolved in a solvent.	
A substance, in which other materials dissolve to form a solution.	

PREVIEW

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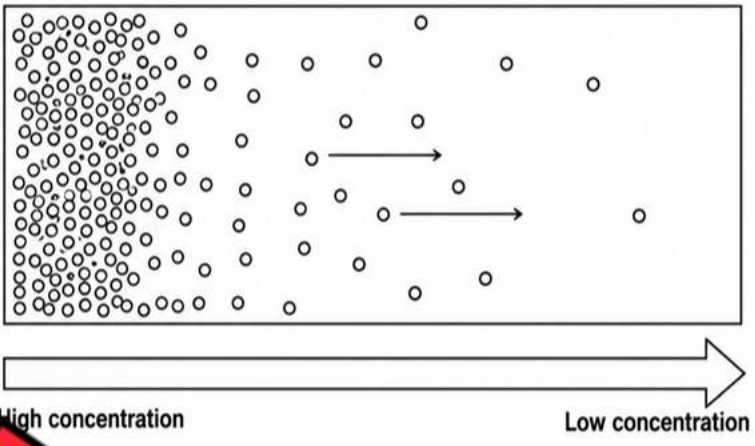
Curriculum Connection
C2.5

Describing Solutions – Concentration/Dilution

Concentration

We can describe a solution in two ways – (1) with words and (2) with numbers. When we use words, we refer to the solution's concentration levels. A **concentrated** solution is a solution that contains a large amount of dissolved solute and very little solvent. Frozen juice concentrate is a concentrated solution of orange juice (solute) and a small amount of water (solvent).



We also use the term dilute to describe the process of making a solution less concentrated. When we make the orange juice, we add 3 cans of water to the frozen concentrate to make delicious juice. If we add more cans of water, we are diluting the orange juice and the flavour is weaker because the solution is diluted.


Strong Concentration – Weak Concentration

Describing Solubility Using Numbers

The amount of solute in a solvent also can be stated in quantitative terms. For example, if 5 grams of sugar are dissolved in 500 ml of water, the concentration of the solution is 5g/500ml or 1g/100ml. This can be read as, five grams per five hundred millilitres, or one gram per one hundred millilitres. We could also call this a 1% solution.

When making hot chocolate, the instructions state to add 50 grams of powder to one cup (250ml) of water or milk. The ratio is 50g/250ml. This would be 20% solution. To make a more concentrated solution, you could double the amount of powder and use a ratio of 100g/250ml. This would be a 40% solution that would taste very chocolatey. If you like your hot chocolate not too sweet, you could dilute the solution by using a ratio of 25g/250ml. The percentage of the solution would be 10% solute to solvent.

PREVIEW

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C2.5

Define What do the terms below mean?

Solubility	
Concentration	
Dil	

Making Connec s the reading remind you of in your life?

Describe Describe the solutions using numbers (ratios) d w ng).

Solute	Solvent	Ratio	Percentage	s
10 g	100 mL			
50 g	100 mL			
15 g	60 mL			
5 g	250 mL			
200 g	100 mL			
200 g	1 L			
1 kg	4 L			

PREVIEW

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Curriculum Connection
C2.4, C2.5

Kinetic Energy in Solutions

Kinetic Energy

Particles move because they have kinetic energy. **Kinetic energy** is the energy of movement. The opposite of kinetic energy is potential energy, which is energy that is not in motion. Anything that is moving has kinetic energy. When a ball rolls down a hill, it has kinetic ene When the ball rests at the top of the hill, the ball has potential energy.

The that matter is made up of have kinetic energy. In solids es in one place, but they do not move very much. W a sub a liquid state, its particles move more and have more i ergy th n it is in a solid state. In a gaseous state, the p es m because they have more room to bounce off th r. The e particles in a gas have more kinetic energy.



PREVIEW

How Temperature Affects Kinetic Energy

Temperature is the measure of the average kine energy of the particles in a substance. It measures how hot a substance is. The higher the temperature of a substance, the more kinetic energy it will have. The particles in a warmer substance will move faster than a colder subst his can be observed when you pour cold oil into a hot frying pan. At first, the oil will not move around the pan very quickly. As the oil heats up, it will travel around the pan much faster. The oil now has more kinetic energy – more heat!



Heat is the energy that transfers from a substance at a higher temperature to one at a lower temperature. You can feel heat transfer when you put a spoon into a cup of hot chocolate. Heat from the hot chocolate causes the particles in the spoon to vibrate faster, making the spoon get hotter. The particles in the spoon move faster causing the entire spoon to get hotter, not just the part of the spoon submerged in the hot chocolate.

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Curriculum Connection
C2.4, C2.5

Questions

Answer the questions below using evidence from the text.

1) What does kinetic energy mean? Do solutions have kinetic energy?

2) How do temperature and the state of matter of a substance affect its kinetic energy?

PREVIEW

Making Connections

es th remind you of in your life?

True or False

Circle whether the statement is true or false.

1) Gas has less kinetic energy than liquids.	True	False
2) Kinetic energy is the energy of movement.	True	False
3) The higher the temperature of a substance, the more kinetic energy it has.	True	False
4) Cold oil has more kinetic energy than warm oil.	True	False
5) The particles in a solid have no kinetic energy.	True	False

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Curriculum Connection
A1.3, A1.4, A1.5

Lab – Making a Crystal

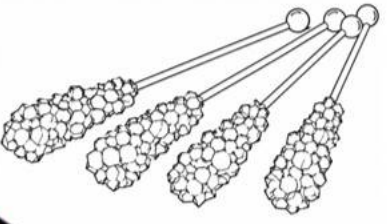
Information — What is this lab about?

Sugar crystals form when you mix boiling water and sugar. The sugar particles are in a crystalline structure, but we cannot see them. When we leave a solution of sugar dissolved in water uncovered, the water will evaporate, and the solution will become mostly sugar. As the water particles disappear, the sugar particles will find each other and join back into crystals. This is how solutions can be separated, through evaporation.

PREVIEW

Materials — What you need for the experiment?

1) 3 cups sugar
2) 1 cup boiling water
3) Food coloring (optional)
4) Flavoring (optional — cinnamon and peppermint)
5) Clean glass or plastic jar
6) Wooden skewer



Procedure — How will you perform the experiment?

1. Dissolve the sugar into the boiling water
2. Add a few drops of food colouring/flavouring if desired
3. Allow the solution to cool off a bit before pouring it into the jar
4. Pour the sugar solution into the jar. Place the wooden skewer into the jar with no lid
5. Place the jar somewhere where it won't be disturbed for a few days.
6. After a few days, you will begin to see crystal growth as the water evaporates.
7. Remove the crystal and enjoy!



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Curriculum Connection
A1.3, A1.4, A1.5

Results

Answer the questions below based on the results of the experiment.

1) What were the two substances in this experiment?

2) Is sugar soluble or insoluble? Explain.

3) Can you separate sugar after it dissolves into the water? Explain.

PREVIEW

Diagram

Draw a diagram of the processes below. Label the substance.

Creating the Sugar Solution	**Evaporating the Sugar Solution in the Jar**

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Curriculum Connection
A1.2, A1.4, A1.5

Experiment – Saturated and Supersaturated Solutions

Information — What is this lab about?

To make a saturated solution, you need a solute and a solvent. Today, we will be experimenting with salt (solute) and water (solvent). If we add just a small amount of salt to water, we will likely have an unsaturated solution as the water can probably dissolve more salt. When the water cannot dissolve anymore salt, we have a saturated solution.

If the water cools, we will have a supersaturated solution because colder water cannot dissolve as much solute as warmer water. Therefore, when the solvent cools, the saturated solution becomes supersaturated, and crystals will form. Let's test this out!

PREVIEW

Materials — What you need for the experiment?

- ✓ 1 cup of water
- ✓ A kettle – optional
- ✓ Fridge – optional
- ✓ Salt – about 7 tablespoons
- ✓ Spoon
- ✓ A clean glass





Procedure — How will you perform the experiment?

1. To make an unsaturated solution, mix 1 tablespoon of salt to water. If you have a kettle, use hot water. Stir the solution.
2. To make a saturated solution, continue adding salt and continue stirring. Count how many tablespoons you have added. When the salt will no longer dissolve (you can see salt on the bottom of the cup that won't dissolve), you have a saturated solution.
3. If you are using hot water, you have created a saturated solution in hot water. As the water cools, the solution becomes supersaturated because more salt has been dissolved into the solvent than the current temperature could dissolve. If you didn't use a kettle, you could put your solution in the fridge to cool it.
4. Optional – Whole class activity - to make a crystal, pour your solution into a new clean glass. Don't pour the salt on the bottom of the cup, only pour the supersaturated solution.
5. Let this solution cool by putting it in the fridge or letting it sit out for awhile.
6. Add a few salt crystals to the cooled solution. Did you see any crystals form?

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Curriculum Connection
A1.2, A1.4, A1.5

Observations | What did you notice?

1) How did you make an unsaturated solution? What did it look like?

2) How di[illegible]ke a saturated solution? What did it look like?

3) How did you make a supe[illegible]d se[illegible]t did it look like? Do you see crystals on the side of the glass or on th[illegible]ton

PREVIEW

Diagram | Draw a diagram of the solutions below.

Unsaturated Solution	**Saturated Solution**	**Supersaturated Solution**

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Curriculum Connection
C2.4

Substance that Dissolve

Dissolving – Soluble Substances

Some substances dissolve in liquids, while others do not. When you mix salt in water and stir, the salt will dissolve into the water. This means you won't be able to see the salt anymore. The salt is still there, it is just mixed in with the water to make a solution. Substances that dissolve into water are called water soluble. Sugar and salt are two examples of water soluble substances.



Insoluble Substances

Some subs[illegible]es do not dissolve in liquids. This means that when you mix the substance [illegible]quid, you can still see the two substances separately. Substanc[illegible] dissolve into liquids are called **insoluble substances**. Exam[illegible]tances are sand and butter.

PREVIEW

Predictions [illegible]es water soluble or insoluble? Test them if you can!

	Substance	Predi[illegible] or Insoluble	Results – Soluble or Insoluble
1.	Dirt		
2.	Vinegar		
3.	Oil		
4.	Honey		
5.	Pepper		
6.	Flour		
7.	Chalk		

Questions Use information from the text to support your answe[illegible]

1) What does the word dissolve mean?

2) What is the difference between soluble and insoluble substances?

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Curriculum Connection
A1.2, A1.4, A1.5

Lab – Testing the Dissolving Process

Part 1 How fast will it dissolve?

Does the size of a solid solute affect how fast it dissolves into the solvent? Consider the following two scenarios.

Option 1. You put an Alka-Seltzer tablet into water.

Option 2. You crush the tablet into powder and add it to the water.

Hypothesis: Which scenario will allow the solute to dissolve faster into a homogenous solution?

_____

_____

Part 2 How [illegible] it fizz

Does the size of the solut[illegible] how lon[illegible]s in the solvent? If we performed the same scenarios as above, wh[illegible]ari[illegible]a[illegible]e fizz to continue longer?

Hypothesis: Which scenario will allow t[illegible] cont[illegible]nger?

_____

_____

PREVIEW

Materials What materials will we need?

- Two beakers
- Stopwatch
- 2 Alka-Seltzer tablets
- 2 cups of water (500ml total)



Procedure What are the steps to do to complete this lab?

1) Fill two beakers with 1 cup of water each.
2) Crush one Alka-Seltzer tablet into powder.
3) Add the tablet and powder to different cups of water at the same time.
4) As soon as the Alka-Seltzer hits the water, press start on the stopwatch.
5) Watch the beakers closely. Record when the powder and tablet fully dissolve.
6) Leave the stopwatch going and wait for the solutions to stop fizzing. Record when this happens for both beakers.

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Curriculum Connection
A1.2, A1.4, A1.5

Results Record your results below.

Scenario	Whole Tablet	Powder
Fully Dissolved		
Fizz Stopped		

1) Were yo[illegible]heses correct or incorrect? Explain.

2) What is the solute [illegible]is ex[illegible]

3) What is the solvent in t[illegible]ment?

4) Is this a homogenous or hete[illegible]nou[illegible]in.

5) Why do you think the powder dissolved faste[illegible]the f[illegible]l[illegible]lain by referencing the particles in the solute and solvent.

6) Why do you think the full tablet fizzed longer than the powder? Explain.

7) Do you think the water temperature would affect the fizz time or how long the solute took to dissolve? Explain.

PREVIEW

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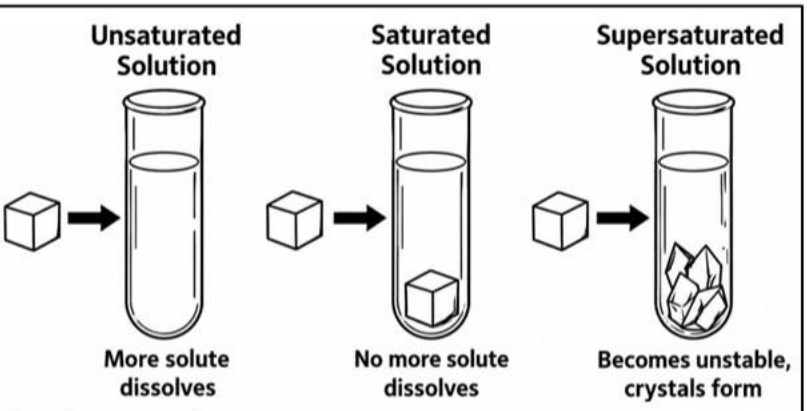
C2.5

Saturation

Saturation



The solubility of a substance in a solvent is measured by the concentration of the saturated solution. A solution is considered **saturated** when adding additional solute no longer increases the concentration of the solution, at a particular temperature.

For example, if we stir sugar into a glass of iced tea, we will get to a point where additional sugar will not mix with the iced tea. Instead, the sugar will drop to the bottom of the glass because the iced tea is saturated with sugar. There is no more room between the iced tea particles to dissolve more sugar.

If more solute can be dissolved in a solvent at a given temperature, then the solution is unsaturated. You can dissolve more sugar in an unsaturated solution.

PREVIEW

Saturated and Supersaturated Solutions

In the diagram above, you can see in the unsaturated solution that when adding more solute, it dissolves to make a more concentrated solution. When the solution is saturated, no more solute can dissolve, so the solute rests at the bottom of the solute because it is heavier than the liquid.



A **supersaturated solution** happens when we heat up a saturated solution and add more solute to the solvent. While the solution is hot, it will allow more solute to dissolve into the solvent. But as the solution cools, the stable solute becomes unstable and begins to form crystals. You may see this in a jar of honey that has been refrigerated. When the honey is made, it is hot, allowing more sugar to dissolve in the solution, but as it cools, the sugar becomes unstable and forms crystals. If you heat the honey again, it will likely lose its crystals.

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Curriculum Connection
C2.5

Define
What do the terms below mean?

Unsaturated Solution	
Saturated Solution	
Supersatu Solu	

Questions
Answer qu ons below using evidence from the text.

1) What is the differe bet ted and saturated solution?

2) How do you make a supersaturated solution?

PREVIEW

True or False
Is the statement true or false?

1) We can dissolve more solute in a saturated solution.	True	False
2) We can dissolve more solute in an unsaturated solution.	True	False
3) We can heat up a saturated solution and dissolve more solute in it.	True	False
4) A supersaturated solution will crystalize when cooled.	True	False
5) The solute we add to a saturated solution will float if it weighs more than the solvent.	True	False

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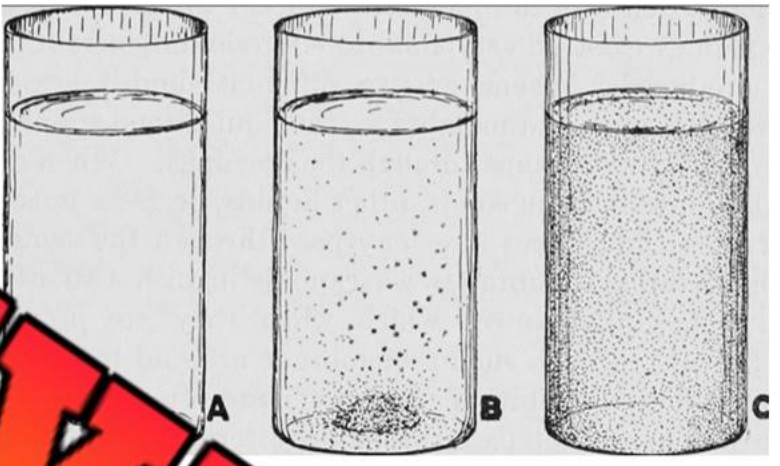
Curriculum Connection
C2.3

Heterogenous Suspensions

What is a Suspension?

A **suspension** is a mixture of a liquid and particles of a solid. A mixture is considered a suspension if the particles in the liquid do not dissolve. Instead, the particles become dispersed throughout the liquid after they have been mixed. They are "suspended" in the liquid.

Over time, the particles will settle at the bottom of a suspension mixture like sand and water. When we stir the sand into the water, the sand will disperse throughout the water. If you leave the sand and water mixture alone, the sand will eventually settle to the bottom because it is heavier than water (it weighs more).



PREVIEW

Check it out

In figure A above, the liquid and the solid particles are both visible. The mixture has not been stirred yet. In figure B, the stirring has begun, and the particles are beginning to disperse throughout the liquid. In figure C, the mixture has been stirred and the particles are now evenly dispersed throughout the liquid. This is a suspension because if we left this mixture long enough, the particles would settle again at the bottom of the liquid, just like in figure A.

Heterogenous Suspensions – Not Solutions

A heterogenous suspension is not a solution because it is a mixture. The one substance has not been dissolved into the other substance. Therefore, we can easily separate the two substances using physical methods, like using a strainer.

Another example would be when we mix flour with water. The flour will be suspended in the water, creating a mixture, not a solution.



Flour and Water Suspension

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C2.3

Questions

Answer the questions below using evidence from the text.

1) Why is a heterogenous suspension considered a mixture and not a solution?

2) Why isn[illegible] water considered a heterogenous suspension?

PREVIEW

Diagram

Draw a diag[illegible] suspension. Label the substances used.

Before Stirring	**After Stirring**	**A[illegible] Time**

True or False

Is the statement true or false?

1) A suspension is a solution.	True	False
2) A suspension is a mixture between a liquid and the particles of a solid.	True	False
3) In a suspension, the particles of a solid will settle after a period of time.	True	False
4) Milk is an example of a suspension.	True	False
5) It's called a suspension because the particles float in the liquid.	True	False

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C2.3

Heterogenous Colloids

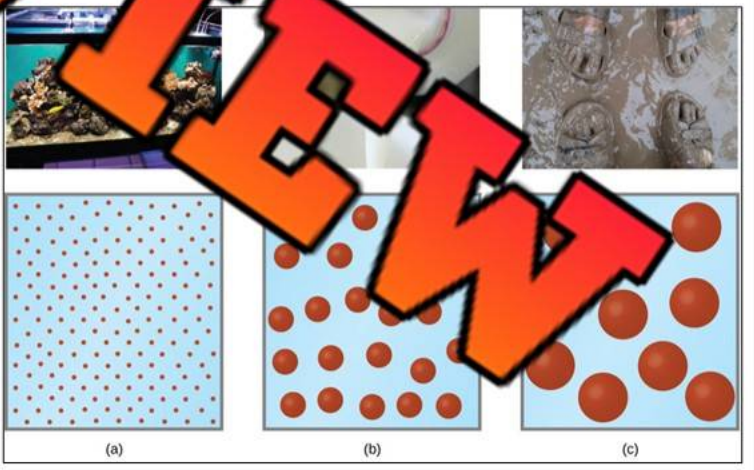
What is a Colloid?

A **colloid** is a mixture where very small particles of one substance are evenly distributed through another substance. A colloid mixture looks like a solution because the small particles appear to dissolve into the other substance. This is not the case however, as the particles a[illegible]ating or suspended in the other substance, even if you cannot see it with your eyes.

[illegible] a suspension except for the fact that in a colloid, the particles do not e[illegible]tually [illegible] bottom. The particles in a colloid will stay suspended or floating.

Colloids can [illegible]ture[illegible]ids or gases. An example of a liquid colloid is milk. Milk has butterfat gl[illegible]dispersed [illegible]pended in water. No matter how long you leave milk, the globules wi[illegible]settl[illegible] example of a gaseous colloid mixture as particles are suspended in th[illegible]

PREVIEW



Check it out

In figure A, the water is a colloid of tiny particles (minerals) mixed in the liquid water. In figure B, the water in the milk is mixed with the butterfat globules that are slightly larger particles than the minerals in figure A. In figure C, the mud is a colloid mixture of water and soil. The soil particles are even larger than the butterfat globules, but they will not settle regardless of how long the mixture sits.

Examples of Colloids

- Mayonnaise – when the egg yolks and oil are mixed, they form a stable mixture that won't separate.
- Perfume – the spray contains gases and liquids that mix together and do not separate.

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C2.3

Questions

Answer the questions below using evidence from the text.

1) What is the difference between a suspension and a colloid?

2) Why is milk a colloid?

Visualizing

Draw you [illegible] while you were reading. Explain the picture.

True or False

Is the statement true or false?

1) Colloids are the exact same as suspensions.	True	False
2) Colloid mixtures do not settle regardless of how long they sit.	True	False
3) A colloid can be a mixture of solids, liquids, or gases.	True	False
4) Sand mixed with water is a colloid.	True	False
5) In a colloid mixture, the particles must be evenly distributed.	True	False

PREVIEW

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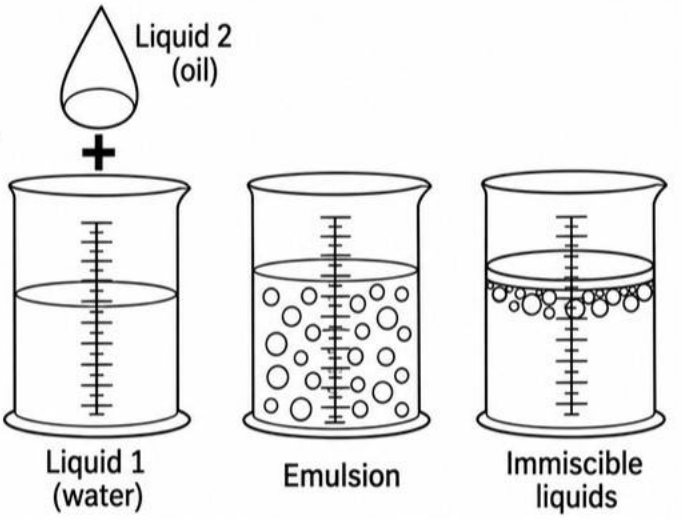
Curriculum Connection
C2.3

Heterogenous Emulsions

What is an Emulsion?

An **emulsion** is a heterogenous mixture of two or more liquids, where one ends up as very tiny droplets inside the other. The liquids are usually not mutually soluble, which means they do not mix completely.

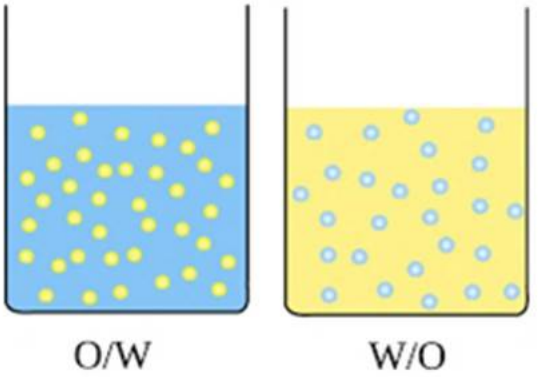


For example, if we add water to a bottle of cooking oil and shake it, we notice that after some shaking the water and oil will not dissolve into the mixture but rather as bits and pools in the oil.

When you leave the mixture for a while, the liquid with the higher density will sink to the bottom. In oil and water, water has a higher density, so it will sink to the bottom. Since the oil is lighter with a lower density, it rises to the top. These two liquids are **immiscible**, meaning they cannot be used to create a homogenous solution.

Oil and Water Emulsions

Most of the emulsions contain water as one of the two liquids. In this case, emulsions are classified into two categories: (1) oil-in-water and (2) water-in-oil. **Oil-in-water** emulsions mean water is the main liquid and an oil liquid is being mixed in the water. **Water-in-oil** emulsions mean that oil is the main liquid with water being mixed into the oil.



Check it out

The image on the left shows how oil and water interact with each other. The O/W beaker shows the oil-in-water type of emulsion, and the W/O beaker shows the water-in-oil mixture. Both are emulsions as they do not mix well enough to resemble suspensions or colloids.

PREVIEW

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Curriculum Connection
C2.3

Questions

Answer the questions below using evidence from the text.

1) What would happen to the O/W beaker if we left it for awhile? Which liquid would rise?

2) What is ulsion? Provide an example of one emulsion.

PREVIEW

Diagram

Draw 2 dia ions. Label the liquids in the emulsions.



True or False

Is the statement true or false?

1) An emulsion is a homogenous mixture where two liquids dissolve evenly.	True	False
2) An emulsion is a mixture where two liquids do not mix completely.	True	False
3) The two main liquids in an emulsion are water and oil.	True	False
4) The liquid with a higher density in an emulsion will rise to the top.	True	False
5) An emulsion is a mixture of a liquid and tiny particles of a solid.	True	False

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Curriculum Connection
A1.3, A1.4, A1.5

Emulsions Lab

Information — What is this lab about?

We've all heard that water and oil don't mix, but what happens when we add them together slowly and mix?

Research Question

1) If we m[illegible]ar (95% water), oil, and an egg together and mix it, will it mix toget[illegible]redients stay separate after mixing?

PREVIEW

Materials — [illegible]u n[illegible]for the experiment?

1) 1 mixing bowl
2) 1 wire whisk
3) 1 measuring cup
4) Measuring spoons
5) 2 plastic cups (for vinegar and oil)
6) 1 egg
7) 4 tsp of vinegar
8) 1 cup of vegetable oil



Procedure — How will you perform the experiment?

1) Add the egg and 1 tsp of vinegar to the mixing bowl.
2) Beat the two ingredients using the whisk until it is slightly thick.
3) Add oil, 1 tablespoon at a time, while continuously beating the mixture until 1/3 cup has been added.
4) Add 1 teaspoon of vinegar and continue to beat the mixture.
5) Repeat steps 2 and 3 until all of the liquids have been added.

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Curriculum Connection
A1.3, A1.4, A1.5

Hypothesis — What do you think will happen?

Do you think the ingredients will become a homogenous mixture (all look the same)? Or will the ingredients stay separate so we can see the ingredients in the mixture?

Results — t[illegible]uestions below.

1) Was your hy[illegible]ect? [illegible]at happened to your mixture?

2) Why is this mixture an emulsion?

3) An emulsifier is an ingredient used often in cooking to st[illegible]uid [illegible]m separating from each other. Emulsifiers are added to emulsions to [illegible]re like solutions or colloids. Which ingredient do you think is the emul[illegible] experiment? Explain.

4) Why do you think emulsifiers are used in cooking? Explain with an example.

PREVIEW

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Curriculum Connection
C2.5

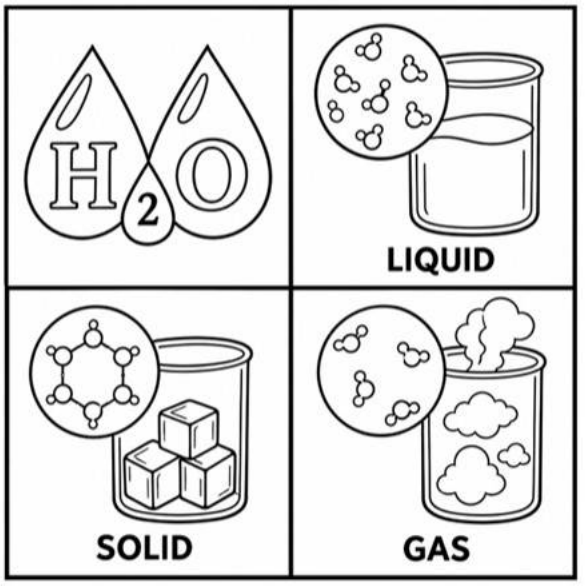
Arrangement of Atoms/Molecules

Arrangement of Atoms and Molecules in Different States of Matter

Solid

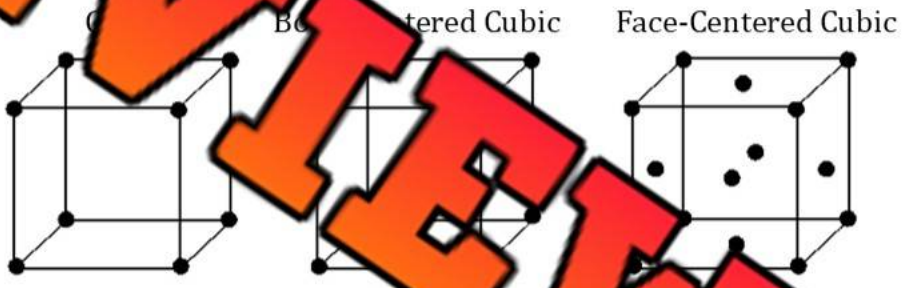
In a solid, the atoms or molecules are held in a fixed position relative to one another and are not free to move around. This is because the forces between the atoms or molecules are strong enough to hold them in place. Th[illegible]oms or molecules are arranged in a specific, re[illegible]pattern called a **crystalline structure**.

[illegible]e described in terms of the unit c[illegible]ich is th[illegible]t repeating unit of the crystal. T[illegible] type [illegible]nd t[illegible] arrangement of atoms within it[illegible]e ph[illegible]roperties of the solid, such as [illegible]ty, m[illegible] and electrical conductivity.



There are many different ty[illegible] cel[illegible]ost common ones are:

- Cubic unit cell: this type of uni[illegible] cell has atoms at each corner of the cube and one atom in the center.
- Body-centered cubic unit cell: this type of unit cell is similar to the cubic unit cell, but it also has an additional atom in the center of the cube.
- Face-centered cubic unit cell: this type of unit cell has atoms at e[illegible] c[illegible] the cube and also has atoms in the centers of each of the faces of the cube.
- Hexagonal unit cell: this type of unit cell has atoms arranged in a hexagonal pattern.



Liquid

In a liquid, the atoms or molecules are not held in a fixed position, but they are still relatively close to one another. They are free to move around, but they are not as free as they are in a gas. The forces between the atoms or molecules are weaker than in a solid, but they are still strong enough to keep the liquid from spreading out indefinitely.

Gas

In a gas, the atoms or molecules are widely spaced and are free to move around. The forces between the atoms or molecules are very weak, and they are not able to hold the gas together. As a result, a gas will spread out to fill any container or space that it is placed in.

PREVIEW

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Curriculum Connection
C2.5

Explain How are the atoms/molecules arranged in each state of matter?

Solid	
Liquid	
Gas	

Question Answ e stions below using evidence from the text.

1) How does the ment olecules affect the behaviour of the matter?

2) What is the crystalline structure of solid matter at are ypes of arrangements?

PREVIEW

Draw Draw the arrangement of atoms/molecules in water as liquid, solid, and gas.

Solid	**Liquid**	**Gas**

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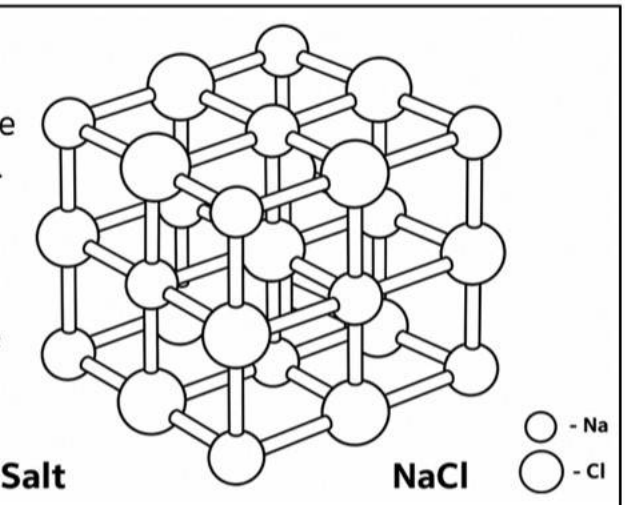
Curriculum Connection
C2.5

Crystalline and Amorphous Solids

What Does Crystalline Structure Mean?

A **crystalline structure** is the way that atoms are arranged in a solid material. It's kind of like a puzzle where the atoms fit together in a repeating pattern. This repeating pattern is called a crystal lattice.

A crystal lattice is the repeating three-dimensional pattern of atoms in a crystalline material. It can be thought of as a framework made up of points, called lattice points, and lines connecting them. The lines of the material occupy the lattice points.



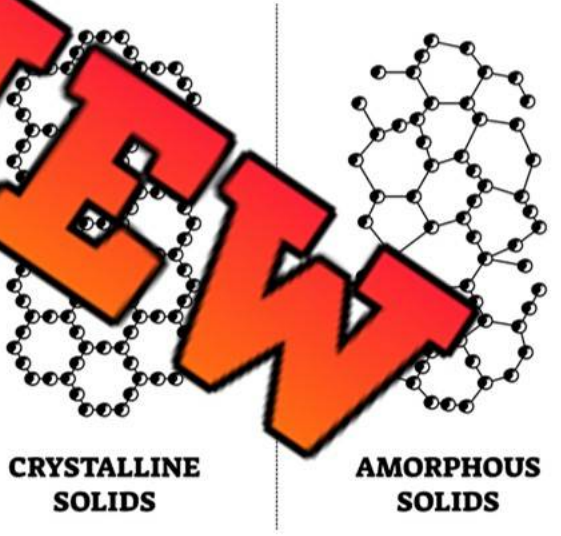
Salt NaCl

The arrangement of the atoms in the crystal lattice determines the properties of the material. For example, the crystal lattice of a metal like copper allows electrons to move freely through the material, which makes it a good conductor of electricity. On the other hand, the crystal lattice of an insulator like rubber does not allow electrons to move easily, which makes it a poor conductor of electricity.

PREVIEW

Difference Between Crystalline and Amorphous Solids

Most solids have a crystalline structure. Examples of crystalline solids include metals, minerals, and most types of ceramics. However, some solids do not have a crystalline structure. These solids are called **amorphous solids**, and they do not have a repeating atomic structure. Examples of amorphous solids include glass, rubber, and some types of plastics.



The arrangement of the atoms in a crystalline solid is very orderly and predictable. Crystalline solids have many unique properties, such as the ability to form well-defined shapes (e.g., diamonds and other gemstones), a high melting point, and good electrical and thermal conductivity.

On the other hand, amorphous solids do not have a repeating atomic structure. This means that the atoms in an amorphous solid are arranged randomly, without any long-range order. As a result, amorphous solids do not have a distinct melting point and are often brittle and fragile. They also tend to have poor electrical and thermal conductivity.

Examples of crystalline solids include metals, minerals, and most types of ceramics. Examples of amorphous solids include glass, rubber, and plastics.

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Curriculum Connection
C2.4, C2.5

Questions Answer the questions below using evidence from the text.

1) What is the difference between crystalline and amorphous solids?

2) Describe several properties of both crystalline and amorphous solids below.

Crystalline	Amorphous

PREVIEW

Making Connections Look around the class and write examples of crystalline and amorphous solids.

Crystalline	Amorphous

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Curriculum Connection
C2.5

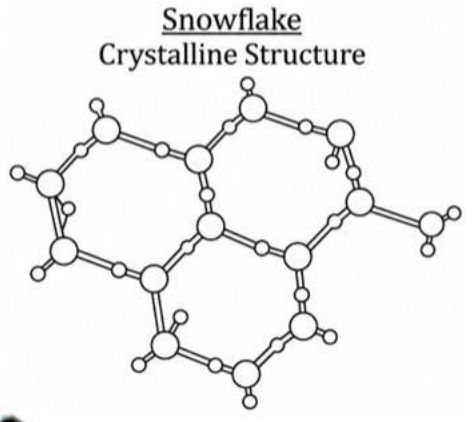
Snowflakes and Rock Candy

Crystalline Structure of a Snowflake

At temperatures below 0°C, water molecules slow down and start to stick together, forming a crystalline solid called ice. The crystalline structure of ice is determined by the arrangement of the water molecules. In ice, the water molecules are arranged in a repeating, three-dimensional pattern called a crystal lattice. This lattice is made up of small, needle-like crystals that are stuck together to form the overall shape of the ice.

Snowflakes are made up of ice crystals, which are a type of crystalline material. The crystalline structure of a snowflake is determined by the arrangement of the water molecules that make up the ice crystals.

In a snowflake, water molecules are arranged in a repeating six-sided pattern called a hexagonal lattice. This lattice is made up of crystal structures called hexagonal prisms that combine to form the overall shape of the snowflake.

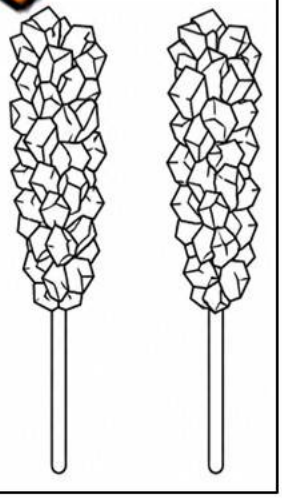


The exact shape and size of a snowflake depends on the temperature and humidity of the air as it falls through the sky. Different conditions can cause snowflakes to form different patterns, which is why no two snowflakes are the same.

Crystalline Structure of Rock Candy

When you make rock candy, you start by dissolving a lot of sugar in hot water. This creates a sugary solution, which is a mixture of sugar and water where the sugar molecules are evenly mixed throughout the water.

As the solution cools, the sugar molecules start to come out of the water and form solid crystals. This happens because the sugar molecules are trying to release energy by arranging themselves in an orderly, repeating pattern called a crystal lattice. The sugar molecules will continue to come out of the solution and form crystals until the solution reaches a state of equilibrium, at which point the concentration of sugar in the solution will be at its maximum (this is known as saturation).



However, if you add more sugar to the solution than it can hold at equilibrium (this is called supersaturation), the sugar molecules will continue to come out of the solution and form crystals even after the solution has reached saturation. This is what happens when you make rock candy: by adding a lot of sugar to the hot water and then allowing the solution to cool slowly, you create a supersaturated solution that is capable of forming large, well-defined crystals.

The size and shape of the crystals will not take on a cubic or hexagonal structure. Instead, the structure will depend on different factors, including the temperature and concentration of the solution. This is why rock candy will look different every

PREVIEW

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C2.5

True or False

Circle whether the statement is true or false.

1) A snowflake has a hexagonal lattice.	True	False
2) Rock candy has a cubic lattice.	True	False
3) The exact shape of snowflakes is the same with all snowflakes.	True	False
4) Liquid water form a hexagonal lattice.	True	False
5) When rain falls, it doesn't have a crystalline structure because it's a liquid.	True	False

Explain

Describe the formation of rock candy and snowflakes below.

1) How do snowflakes form? Why do they look like crystals?

2) How does rock candy form? Why does it look like crystals?

PREVIEW

Draw

Draw the crystalline structure of a snowflake below. Describe your drawing.

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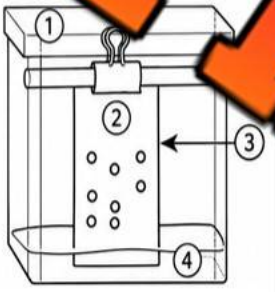
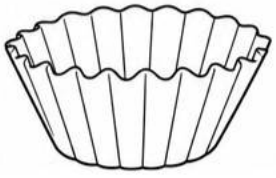
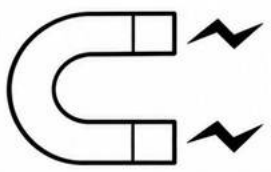
Curriculum Connection
C2.7

Separating Mixtures

Separating Mixtures
Many of the substances we use everyday were once part of a mixture. Humans have been separating mixtures for many years. In ancient history, industrious humans separated metal from ore to make tools and weapons. Read below to learn more about some of the common separation processes.

Separa... Proce...	How It Works
Pa... Chro... 	...method is commonly used in the food industry. It is used to ...e how many substances are in a mixture and what the ...es ...e. The process works like this: ...hea... ...ixture on filter paper ...Place... ...in a solvent. The various substances that make ...up t... ...e attracted to the solvent at different rates, ...ows us ...he different substances in the mixture 3) The ...pap... ...the separated substances attached to the p...er.
Filtration 	Filtration is used to separate i... ...ble ...from a liquid. We use filtration in water treatmen... ...s wh... ...er from rivers is filtered to remove solid parti... To ...use filter paper to allow only the water to pour th... ...paper... ...olid particles cannot pass through the paper, whic... ...he... ...ter... out and separated from the liquid.
Evaporation 	Evaporation is often used to separate a homogeneous ...on. When salt has dissolved into a liquid, we can evaporate the ...id to separate the salt again. Evaporation occurs when we heat the liquid to its boiling point. The liquid becomes a gas and when all the liquid has evaporated, the solid particles remain. We can use **simple distillation** to collect the evaporated water (condensation) to enjoy clean water.
Magnetism 	Magnetism is ideal for separating a mixture of two solids with one part having magnetic properties. If we mixed sand and iron together, it would be difficult to pull all the little pieces of iron out manually. Instead, we could use a magnet to attract the iron pieces out of the sand, leaving only the sand remaining.

PREVIEW

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Curriculum Connection
C2.7

Separation Process?

Read the scenario and write which process you'd use.

1) Separating stone from water	
2) Separating and determining which chemicals are in a liquid	
3) Separating salt from water	
4) Separating metal from rocks	
5) You spil[illegible] grinds in your coffee and want to remove them	

Ques[illegible]g

W[illegible]tions do you have after reading the information?

1)	
2)	

Questions

Answer the questions below using ev[illegible]om th[illegible]

1) When have you ever separated substances in a mixture?

2) Why is it important for humans to separate mixtures? How would life be different if we couldn't separate mixtures?

PREVIEW

Name: _____ 103

Curriculum Connection
A1.3, A1.4, A1.5

Separating Mixtures

Information — What is this lab about?

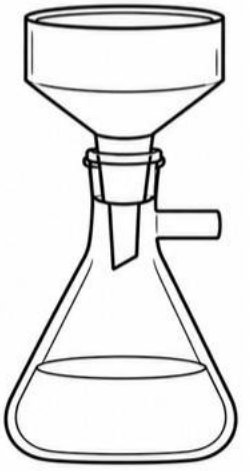
There are many ways to separate substances in a mixture. In many mixtures, you can visibly see the different substances and pick them out to separate them. This is time consuming though, so you'd be better off choosing a more efficient method.

Try to separate the mixtures below using the materials you are provided with. See how fast you can separate these mixtures.

PREVIEW

Materials — What will you need for the experiment?

- ✓ Rocks (large, medium-sized, and small)
- ✓ Dirt
- ✓ Gravel
- ✓ Sand
- ✓ Water
- ✓ Salt
- ✓ Spoons
- ✓ Sieves or strainer - different sizes work best
- ✓ Coffee filter
- ✓ Tweezers
- ✓ Plastic bowls that can get dirty – at least 2
- ✓ Funnels or plastic bottle cut in half to act as a funnel
- ✓ Plastic bottles with the bottoms cut off work well as
- ✓ bowls to play with the mixtures







Procedure — How will you perform the experiment?

1) We will try to separate three different mixtures today as fast as we can. The challenge will be to show your teacher the separated substances.
2) Your teacher could prepare the mixtures ahead of time and let you work to separate them any way you can.
3) You can use the materials above any way you want to separate the mixtures.

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Curriculum Connection
A1.3, A1.4, A1.5

Mixtures

Create the mixtures below and then separate the substances.

1) Mix different sized rocks – have three categories (large rocks, medium sized, and small). Separate all three.

2) Mix a handful of dirt, sand, gravel, and water in one bowl. Separate the water from the sand, dirt, and gravel. Then try to separate the sand from the dirt and gravel.

3) Mix 1 tablespoon of salt with 1 tablespoon of sand. Separate the sand from the salt. This [illegible]ugh one.

Hint – u[illegible]ledge of solutions and consider adding water to separate the sand[illegible]lt

Results

An[illegible]t[illegible]esti[illegible]low.

1) How did you separa[illegible]th[illegible]ntity[illegible]cks?

2) How did you separate the dirt, sand, gravel, and water?

3) How did you separate the salt from the sand?

PREVIEW

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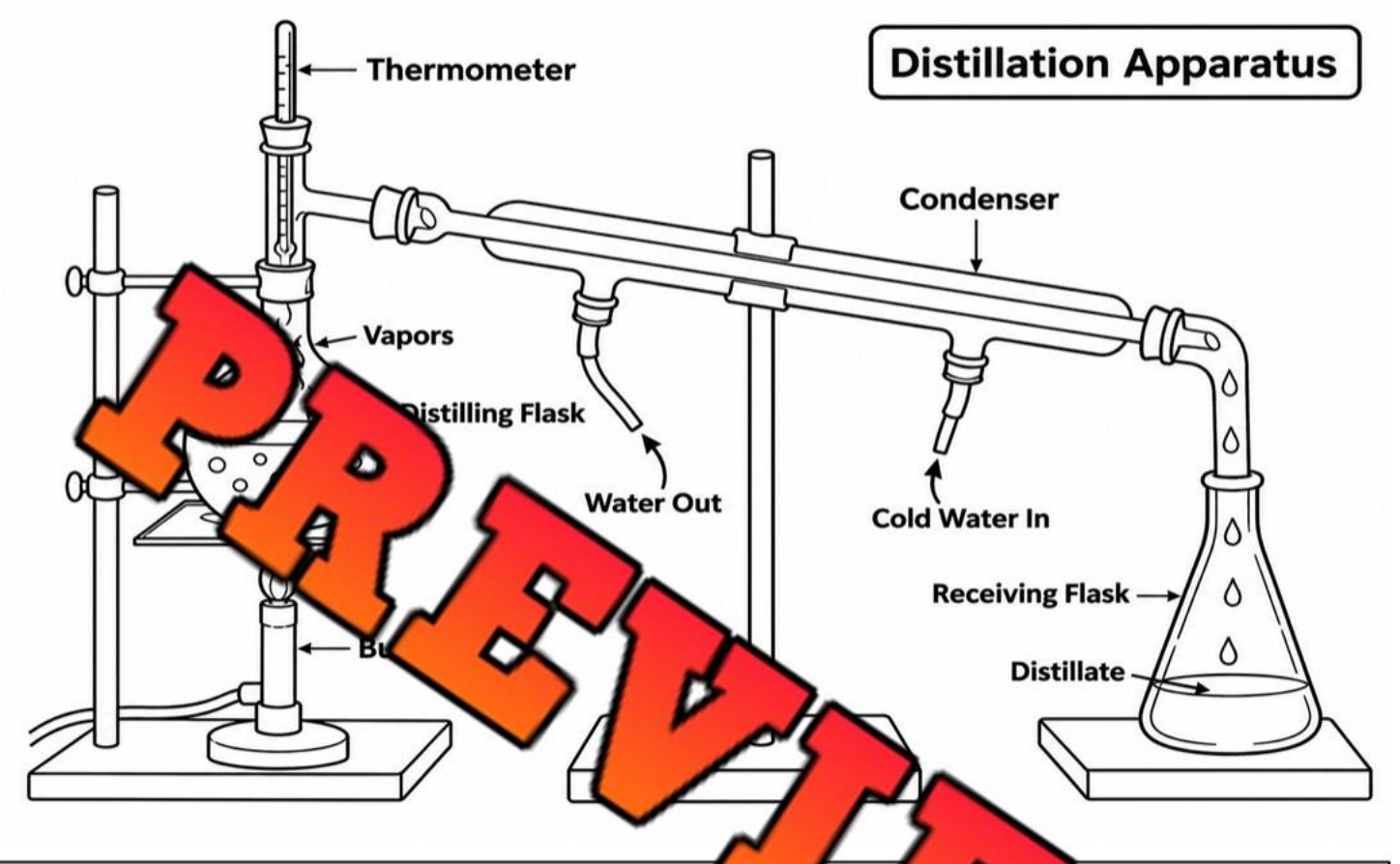
Curriculum Connection
C2.7

Separating Mixtures - Distillation



PREVIEW

Distillation

Distillation allows you to separate the solute from the s... solu...uring the distillation process, the solution is boiled. This vaporizes the s...ent (...s) and separates it from the solute. The solute remains in the original c...

Then the solvent gas rises and condenses on a relatively cool surfa...lled the condenser. The condenser collects the vapour which creates water droplets that travel down the condenser tube before dropping into the receiving flask. The drops are called the distillate, which will now be the solvent. At this point, the solvent has been separated from the solute as the solute will be the only thing remaining in the original flask (distilling flask).

Some types of bottled water are created by distillation. This process is common when creating drinking water from salt water, also called desalination. Distillation removes the salt (solute) from the water (solvent).

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Curriculum Connection
C2.7

Questions

Answer the questions below using evidence from the text.

1) What does distillation mean? How does it work?

2) Explain why separating a solid mixture is often easier than separating components of a solution.

3) A chef is cooking a stew but it is too watery. What separation technique could they use to separate some of the water? Why do they need to use distillation? Explain.

PREVIEW

Diagram

Draw a diagram of the distillation process.

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Curriculum Connection
C2.7

Separating Processes

Research Research the following separation processes and fill in the table.

Separation Process	How It Works	Diagram
Centri		
Settling		
Sieves		

PREVIEW

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Curriculum Connection
C2.7

Research Research the following separation processes and fill in the table.

Separation Process	How It Works	Diagram
Filters		
Separating Funnel		
Sublimation		

PREVIEW

Name: _____ 109

Curriculum Connection
C2.2, C2.8

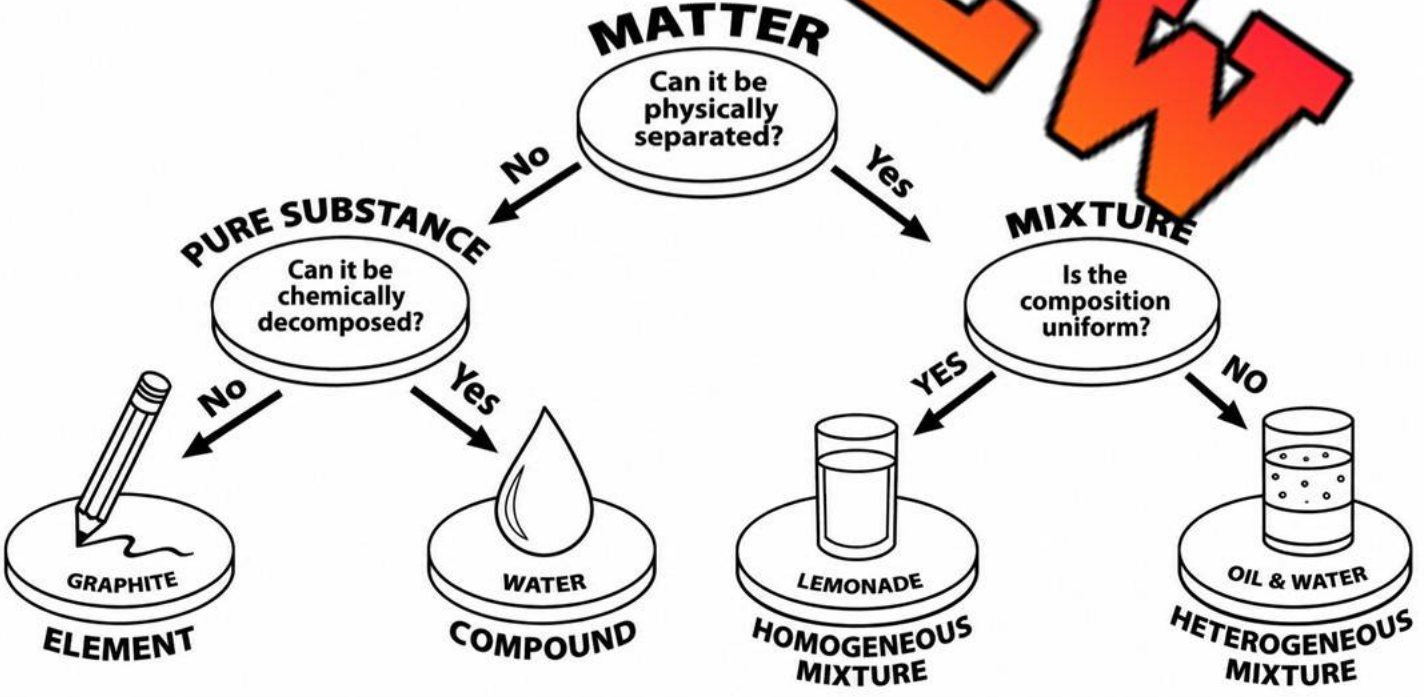
Identifying and Classifying Matter

Classifying Matter

The flow chart below helps us classify matter into pure substances or mixtures. It can also be used to further classify matter into elements, compounds, homogenous mixtures, or heterogenous mixtures. Follow along below.

1) Can the matter be physically separated? Can you use methods like evaporation, filtration, distillation, or chromatography to separate the substances? A simple example would be separating water from salt by evaporating the saltwater solution and collecting the condensation that is just water. The salt will remain in the container. If yes, the substance has been physically separated. If the matter can be separated physically, it is a mixture. If not, it is a pure substance.
2) Can the pure substance be chemically decomposed? Can you separate the compound into only one element? If not, then you have an element. If yes, it is a compound that can be separated into elements.
3) Is the mixture uniform? Does it look the same throughout? If yes, the mixture is homogenous. If not, the mixture is heterogeneous.

PREVIEW



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Curriculum Connection
C2.2, C2.8

Use the classification of matter flowchart to classify 7 common substances used in your home. Explain how you know which classification it is.

Classify Think of a substance and classify it below.

Substance	Classification	How Do You Know?
Water	Pure Substance - Compound	Cannot be separated physically. Has two elements (oxygen and hydrogen)

PREVIEW

Name: _____ 114

Curriculum Connection
C1.1

Environmental Effects of Pure Substance

Pure Substances – Elements and Compounds

Humans have benefitted from the use of pure substances since the beginning of time. Remember that all elements and compounds are pure substances. Examples of pure substances are iron, diamond, sugar, salt, gold, and aluminum. To get these pure substances, they need t[illegible]mined and then refined.



Mining

Most [illegible]nd in the ground, where they need to be mi[illegible]and e[illegible]th Earth. Mining is either done in open pits or t[illegible]d. Whil[illegible]ubstances are needed to build the things we [illegible]in o[illegible]cess of mining harms our environment.

Mining for gold is oft[illegible]e open[illegible] When it rains, groundwater runs over the ground that has been disturbed b[illegible]digg[illegible]groundwater picks up elements such as mercury, cadmium and lead and c[illegible]t over [illegible]here crops are grown and into lakes and rivers. Plants and marine life absorb these [illegible]hous[illegible]ts and when people eat the fish and plants, they also ingest these poisono[illegible]ment[illegible]

PREVIEW

Refining Pure Substances

Pure substances don't usually occur in their pure form in nature, in order to obtain pure substances, people must refine the raw materials they are found in. **Refining** is a process used with metals to separate the desired material from the impurities surrounding them.



For example, when gold is mined from the earth, it isn't found in its pure form. Instead, it is mixed with other elements, usually zinc, copper, silver, and iron. To refine the gold, it is often put into a mixture of hydrochloric acid and nitric acid. The result is the other elements separate from the gold so they can be removed, leaving 99.999% pure gold.

The refining process uses acids that are bad for the environment. When an acid has been used, it becomes waste. The acid waste pollutes water, affecting our drinking water and the habitats for marine animals. Producing gold for one wedding ring generates 20 tons of waste.

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Curriculum Connection
C1.1

Questions

Answer the questions below using evidence from the text.

1) What two processes need to happen to get pure substances from the Earth and to make them usable for humans?

2) What do[illegible]ing mean? Why is gold refining bad for the environment?

PREVIEW

Making Connections

[illegible]s the[illegible]remind you of in your life?

True or False

Is the statement true or false?

1) Gold refining uses acids that pollute our water.	True	False
2) Open pit mining only affects the habitats on land.	True	False
3) When it rains over an open pit, the groundwater gets polluted.	True	False
4) Getting pure substances from the Earth isn't harmful to the environment.	True	False
5) Gold is found in its pure form underground.	True	False

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Curriculum Connection
C1.1

Research Assignment – Uranium

Uranium is a pure substance that is radioactive. Learn more about the benefits and drawbacks to using uranium by answering the questions below.



Questions Answer the questions below.

1) What is uranium used for?

2) Where is uranium found? How is it extracted from the Earth?

3) Why is uranium harmful to humans?

4) What are the benefits of using uranium?

PREVIEW

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Curriculum Connection
C1.1

Questions Answer the questions below.



5) How do people dispose of uranium? Why is this a problem?

6) How l… …ium stay radioactive? Why is this a problem?

7) Do nuclear power stations create air …ion? Ex…

8) Do you think humans should continue to use uranium? Explain why or why not.

PREVIEW

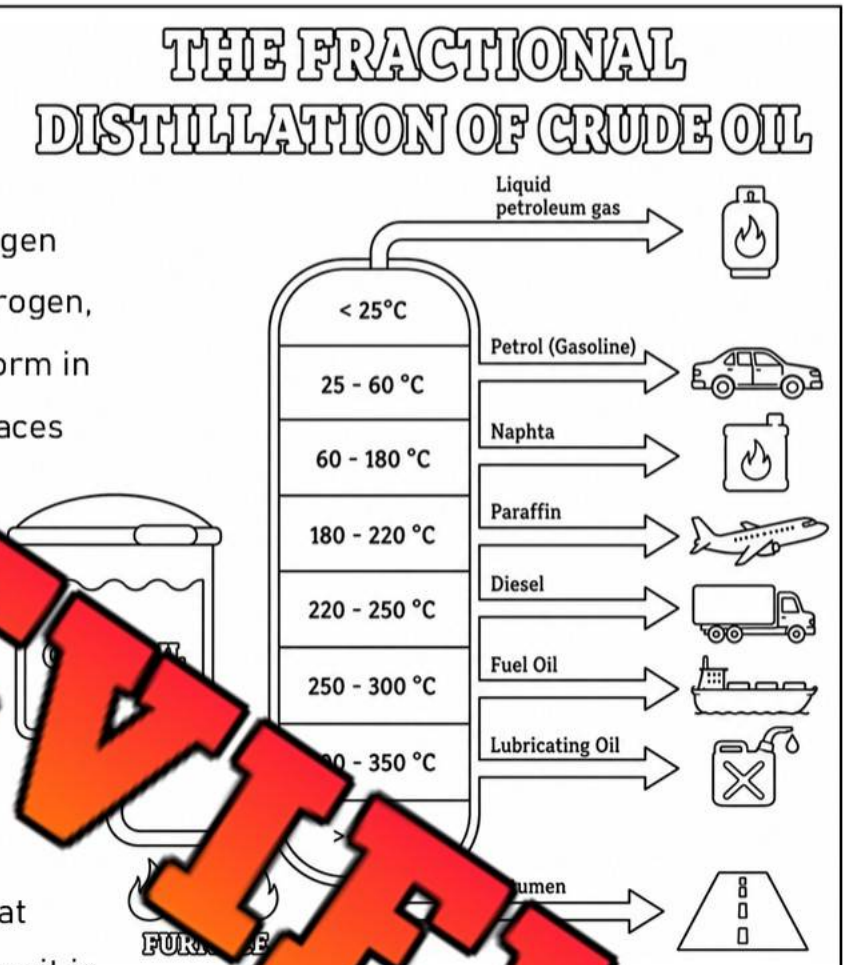
Name: _____ 118

Curriculum Connection
C1.2

Refining Oil

Crude Oil

When oil is found in its natural form underground, it is called **crude oil**. Crude oil is a mixture of mainly hydrogen and carbo[illegible] small amounts of nitrogen, sulfur, an[illegible]lt exists in liquid form in unde[illegible]rv[illegible]the tiny spaces within s[illegible]mentar[illegible] Canada, crude [illegible]f[illegible] most in Alberta, where 42[illegible]rilli[illegible] are pumping out crude oil[illegible]h ground.



PREVIEW

Refining Crude Oil

Crude oil is a dark and sticky liquid that cannot be used without refining it. Once it is refined, it is used to make bitumen for roads, lubricating oil[illegible] engi[illegible] diesel, propane, and fuels for different machines (airplanes, ships, [illegible]

Fractional Distillation of Crude Oil

To refine crude oil, a process known as fractional distillation is used. First, a furnace is used to boil the liquid crude oil. The vapours from the boiling crude oil rise into the next chamber, where they are heated at a different temperature. The only thing remaining is the parts of the crude oil that do not vapourize at that temperature.

As you can see from the graphic, liquid gas (propane) continues to vapourize as it is heated at lower and lower temperatures. Using the fractional distillation method allows crude oil to be used in many useful ways so nothing is wasted.

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Curriculum Connection
C1.2

Questions
Answer the questions below using evidence from the text.

1) What is crude oil? Where is it found?

2) Why do[illegible]de oil need to be refined? How is it refined?

PREVIEW

Summarize
How do[illegible]llation refining process work?

True or False
Is the statement true or false?

1) Crude oil is very useful in its natural state.	True	False
2) Crude oil is found in solid form underground.	True	False
3) Crude oil is found in liquid form between sedimentary rocks.	True	False
4) When you heat crude oil, it boils and vapours rise.	True	False
5) The fractional distillation method wastes a lot of crude oil.	True	False

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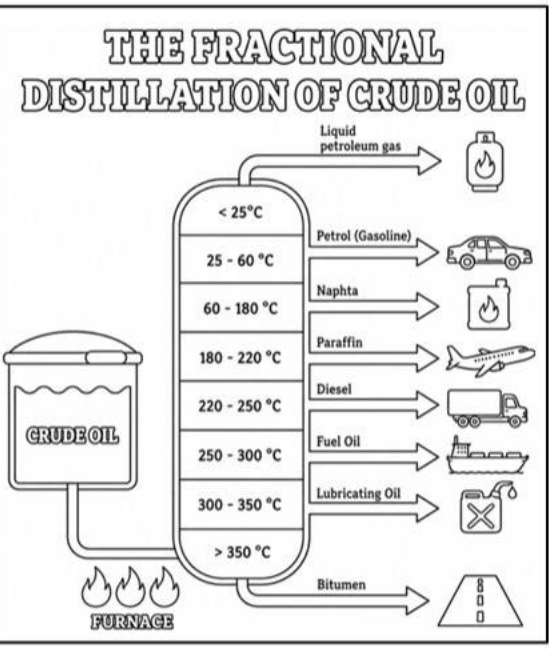
Curriculum Connection
A2.1, A2.2

Coding – Oil Refinery

A computer is programmed at an oil refinery in Alberta. The refinery heats up crude oil to 400° C. The computer uses temperature sensors on a feedback loop to keep the temperature at 400° C.



Example of feedback loop for a self driving vehicle

Run inf loop
if s el w 100
speed u 00
if speed i 0
then slow peed

PREVIEW

Coding Write your own f k lo o il refinery computer to keep the temperature at 400 .

IF/THEN Write the if/then statements for the code below, showing what will be made from the crude oil at the temperatures below.

If the temperature is between 250 – 300 ° C
THEN

If the temperature is between 220 – 250 ° C
THEN

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Curriculum Connection
A1.1, A1.2

Researching Oil Refineries



We have become reliant on the use of oil in our everyday lives, but the extraction and refining of oil is bad for the environment. Research below the effects that refining oil has on the environment.

Research Answer the questions below to learn more about the effects of oil refineries.

1) Why do [illegible] oil refineries?

2) Do oil refineries pro[illegible]ution? [illegible]in the air pollution they create.

3) Do oil refineries produce water pollution? Explain the water pollution t[illegible] create.

PREVIEW

Name: _____ 122

Curriculum Connection
A1.1, A1.2

Research Answer the questions below to learn more about the effects of oil refineries.



4) How do oil refineries affect humans that live nearby?

5) Oil spills can h… re…ery process. What is an oil spill and how do oil spills hurt the envir…nt

6) How do you feel about oil refineries now that you have learned m… a…n. Should we continue using oil in our new technologies? Explain your opini…

PREVIEW

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Curriculum Connection
C1.2

Impact of Separating Mixtures – Maple Syrup

Impact of Separating Mixtures - Maple Syrup



To make maple syrup, sap from a maple tree needs to be collected. The sap is a mixture of sugar, water, and minerals. Almost all (98%) of tree sap is water, and the remaining 2 percent is almost all sugar. To make maple syrup, the sugar needs to be separated from the water.

Harvesting Sap

Maple syrup is made by boiling the sap from maple trees to evaporate the water content and leave the sweet syrup behind. To make one litre of maple syrup, you will need dozens of litres of sap.

The sap is a very dilute concentration of sugar to water, with 98% being water. Therefore, the ratio of sugar to water is only 2 parts in 100, or 2%. To make maple syrup, the sap is heated up and boiled so that the water evaporates. As the water evaporates, the concentration of the mixture becomes less diluted with water and more concentrated with sugar. In fact, when the maple syrup is finished, you should have a mixture that is 66% sugar and 34% water.



The separation process is traditionally done in small sugar shacks that use wood burning stoves to heat the maple sap. The fuel used to create the heat needed to evaporate the mixture is usually wood.

When wood is burned, the fire produces carbon dioxide emissions that are bad for the environment. Carbon dioxide is a greenhouse gas that is thickening the blanket in our atmosphere. The thickening blanket is trapping extra heat that should be reflected back into space. The extra heat is causing global warming and climate change.

PREVIEW

Name: _____ 124

Curriculum Connection
C1.2

Questions

Answer the questions below using evidence from the text.

1) What is maple syrup? What is it made of?

2) What is [illegible]rocess of making maple syrup? Is it good for the environment? Explain.

3) In sap, what is the so[illegible]ain so[illegible]

Solvent	Solute

4) During the evaporation separation process, is [illegible]ater c[illegible]r is only the solute needed?

PREVIEW

True or False

Is the statement true or false?

1) Sap is made of mostly sugar.	True	False
2) Maple syrup has a higher concentration of sugar than sap.	True	False
3) Sap is a mixture of sugar, water, and minerals.	True	False
4) Sap is a pure solution.	True	False
5) Maple syrup is a solution.	True	False

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Name: _____ 126

Curriculum Connection
A1.1, A2.2, A3.1, A3.2, A3.3

Chemistry and Automation

What is Automation?

Automation is the use of robotics and programming to develop technologies that can take over for humans. Automation is becoming more and more important in the manufacturing industry as machines are interacting with each other to complete boring, unsafe work that humans use to have to do.



Automation in Chemistry

Chemistry is the study of substances and their interactions with each other. The field of chemistry is important as chemists make medicines, powerful cleaning solutions, and even plastics. Chemists mix substances and make solutions that help us in our day-to-day lives.

When we look around us, robots are now doing many of the jobs humans use to do. At the grocery store, machines now sell food to customers.

In chemistry labs, it is no different. Robots are making jobs more efficient, more productive, and more creative. This is because robots can perform simple tasks that humans use to have to do. For example, when dissolving a substance, the temperature of the solvent has a big impact on the dissolving process. Robots with temperature sensors allow the temperature of a solvent to be measured instantly so that it can be changed if the dissolving rate is not what the scientist wants to be.

Laboratory Automation Safety

Artificial intelligence (AI) is being used in chemistry laboratories to make them safer for humans. The AI has pre-set limits that are constantly monitored so that if a human is getting close to one of these limits, an alarm is sounded or the machine is shut-down. The accidents by user-error are reduced as robotics won't make mistakes because they didn't get enough sleep last night!

Automation – More Productivity

Mixing substances and changing temperatures is something all chemists do. It is a tedious task as every combination needs to be remembered and noted. In addition, the order of when the substances were mixed also needs to be recorded.

Good news though, AI is now performing these tasks more efficiently, leading to more productivity. It is estimated that using AI can cut down chemistry processes from days and weeks to mere hours.

PREVIEW

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Name: _____ 127

Curriculum Connection
A1.1, A2.1, A2.2, A3.1, A3.2, A3.3

Questions

Answer the questions below using evidence from the text.

1) What is automation? How is it taking the jobs of humans?

2) How is [illegible]on and AI helping chemists?

PREVIEW

Coding

Use if/else codes to perf[illegible] jobs

Make a saltwa[illegible]tion	
if water is not [ ]	E[illegible]
then add a tablespoon of [ ]	[illegible]op a[illegible]

Make a supersaturated saltwater solution	
if water is not [ ]	Else
then turn up [ ] and add [ ]	stop adding [ ] and [ ]

Make an unsaturated saltwater solution	
if solution is [saturated]	Else
then add 1 tablespoon of [ ]	[ ]

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Curriculum Connection
A1.1, A2.1, A2.2, A3.1, A3.2, A3.3

Exit Cards

Cut Out Cut out the exit cards below and have students complete them at the end of class.

Name: _____ Mark

List ways automation helps in chemistry labs.

- _____
- _____
- _____
- _____
- _____
- _____

Name: _____ Mark

List ways automation helps in chemistry labs.

- _____
- _____
- _____
- _____
- _____
- _____

Name: _____ Mark

List ways automation helps in chemistry labs.

- _____
- _____
- _____
- _____
- _____
- _____

Name: _____ Mark

List ways automation helps in chemistry labs.

- _____
- _____
- _____
- _____
- _____
- _____

PREVIEW

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Name: _____ 129

Curriculum Connection
A2.1, A2.2, A3.1, A3.2, A3.3

STEM – Making Cough Medicine

You own a company that makes cough medicine. You're tired of paying chemists to mix the substances, so you're developing a cough medicine making machine.

Your all natural medicine only has three ingredients – lemon, honey, and ginger. The ingredients are mixed to the following ratio

1:2:1
(lemon to honey to ginger)



When the [illegible]er adds too much lemon or honey, it needs to add more ginger. L[illegible] know how to write code to balance the mixture.

PREVIEW

IF/TH[illegible] for your invention.

If there is 2 par[illegible]n to 4 [illegible]ey to 1 part ginger

THEN

If there are 5 parts lemon to 5 parts [illegible]o 5 p[illegible]nger

THEN

If there are 3 parts lemon to 12 parts honey to 6 p[illegible]nger

THEN

If there are 4 parts lemon to 2 parts honey to 2 parts ginger

THEN

If there are 8 parts lemon to 16 parts honey to 1 part ginger

THEN

If there are 6 parts lemon to 10 parts honey to 5 parts ginger

THEN

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Name: _____ 130

Curriculum Connection
A2.2, A3.1, A3.2, A3.3

Draw the machine that makes the medicine. Make sure you have a place for the ingredients to be added. It should also have a screen that displays the progress of the medicine.



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Curriculum Connection
A2.1, A2.2, A3.1, A3.2

Questions Answer the questions about your machine below.

1) How does your medicine making machine work?

2) How does your machine code? Write an example line of code for the machine to process.

3) How much does it cost to make the medicine you

4) How much will you sell your medicine for?

5) If the machine cost $10,000 to make, how many bottles of medicine will you need to sell to earn back the $10,000?

6) How many bottles will you need to sell to earn $1 million?

PREVIEW

Name: _____ 132

Activities – Pure Substance and Mixtures

Word Search

Find the word bank words in the puzzle!



S	H	Z	I	Q	V	D	E	C	W	A	V	N	Z	G	W	T	S	W	D
O	W	C	F	U	U	I	U	Q	Y	J	W	C	K	G	B	L	F	A	D
M	E	O	V	N	X	S	N	O	E	N	A	G	T	D	U	T	X	E	O
T	Q	N	[illegible]	Y	T	B	K	W	V	T	N	P	A	S	V	T	C	C	
D	M	C	[illegible]	I	S	M	G	X	E	Z	K	S	E	W	H	Y	R		
X	F	[illegible]			N	M	V	R	S	T	C	P	N	M	K	S			
D	B	S	U	F	[illegible]	M	P	M	O	L	G	A	Z	D	N	F			
W	B	T	O	R	[illegible]	E	L	A	T	R	G	N	W	Q					
F	M	R	L	A	[illegible]	U	S	E	A	E	N	S	D						
I	E	A	U	T	I	[illegible]	I	M	T	L	O	E	Q						
L	T	T	T	E	T	O	[illegible]	I	C	I	R	C							
T	U	I	E	D	A	N	T	[illegible]	I	T	U	T							
R	L	O	L	N	R	X	X	F	G	[illegible]	T	Y							
A	I	N	S	S	U	B	S	T	A	N	[illegible]	T							
T	D	I	N	B	T	A	P	I	M	X	A	S	O	[illegible]	O				
I	C	A	E	U	A	R	D	N	S	T	L	T	L	[illegible]					
O	P	E	R	Z	S	W	I	G	K	G	Q	Q	I	R	[illegible]	O			
N	X	I	U	W	K	V	H	T	C	O	A	P	D	E	E	T	[illegible]		
V	W	I	P	S	N	O	K	Z	W	X	R	P	Q	F	N	G	E	[illegible]	Y
R	M	H	Z	C	T	M	M	L	S	R	I	A	R	R	T	R	W	B	F

Word Bank

- ❑ Distillation
- ❑ Separating
- ❑ Pure
- ❑ Substances
- ❑ Mixtures
- ❑ Salt
- ❑ Water
- ❑ Particle
- ❑ Theory
- ❑ Temperature
- ❑ Solution
- ❑ Solute
- ❑ Solvent
- ❑ Mechanical
- ❑ Evaporation
- ❑ Filtration
- ❑ Magnetism
- ❑ Sifting
- ❑ [illegible]ilute
- ❑ [illegible]oncentration
- ❑ [illegible]
- ❑ [illegible]ed
- ❑ [illegible]

PREVIEW

Word Scramble

Unscramble the word bank words from above.

ASTL		EPUR	
LITITIOSANDL		NGRESAITAP	
AHCLCEAMIN		TWRAE	
SCABTSENSU		TAMGNESMI	
TUSOLE		RITUESMX	

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Name: _____ Date: _____

Unit Test – Pure Substance and Mixtures

Multiple Choice /10

1) When we combine two substances, we always form a... a) Mixture b) Solution c) Solute d) Solvent	2) When we put sugar in our coffee, we are adding a _____ to a _____. a) Solute to a solution b) Solvent to a solution c) Solute to a solvent d) Solvent to a solute
3) The ... the _____ Solvent b) Solute c) Solution d) Mixture	4) As particles heat up, they begin to move... a) Slower b) Faster c) Sideways d) Up and down
5) When we boil a solution to s... th... solute from the solvent, we are using... a) Sifting b) Paper Chromatography c) Magnetism d) Evaporation	...lt mixes into water, it is... a) Co... rati... b) ...ed c) Ac... c... d) Dissolvi...
7) In hot chocolate, the powder is the... a) Solute b) Solution c) Solvent d) Concentration	8) Water is an ex...mpl... a) A single atom b) An element c) A compound d) A common solute
9) A solution with a lot of sugar compared to water has a _____ concentration. a) Strong b) Weak c) None of the above d) All of the above	10) To refine oil, which separation method is used? a) Sifting b) Filtration c) Distillation d) Magnetism

PREVIEW

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Definitions – What does the term mean (1 mark each) /3

Term	Definition (what does it mean)
Mixture	
Dissolve	
Pure Substance	

PREVIEW

Short Answer Questions (2 m ch)

1) What is the particle theory?

2) What substances will dissolve in water and what substances won't

3) What is the difference between a saturated solution and an unsaturated solution?

Long Answer (5 marks each) **/10**

1) How does mining oil and refining it affect the environment? What separation process is used to refine the oil? Why is it bad for the environment?

2) Choose a solution and explain its properties related to these terms: solute, solvent, concentration, how to dilute it, and how you could separate the parts of the solution.

PREVIEW

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