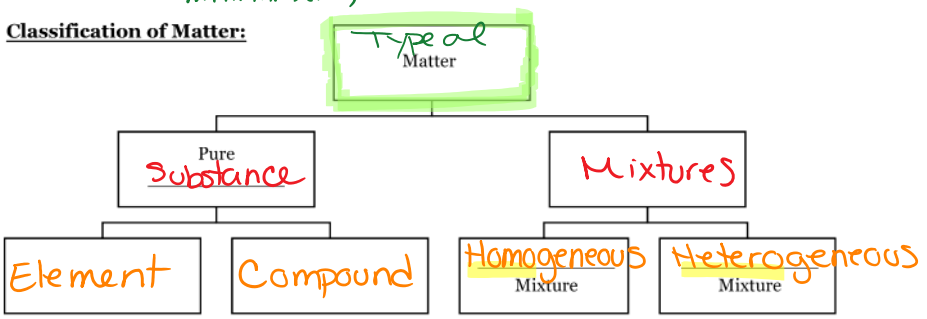
Classification of Matter

PART B: WHAT IS MATTER, AND HOW DO WE CLASSIFY IT?

- **Matter** is anything that has mass and volume.
  - Mass is the amount of matter in a substance or object (measured in grams (g) kiliograms (kg))
  - Volume is the amount of space a substance or an object occupies "takes up" (measured in Litres (L) or cubic metres (cm^3)) millilitres (mL)

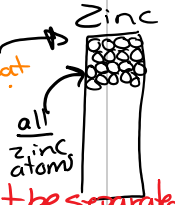
Classification of Matter:



Pure Substance: A type of matter that contains only ONE type of particle. This particle can be an atom or a molecule (2+ atoms eg. H_2O).

"Particles"

- **Element**: A type of matter that contains only one type of ATOM ← smallest thing that can exist.
  - *Examples*: zinc, oxygen, sulfur, calcium



- **Compound**: A type of matter that contains 2 or more atoms. These elements are in definite ratio/amounts (chemically bonded together).
  - *Examples*: water (H_2O); tablesalt ($NaCl$) ← can't be separated physically

Mixture: A type of matter that contains 2 or more pure substances. These substances are NOT chemically bonded together. ⇒ can easily be separated

- Homogeneous **Mixture:** Is a mixture that is evenly and microscopically mixed together. The particles in this type of mixture are physically separate from each other but they are visibly indistinguishable. → hard to tell apart without microscope
  - When in Fluid form (liquid or gas) we call these mixtures solution eg. Orange Juice
  - When in solid form, like certain metals, we call these mixtures alloys
  - *Examples*: salt water ($NaCl + H_2O$); brass (copper + zinc)
- Heterogeneous **Mixture**: Is a mixture that is not uniform (same) in its composition. In fact, parts of the mixture can be visibly distinguished from other parts. ⇒ Looks clearly different
  - *Examples*: trail mix; sand; salad dressing

chemical formula : atoms bonded together

chem. formula

matter
- pure sub.
  - element (1 type of atom) — N_2 (Nitrogen, 1 type of atom)
  - comp. (2+ types of atoms) — CO_2 (carbon, oxygen; 2 types of atoms)
- mixture
  - homog. ("look same")
  - heterog. ("look different")

PRACTICE PRACTICE CLASSIFYING MATTER!

Matter	Pure Substance	Element	Compound	Mixture	Homogeneous Mixture	Heterogeneous Mixture
H_2O water	yes	no	yes	no	no	no
carbon dioxide CO_2	✓	✗	✓	✗	✗	✗
nitrogen gas N_2	✓	✓	✗	✗	✗	✗
glucose $C_6H_{12}O_6$	✓	✗	✓	✗	✗	✗
sugar water	✗	✗	✗	✓	✓	✗
salt water	✗	✗	✗	✓	✓	✗
orange juice	✗	✗	✗	✓	✓ (no pulp)	✓ (pulp)
mercury	✓	✓	✗	✗	✗	✗
air	✗	✗	✗	✓	✓	✗
gold	✓	✓	✗	✗	✗	✗
ocean water	✗	✗	✗	✓	✓ (salt water)	✓ (seaweed, organisms, etc.)

$C_6H_{12}O_6 + H_2O$

$NaCl + H_2O$

Hg

H_2, CO_2, O_2, N_2

Au

salt water

6

Assignment

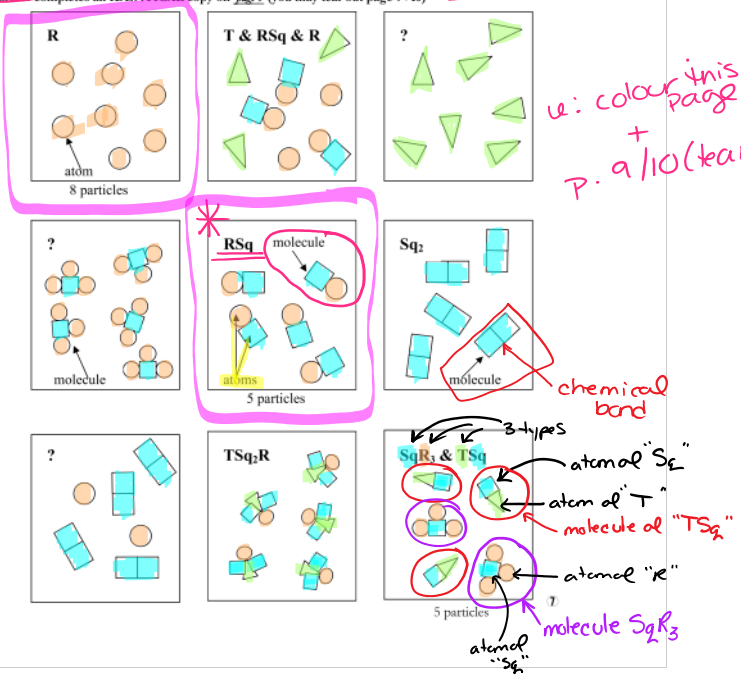
In Class Partner Activity: Classification of Matter

How do atoms combine to make different types of matter?

Why?

Look at the things in this room. They are all matter. That matter may be pure or it may be a mixture. Can you tell by looking at it? What if you looked at it under a microscope? Then could you tell? Something that looks pure may not really be pure. It depends on what type of particles that thing is made of. In this activity we will explore how the smallest chemical units of matter determine whether something is classified as an element, a compound, or a mixture.

Model 1: *Step 1: begin by coloring each different kind of particle (R, Sq and T) a different color in every box of Model 1.* (eg. all circles are orange, all squares are blue, etc) 1 Person can do this page, while your partner completes an IDENTICAL copy on page 9 (you may tear out page 9+10)



u: colour this page + p. a/10 (tear out)

chemical bond

3 types
atom of "Sq"
atom of "T"
molecule of "TSq2"
atom of "R"
molecule Sq2R3
atom of "Sq"

In Class Assignment: Classification of Matter

Name(s): Key Date:

How do atoms combine to make different types of matter?

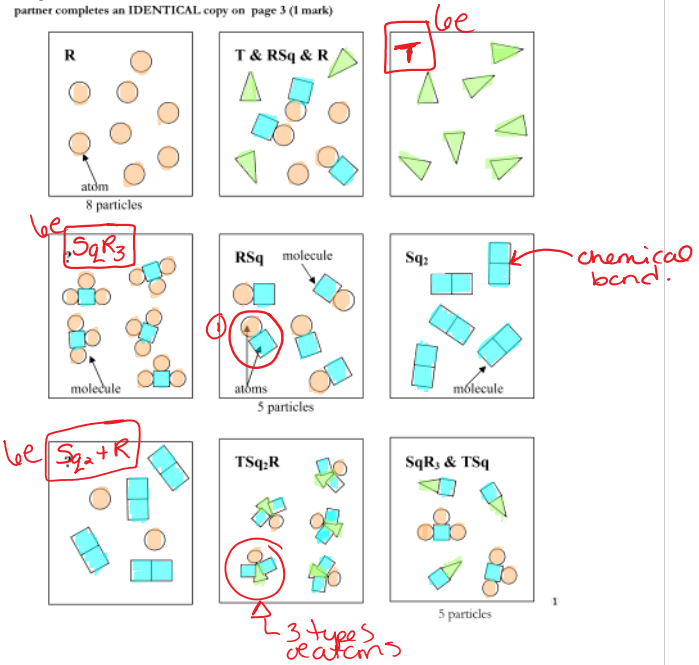
Score: ____ + ____ / 40 / 9 (bonus)

Why?

Look at the things in this room. They are all matter. That matter may be pure or it may be a mixture. Can you tell by looking at it? What if you looked at it under a microscope? Then could you tell? Something that looks pure may not really be pure. It depends on what type of particles that thing is made of. In this activity we will explore how the smallest chemical units of matter determine whether something is classified as an element, a compound, or a mixture.

Model 1:

Step 1: begin by coloring each different kind of particle (R, Sq and T) a different color in every box of Model 1. **(eg. all circles are orange, all squares are blue, etc) 1 Person can do this page, while your partner completes an IDENTICAL copy on page 3 (1 mark)**



1

Procedure & Questions:

1. **Circle a molecule of RSq** in Model 1. How many atoms are in a molecule of RSq? (1 mark)
   2 atoms (1 circle + 1 sq)
2. **Circle a molecule of TSq_2R** in Model 1.
   a) How many different types of atoms are found in a molecule of TSq_2R? (1 mark)
   3 different types of atoms
   b) How many Sq atoms are in a molecule of TSq_2R? (1 mark)
   2
3. Locate the drawing labeled SqR_3 & TSq in Model 1
   a) How many different types of **atoms** are found in a sample of SqR_3 & TSq? (1 mark)
   3 types of atoms (Sq, R, T)
   b) How many different types of **molecules** are found in a sample of SqR_3 & TSq? (1 mark)
   2 molecules (Sq_2R_3 + TSq)
4. a) What does it mean when two atoms are touching in the drawings of Model 1? (1 mark)
   chemical bond (compound - ½)
   b) What does it mean when two atoms or molecules are **not** touching in the drawings of Model 1? (1 mark) NOT chemically bonded.
5. With your partner, discuss the following questions & record your answers:
   a) Can a *particle* of matter be a single atom? (1 mark)
   Yes
   b) Can a *particle* of matter be a molecule? (1 mark)
   Yes
   c) How many particles are in the drawing representing T & RSq & R in Model 1? (1 mark)
   8 particles (total)
   d) What is your groups definition of the word "particle" as we use it in chemistry? (1 mark)
   a single atom, or group of atoms bonded together
6. Compare the codes listed at the top of each drawing in Model 1 with the shapes in that box.
   a) What do the letters R, Sq and T in the codes represent? (1 mark)
   R = circle Sq = square T = triangle
   b) What do the small numbers (subscripts) in the codes represent? (1 mark)
   The number of atoms in that molecule/compound
   c) When atoms are touching, how is that communicated in the code? (1 mark)
   written as one-word (no + or space in code)
   d) When atoms or molecules are not touching, how is that communicated in the code? (1 mark)
   written as 2+ words/codes with "+" sign.
   e) In Model 1 there are three drawings that are labeled "?".
   Write codes to properly label these drawings **on model 1 on the front page.**. (1 mark)
   T ; Sq_2R_3 ; Sq_2 + R

2

7. Remove page 3-4 (second copy of Model 1) from your booklet and cut apart Model 1 to separate the nine drawings. As a team, sort the pictures into those where all the particles in the drawing are identical, and those that have more than one type of particle in the drawing.

Read This!

Matter is classified as a **pure substance** when all of the particles are the identical. Matter is classified as a **mixture** if there are different particles present.

8. Identify which set of drawings from #7 are pure substances and which set are mixtures. List the codes for each set here. (9 marks)

Pure Substances		Mixtures
R	RSq	T + RSq + R
T	Sq_2	R + Sq_2
Sq_2R_3	TSq_2R	Sq_2R_3 + TSq_2

9. How are the codes (chemical formulas) for pure substances different from those for mixtures? (1 mark)
   The codes for mixtures all contain "+"; more than one code/word

10. As a team, take the set of pure substances drawings from #8 and sort them into those containing only one type of atom and those with two or more types of atoms.

Read This!

Elements are defined as substances made from only one type of atom. **Compounds** are defined as substances made from two or more types of atoms.

11. Identify which set of drawings from #10 are elements and which set are compounds. (6 marks) List the codes for each set here:

Elements	Compounds
R	Sq_2R_3
T	RSq
Sq_2	TSq_2R

12. How are the codes (chemical formulas) for elements different from those for compounds? (1 mark)
    The codes for elements contain only 1 type of atom.

13. Use what you have just learned about chemical formulas to identify the following as element, compound or mixture. (6 marks)
    a. Br_2 element b. $NaHCO_3$ compound c. $C_6H_{12}O_6$ & H_2O mixture
    d. Cu & Zn mixture e. CO_2 compound f. Al element

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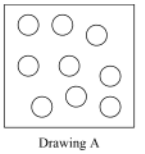
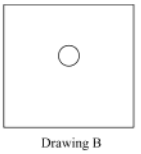
Extension (BONUS) Questions (+ 9 marks)

14. Often times it is useful to separate matter. For example, you strain cooked pasta to get the liquid out. In a fuel cell, water is separated into hydrogen and oxygen.
    a) Which type of matter can be separated by physical methods (no bonds need to break) such as filtering or distillation? (2 marks)
    only mixtures
    b) Which type of matter needs to be separated by chemical methods (breaking of bonds required) such as electrolysis or decomposition?(2 marks)
    only compounds

15. Students in a chemistry course were asked the following question on a unit exam:
    "Draw a diagram representing an element using circles as atoms."
    a) The following diagrams represent the two types of answers given by students. Which drawing is the best representation of an element? Explain. (2 marks)


Drawing A


Drawing B

Drawing A is better b/c "element" refers to a collection of atoms of the same type.

b) If Drawing B was a sample from the substances in Model 1, which substance(s) could be represented? Is a single atom a good representation of any of them? (3 marks)

R or T + RSq + R or R + Sq_2 could be the element "R"

no, a single atom is still not a good representation of an element.

6

"characteristics"; how we describe something

PROPERTIES OF MATTER

Physical properties - characteristics we can observe, without changing the object/substance

Chemical Properties - ability of matter to react with another substance to form something NEW. (chemical reaction)

Physical Properties	Chemical Properties
• colour • texture • state (solid / liquid / gas) • hardness (or soft) • Boiling Point + Melting Point • solubility (does it dissolve?) • viscosity (thick / thin liquids) • malleability (change shape: bend/flex) • conductivity (transfer heat/electricity)	• flammable • oxidize (react with oxygen ⇒ rust) • reactivity (how does it behave with oxygen? acids?) • combustability

- shiny / dull
- transparent (clear)
- opaque

chemical reactions form NEW substance

Activity: Visit the stations at the lab benches and classify the type of matter you see on display and then identify three physical properties of that matter.

Type of matter

(PS) Pure Substance — Element (E), Compound (C)

Mixture (M) — Homogeneous (Homo), Heterogeneous (Hetero)

Lab Station	Type of Matter	Physical Properties
2 Beach	M - Hetero	solid, multi-coloured, various shapes
3 salt water	M - Homo	liquid, soluble, clear (transparent)
4 zinc	PS - E	bend (malleable) hard(ish) reflective/shiny smooth
5 veg. oil	M - Homo	translucent thick (viscous) liquid
6 sodium bicarb. ($NaCO_3$)	PS - C	solid powder "soft" white
7 copper	PS - E	conductive solid rust coloured shiny
8 glitter glue	M - Hetero	opaque multi-coloured liquid viscous (thick)
9 mercury	PS - E	liquid, silver, malleable

HW

Quiz tomorrow "classifying matter" 10-12 questions

Homework

ASSIGNMENT #2: Understanding Key Ideas: Practice Questions

This assignment is to be completed below in the space provided.

Understanding Key Ideas

1. State whether each of the following is an example of matter. Explain your answer in each case.
   a) a brick
   b) sunlight
   c) the sound of a train
   d) air
   e) the colour red
   f) a text message
2. Classify each of the following as an element, a compound, or a mixture.
   a) ocean water
   b) gold
   c) carbon dioxide
   d) a pencil
3. List at least two physical properties of each of the following pure substances.
   a) oxygen
   b) copper
   c) carbon (diamond)
   d) carbon (coal)
4. Physical and chemical properties define both the uses and hazards associated with materials.
   a) What does the chemical property of combustibility refer to?
   b) List three combustible materials.
   c) List three materials that are not combustible.
   c) List one application in which a combustible material is needed.
   d) List one application in which a material that is not combustible is needed.

Let's Stretch Our Thinking:

Consider the following mixtures. How might they be separated into pure substances?

1. Very tiny sand granules and very tiny sugar crystals
   ADD water - sugar will dissolve - filter out sand - boil off water to leave sugar.
2. Very tiny aluminum filings and very tiny iron filings
   Use a magnet to pull out the iron, aluminum will remain.
3. Very fine saw dust and very tiny sand granules
   ADD water - sawdust will float - scoop off top - filter out sand.
4. Sugar dissolved in water
   Boil to evaporate water away, sugar remains.

14

ANSWERS:

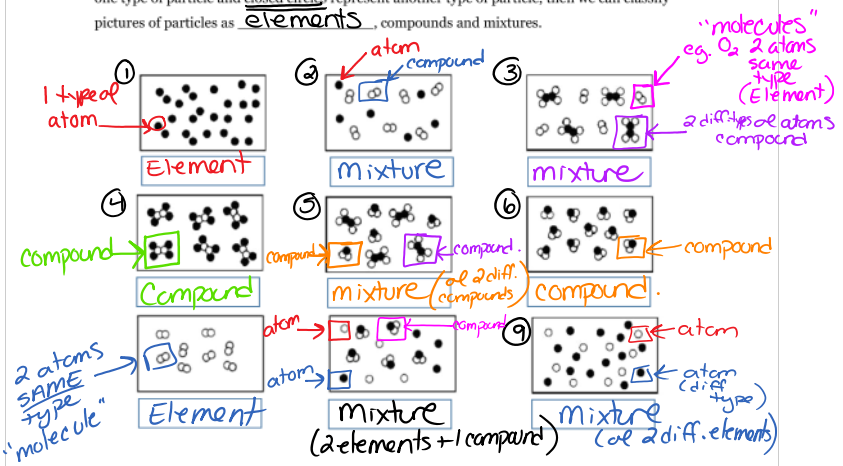
1.
   a. matter (has mass and volume)
   b. energy
   c. sound is also energy
   d. matter (has mass and volume)
   e. red is a concept/idea...can't be measured
   f. text is virtual...can't be measured, no mass or volume
2. E=element C=compound M=mixture
   a. M
   b. E
   c. C
   d. M
3. *answers will vary (examples provided)*
   a. gas, clear
   b. orange, shiny, hard
   c. translucent, shiny, hard
   d. black, brittle, dull
4.
   a. combustibility is a measure of how easily a substance bursts into flame, through fire or combustion.
   b. paper, alcohols, fabric *(answers will vary-anything that can burn)*
   c. igniting a fuel source: in a car engine
   d. a fire blanket is important that it be made out of NON-combustible materials

"particle" < 1 atom (element)
2+ atoms (compound)

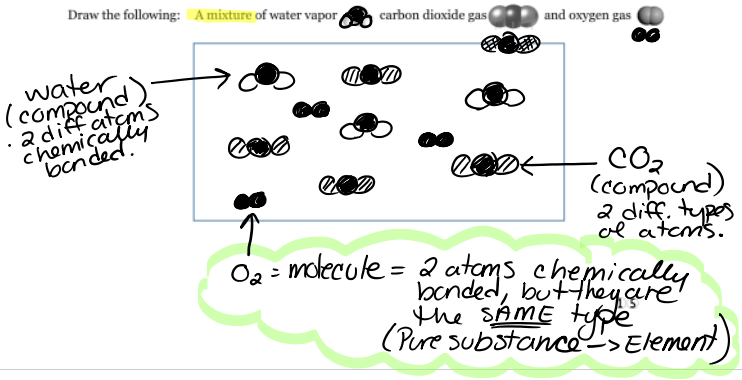
imagine you are looking under a REALLY good microscope!

Now, let's look at "particles" a bit more closely.

If we assume that circles represent particles and that open circles represent one type of particle and closed circles represent another type of particle, then we can classify pictures of particles as elements, compounds and mixtures.



Draw the following: A mixture of water vapor carbon dioxide gas and oxygen gas

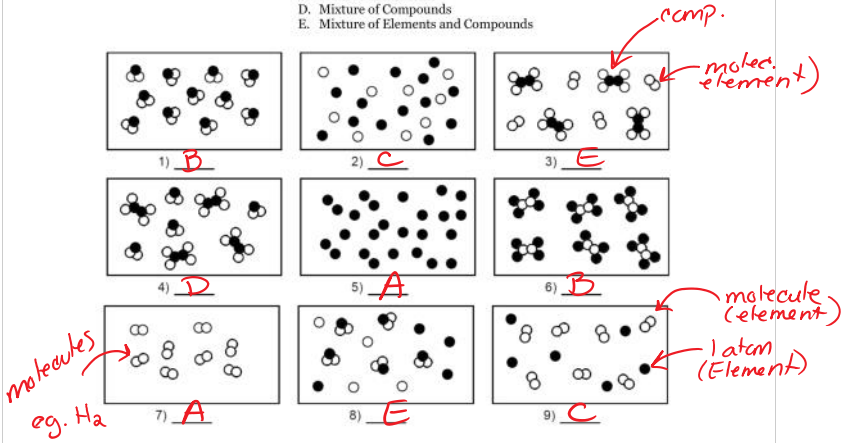


Work on

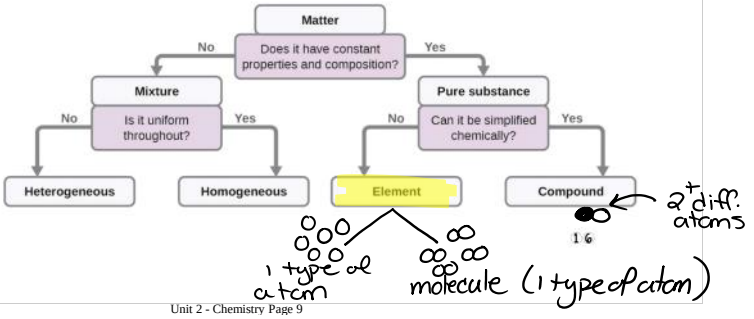
PRACTICE

Now, you try these! Use the following legend:

A. Element
B. Compound
C. Mixture of Elements
D. Mixture of Compounds
E. Mixture of Elements and Compounds



Summary Chart:



ASSIGNMENT #3: Topic Review Questions
This assignment is to be completed below in the space provided.

Topic Review

1. Matter is anything that has both ___mass___ and ___volume___. Matter can be classified as ___pure substances___ or mixtures. Matter that is not a mixture is classified as either elements or ___compounds___. Mixtures in which you can see "particles" are said to be ___heterogeneous___ mixtures.
2. Complete the chart by writing yes or no in each of the boxes:

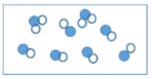
matter	pure substance	element	compound	mixture	homogeneous mixture	heterogeneous mixture
oxygen	✓	✓	X	X	X	X
ice	✓	X	✓	X	X	X
milk	X	X	X	✓	✓	X
chocolate chip cookies	X	X	X	✓	X	✓

3. Classify the following by using the following key.

A. Element
B. Compound
C. Mixture of Elements
D. Mixture of Compounds
E. Mixture of Elements and Compounds


C


E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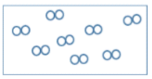
A