Matter Chemistry

What's the matter with you? ☺

Fill in the entire PINK part of this handout, the front, back and inside back cover.		
Formula	Name	Know this…
CO_2	Carbon dioxide	3 total atoms, this is a compound
H_2O	Dihydrogen monoxide	3 total atoms, this is a compound
O_2	Oxygen	2 total atoms. This is a diatomic element, not a compound
$C_6H_{12}O_6$	Glucose	24 total atoms, this is a compound
Fe	Iron	1 atom, this is an element, not a compound
HCl	Hydrogen monochloride	2 atoms, this is a compound
Hg	Mercury	1 atom, this is an element, not a compound
NaCl	Sodium chloride	2 atoms, this is a compound
$CaCl_2$	Calcium chloride	3 atoms, this is a compound
AlF_3	Aluminum fluoride	4 atoms, this is a compound
H_2	Hydrogen	2 total atoms. This is a diatomic element, not a compound
NH_3	Ammonia	3 total atoms, this is a compound

Matter Notes

OB: We will determine what matter is, what are the phases of matter, and describe various physical properties of matter. We'll also cover lots of vocabulary that you MUST MASTER ASAP

1. Matter

2. All matter is in one of these 4 "states" or phases:

   A. _______________ B. _______________ C._______________ D. _________________

3. The word aqueous means:

4. Matter can be PURE or MIXED. Pure matter includes the ______________________________

   (from the ___________________ table) and the millions of __________________________

5. Mixtures are _________________ _____________________ of pure _____________________________.

6. What is a physical property of matter?
   Qualities that can be… __________________________________ and are __________________________

7. Some examples of physical properties include…

8. Physical Changes are also called ______________________________ changes.

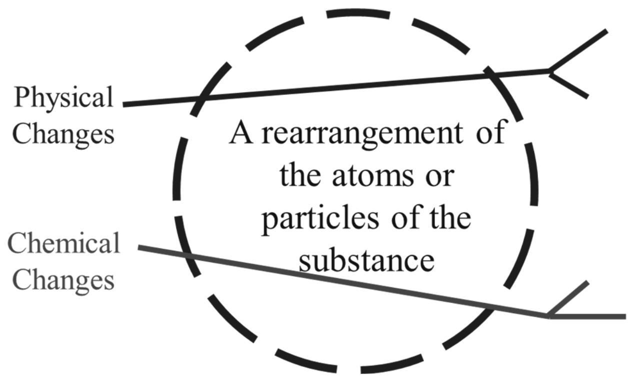
9. When matter changes phases (6 different ways, know all of these) we give them these specific names.

   Solid → liquid is called ______________________ Liquid → solid is called _______________________

   Gas → liquid is called ______________________ Liquid → gas is called _________________________

   Solid → gas is called ______________________ Gas → solid is called _________________________

10. Chemical & Physical Changes in matter (fill in the blanks)



11. Physical changes are just ____.

Chemical changes are ____________________, which make new stuff.

12. What are mixtures? Mixtures are… ____

The properties of matter in a mixture… _______________.   THEY ARE STILL PRESENT.

____ ARE FORMED WHEN MAKING A MIXTURE.

____FORM EITHER.

14. Mixtures are either ____ or are

____together.

15. Mixtures that are mixed the SAME THROUGHOUT are called ______________________________

16. Mixtures that are mixed DIFFERENTLY THROUGHOUT are called ___________________________

Examples of mixtures

17. _______________ and _______________ are ________________________________

18. _______________ and _______________ are ________________________________

19. Salt water is ______________________________ – it's the same throughout.

20. Chocolate milk is ______________________________, because the chocolate will settle to the bottom.

21. Oil and vinegar are ________________________________, they will not mix.

22. Mixtures can come in ALL PHASES. Examples of mixtures— Fill in this chart

Solution phase	Contains this	Mixed into this	examples
	Carbon	Iron	
	Zinc	Copper	
	Ethanol	Fruit juice	
	Acetic acid	Water	
	Oxygen	Nitrogen	
	Table salt	Water	
	Sugar + Food color	Water	

23. Draw this chart (it's the most important diagram of the whole course, please take this seriously.

24. State the Law of Conservation of Matter:

____

25. The sodium + chlorine are called ____________

26. Sodium Chloride is the __________________

27. The mass of the ______________________ EQUALS the mass of the ________________________

because all chemical reactions follows the… ____

28. If you completely react 46 grams of sodium with 70 grams of chlorine gas, how many grams of sodium chloride form?

____

29. If you completely react 8 g hydrogen with 64 g of oxygen, how many grams of water will form?

____

30. If 4 g hydrogen reacts with sufficient oxygen and forms 36 grams water, how many grams of oxygen was used up in this reaction?

____

31. ____ g H_2 + 28 g N_2 → 34 g NH_3

32. 223 g Fe + 96 grams O_2 → _____ g Fe_2O_3 (rust)

33. Rust has this formula: Fe_2O_3

It has ___ atoms of iron bonded to ___ atoms of oxygen for a total of ____ atoms in this compound.

34. Carbon dioxide is CO_2

It has ___ atoms of carbon bonded to ___ atoms of oxygen, for a total of ____ atoms in this compound.

35. How many atoms are in each compounds?

NH_3 (ammonia) 4	H_2O	CO_2	NaCl
$C_{12}H_{22}O_{11}$ (table sugar) 45	H_3PO_4	$C_6H_{12}O_6$	H_2SO_4

36. These are harder, how many atoms of each kind, how many all together in each compound?

SnO_4 H_3PO_4 $KHCO_3$ $Li_2C_2O_4$

$Ca(OH)_2$ $Al(OH)_3$ $Al_2(Cr_2O_7)_3$ $(NH_4)_2SO_3$

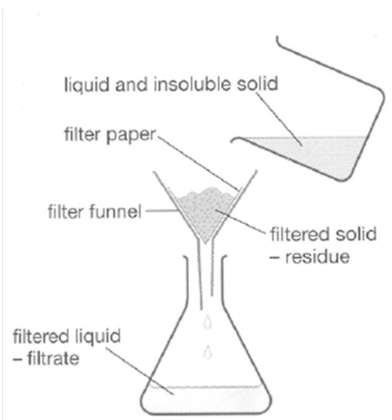
37. Mixtures are just physical blends of pure substances, they could be

__________________ + __________________, or __________________ + __________________, or

__________________ + __________________

38. Compounds are chemically bonded atoms, which make ____.

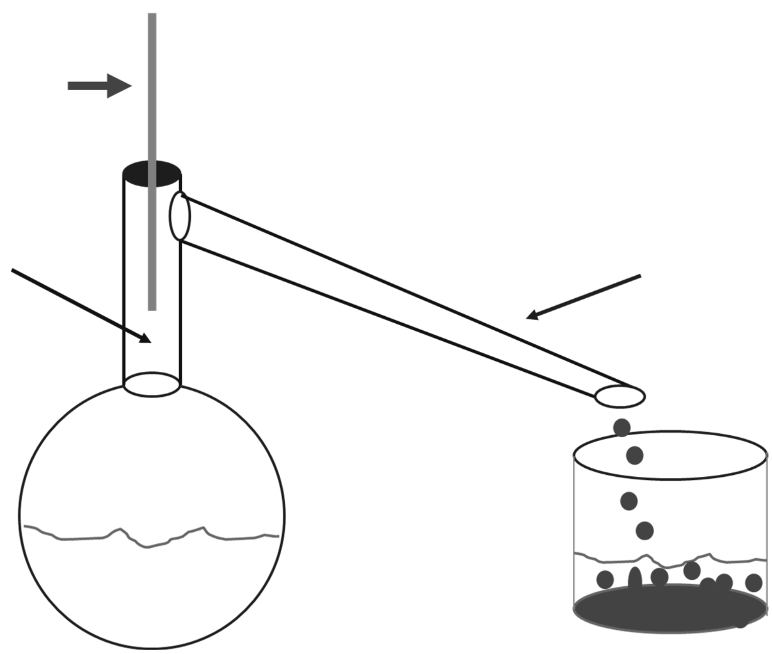
39. Mixtures retain the properties of the parts, ____.



40. The "principle" that allows us to do this is that the sand is much bigger than the water particles, and sand gets stuck in the filter paper. We…

41. If you have an aqueous solution of ethanol and water and need to separate them, you can't filter them, both particles are too small to be caught in a filter paper. You can take advantage of the fact that they have a different boiling point (about 100°C for water, about 81°C for the alcohol).

42. Label the distillation apparatus



43. Here, the iron is separated from sulfur, by

______________________ _________________________
of the magnetic attraction of iron to the magnet, which sulfur does not have.

44. Something that we will do in class is called ____.
It will allow the separate of colors by taking advantage of both solubility of ink in water, and density of particles.

46. You could also separate mixtures by taking advantage of differences in…

A chemical reaction is when 2 or more substances are combined in a chemical reaction, and we get…

____________________________that form, and these have ___________ properties than the reactants had.

47. How will we recognize if a chemical reaction has probably happened? We will use the acronym…

____

48. If these things "happen", a chemical reaction probably happened.

T—

O—

P—

I—

C—

B—

49. A ________________________________ shows the idea of chemical substances in a cartoon sort of way

50. Particle diagrams for a GAS, a LIQUID, and SOLID

Gas	Liquid	Solid

	phase	shape	volume
51	Gases		
52	Liquids		
53	solids		

54. Particles are small shapes. A single shape alone indicates an _____________________

55. When 2 or more shapes touch, this symbolizes a _____________________________.

56. If the 2 shapes that touch are IDENTICAL, that indicates a ____________________ _____________

57. Draw

58. How will you remember the 7 diatomic elements? __________________________________ TWINS

Atoms	Molecules	Diatomic elements

59. A physical change is another way to say

A. a compound forms
B. a phase change happens
C. Matter is turned into other matter
D. You change the shape by squishing or pushing matter

60. Match these up

GAS	Definite shape, Definite volume
LIQUID	Indefinite shape, indefinite volume
SOLID	Indefinite shape, definite volume

61. Define Heterogeneous:

62. Which CAN be decomposed by a chemical change? A. Co B. CO C. Hg D. Fe

63. How can we separate a mixture of salty water?
A. A chemical reaction B. Filter paper C. With a magnet D. With a distillation apparatus

64. Convert the melting point of copper into centigrade degrees.
Use a formula.

65. If 502 grams of iron completely combines with 216 grams of oxygen to form rust, how many grams of rust form?

66. When 2 elements chemically combine the product…
A. has the same properties as the reactants
B. has a blend of properties of the reactants
C. has new, unique properties, unlike the reactants
D. may or may not be similar, it depends on the elements combining

67. Count the number of atoms in these formulas
A. aluminum permanganate $Al(MnO_4)_3$

B. ammonium carbonate $(NH_4)_2CO_3$

C. nickel (III) acetate $Ni(C_2H_3O_2)_3$

68. Name the phase changes

Solid to Gas _______________ Liquid to Gas _______________ Solid to Liquid _______________

Gas to Solid _______________ Liquid to Solid _______________ Gas to Liquid _______________

69. State standard temperature in both Kelvin and in Centigrade. ___________________________________

70. Calculate (with a formula) the volume of 375 grams of sodium metal.

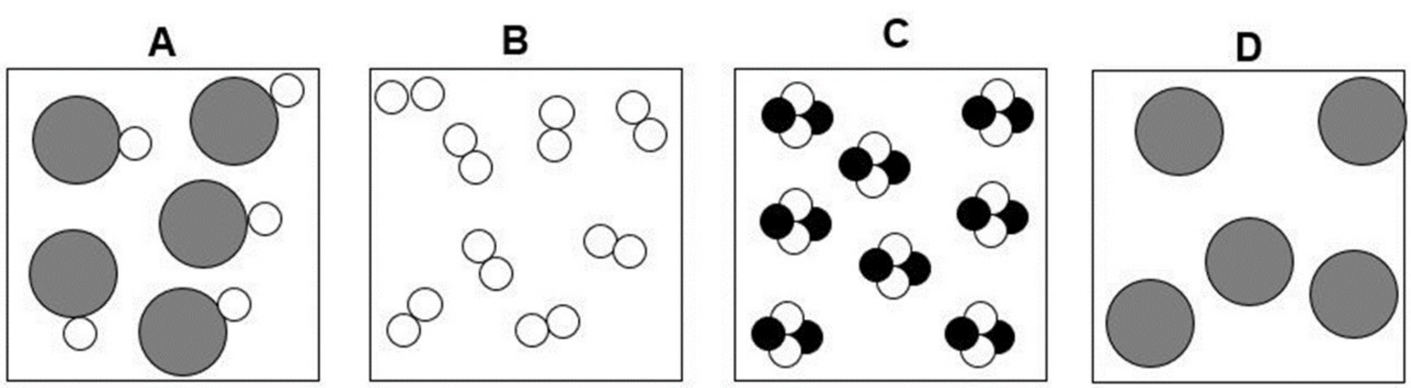
$C_7H_{16(L)} + 11O_{2(G)} \rightarrow 7CO_{2(G)} + 8H_2O_{(G)}$ This is a balanced equation for the combustion of heptane.

71. Which of the four are reactants? ____________________ and ________________________

72. Which are the products? ____________________ and ________________________

73. How many atoms in heptane? __________________

74. Name some ways to separate mixtures, (use the "one liner" that tells us how to do it).



75. Which box or boxed contain

A diatomic element? ______________ A mixture? ____________

A monoatomic element? ______________ A compound? ______________

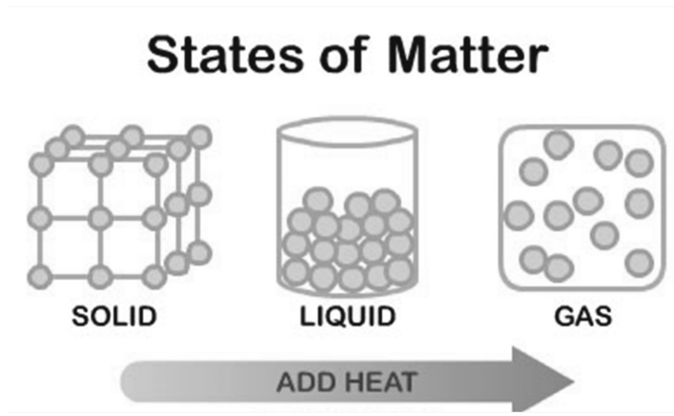
Matter Basics

Chemistry is the study of matter. What it is, what is it made up of and how does matter react with other matter. Matter is the "stuff" that makes up the whole universe. It's the stuff that takes up space and has mass. Matter is measurable, and matter reacts in predictable ways that we will be learning about all year.

The simplest forms of matter are the elements, all are in the Periodic Table. Elements are the unique forms of matter that cannot be broken down into simpler substances by any chemical or physical process. Examples include mercury, iron, carbon, and uranium. The smallest bit of an element is an atom.

We'll learn more about atoms and atomic structure in the next portion of our class, but you may already know that atoms are made up of neutrons, protons, and electrons. If you "split" an atom into those smaller parts you still have matter, but you no longer have an element, just these sub-atomic particles.

Each element on the periodic table has unique properties that can be measured by us in class, or by scientists. Each element reacts in ways that are known, and which can be relied upon. We will learn later in the year how the atoms of certain elements can chemically combine, or bond, with other atoms to form new substances called compounds. The smallest part of every compound is called a molecule (or formula unit in some cases). These new substances have their own measurable properties which are different from the properties of the atoms that bonded into the compound. Compounds can only be broken back down into elements by a chemical reaction, usually requiring energy.



Pure substances are types of matter made up of only one kind of matter. Examples include elements which are each made up of only one kind of atom.
Another example are the compounds. Compounds are made up of a specific ratio of at least 2 different kinds of atoms.
Examples are water (H_2O), or table sugar ($C_{12}H_{22}O_{11}$).

Pure substances are always the same throughout, which is called homogeneous. The properties of the elements are always the same in every sample, and within any one sample. All samples of pure water have the same density (for example), and all of the properties water has are the same for all samples of pure water.

Some of the properties of matter that we'll be measuring, and that you will need to be familiar with are density, boiling point, melting point, solubility, and particle size. A physical property of matter is a quality that can be changed, or measured, without changing the chemical properties of the matter itself.
PURE Matter comes in 3 states, or phases: Solids, liquids and gases

Solid matter has its atoms (or molecules) packed in very close together. These particles are stick in a rigid arrangement that does not change. Because of this the solids are hard, and hold their shape and volume. Solids cannot be compressed practically at all because of the closeness of the particles.

Liquids also have their atoms (or molecules) packed close together, but they are not locked in place, they move, or flow over each other. The closeness of the particles means that liquids have a definite volume.
Liquids do not hold their own shape, they take the shape of any container they are put into.
Liquids cannot be compressed because of how close the particles are to each other.

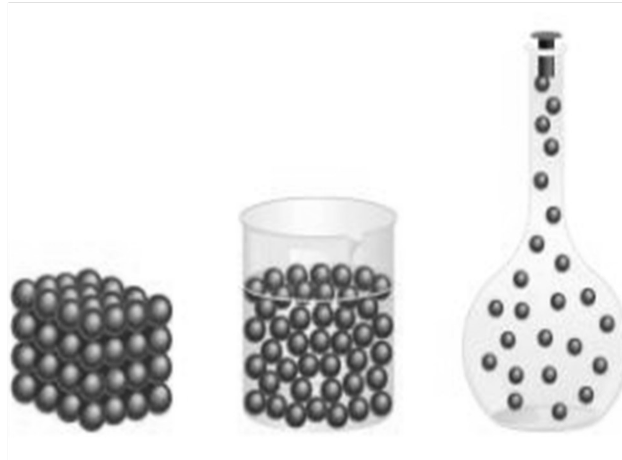
Gases are very different than solids or liquids. Most different is the proximity of their particles. Gas atoms or molecules, are very far apart from each other compared to their size. They move very rapidly in straight lines, bounce around off of each other and the walls of any container that holds them. Gases have no definite shape and will expand to fill any size container they're put into. Gases have no definite volume either, they can be greatly compressed into small containers.

Here is a diagram of a solid, liquid, and a gas.
Each little ball represents a particle.

The atoms of a solid are very close together, and have a definite shape and volume.

The liquid has close packed particles - moving around, but take the shape of the container.

The gas has a lot of space between the particles, and fills any shape or sized container it's put into.

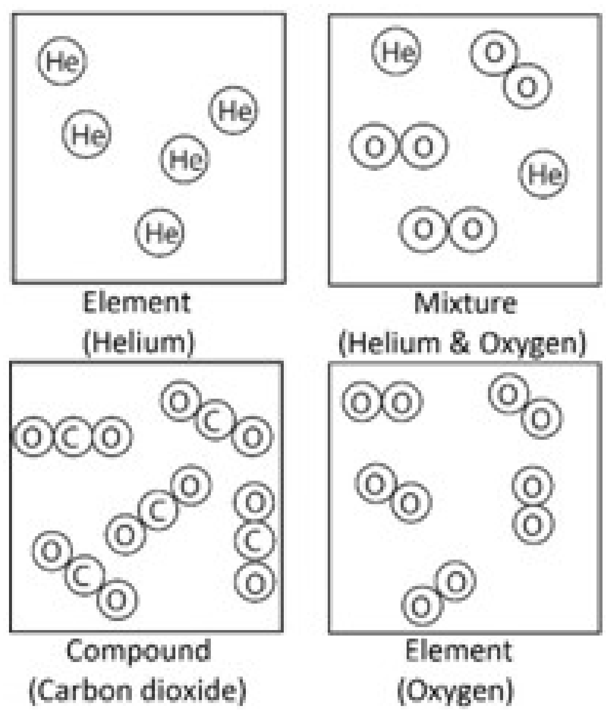


Matter that is dissolved into water has a 4th phase, which is called AQUEOUS. Solids, like salt, that dissolve into water are in the aqueous phase, written as $NaCl_{(AQ)}$ which is salt dissolved into water.

Aqueous solutions are homogenous mixtures of a substance in water (which is another substance). This is not a "pure" substance, it is a mixture. Homogeneous mixtures are mixed the same throughout.

Matter can be chemically combined into compounds, or just mixed together, into mixtures. A mixture is a physical blend of pure substances. Two or more elements can be mixed, two or more compounds can be mixed, or elements and compounds together can be mixed.

Mixtures have no definite ratio (no formulas) of the component parts like compounds have. Because of this mixtures are not always homogeneous. They can also be heterogeneous, or different throughout.



Mixtures are just stirred up, and the pure substances that make them up keep their properties. No new substances are formed, rather there is just a rearrangement of the atoms or particles. Compounds *are* new pure substances, with new properties.

Since these mixtures are just physical blends, they can be separated easily, by physical means (no chemical reactions required).

Our examples at right include the element helium, made up of single atoms.

Oxygen (bottom right) is also an element, but does not exist in the pure form as single atoms, it is always O_2 molecules. They are diatomic.

A compound, (CO_2) is when 2 or more different atoms bond together to form a new pure substance. That new substance has unique properties, not any mixing of the carbon and oxygen properties.

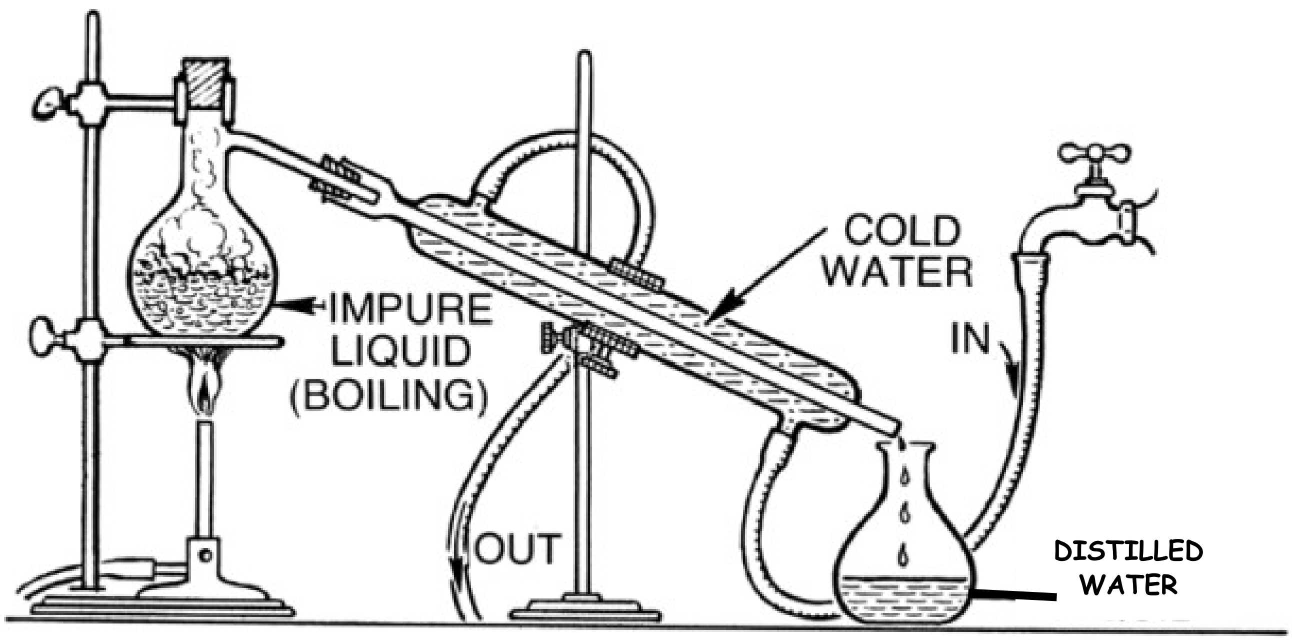
The mixture is just that, when elements are put together but do not chemically combine. There are NO NEW PROPERTIES. This mixture of oxygen gas and helium gas has the properties of oxygen and of helium.

The processes used to separate these mixtures work "because they take advantage of differences in certain physical properties of the parts of the mixture.   Here are several examples…

Distillation

Distillation is used to separate a mixture called a solution (when a solute is dissolved into a solvent). If salt water is our solution, salt is the solute, water is the solvent. Since salt (sodium chloride) and water each have a different boiling point, 1465°C for the salt, just 100°C for the water.

Boiling salt water (impure liquid) causes the water change phase into steam (gas), which travels out the top into the tube towards the right. That tube is cooled with water, which causes the H_2O Gas to condense back into pure H_2O Liquid, which is captured in the round bottomed flask at right. The salt never reaches its own boiling point, it just gets warm, and it gets stuck in the distilling flask at left.



The mixture here (salt and water) is separated by taking advantage of the differences in the boiling points of the parts of the mixture.

All mixtures are separated by taking advantage of differences in their physical properties. Distillation is our first example.

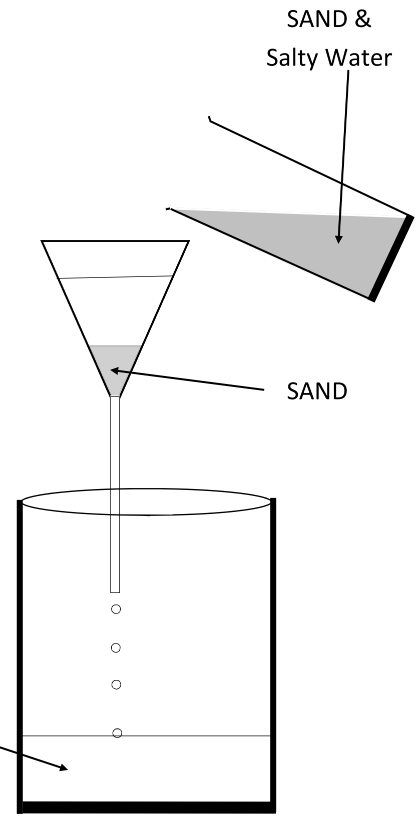
Filtration of Mixtures

If you pour beach water, containing salt and sand, through a filter as shown here, the sand will be caught in the filter, but the salty water will go right through.

To separate a mixture you must take advantage of the differences in physical properties, here it is particle size. The filter can separate the larger particles from the molecular sized ones that slip past the filter.

To get the salt apart from the water, you'd need to put it into the distillation apparatus. The salt and the water have no real particle size difference to take advantage of. Filtering can't take the salt out of water.

Separating mixtures can be done by taking advantage of particle sizes only when there is a size differential.

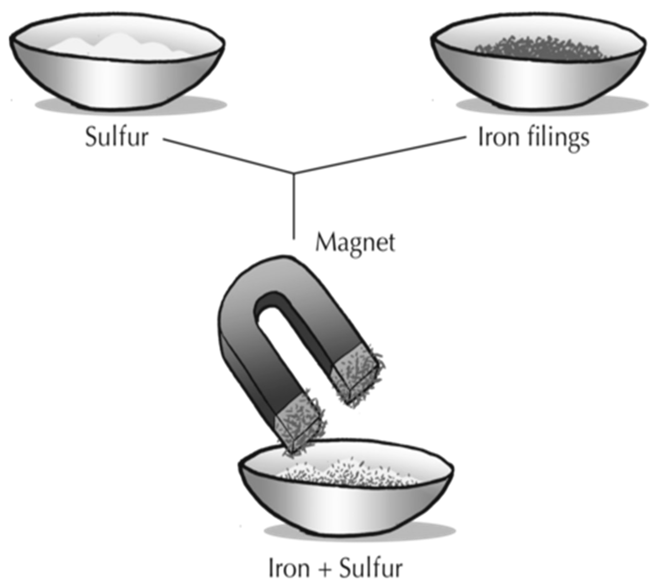


Magnetism separates some mixtures

If the mixture you have is iron filings (bits) and sulfur powder you couldn't run it through a filter, both the iron and the sulfur would be caught by the filter.

You couldn't separate them with distillation either, they'd chemically react before one boiled away. You could use a magnet to separate out the iron. Iron is attracted to the magnet while the dirt is not.

To separate a mixture requires you to take advantage of a difference in physical properties, in this case, if one is attracted to a magnet and the other part of the mixture is not.



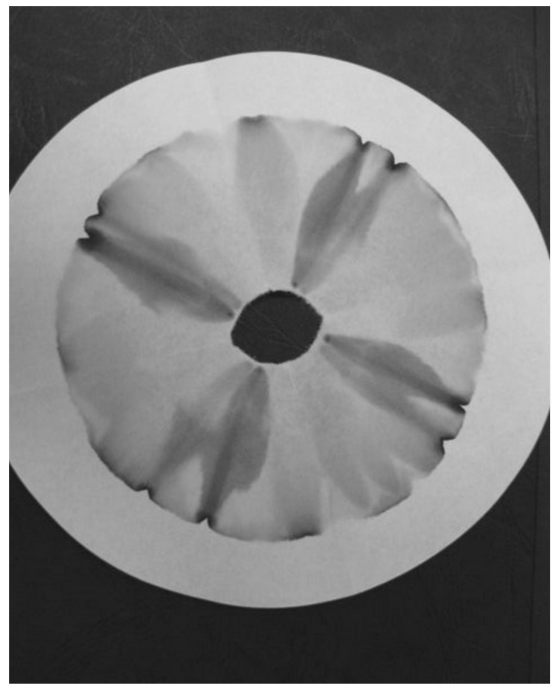
Separating mixtures by Paper Chromatography

We did this in class, taking advantage of the differences in both solubility and the density of the particles of color from our magic markers. We "think" our magic markers are one color, but they're made up of several different colors of particles, so close together, that they blur into one color to our eyes.

The water flowing through the filter paper can dissolve some inks, and can transport the color particles and take them on a ride. The densest, or heaviest, drop out quickly, the lighter, or less dense travel further along on the paper.

Although this is "just colors", this is how paper chromatography works chemically as well. Our colors are really mixtures of colors, which we proved by our lab work.

Taking advantage of the different densities of the color particles allows us to separate this kind of mixture.



The most important thing to remember about separating mixtures is that since they are not chemically combined, you don't need to do "chemistry" to get them apart. They are physically blended, so you use physical means to take them apart. You need to find a difference in the physical properties of the substances that are mixed together, and take advantage of them to get them apart.

Mixtures do not have formulas, they do not have exact ratios of substances.

H_2O or Water has 2 hydrogen atoms bonded to one oxygen atom. It has an exact 2:1 ratio of atoms.

Some chocolate milk is very chocolatey, some chocolate milk is weaker.
The mixture of chocolate and milk in not in an exact ratio.

More about mixtures.

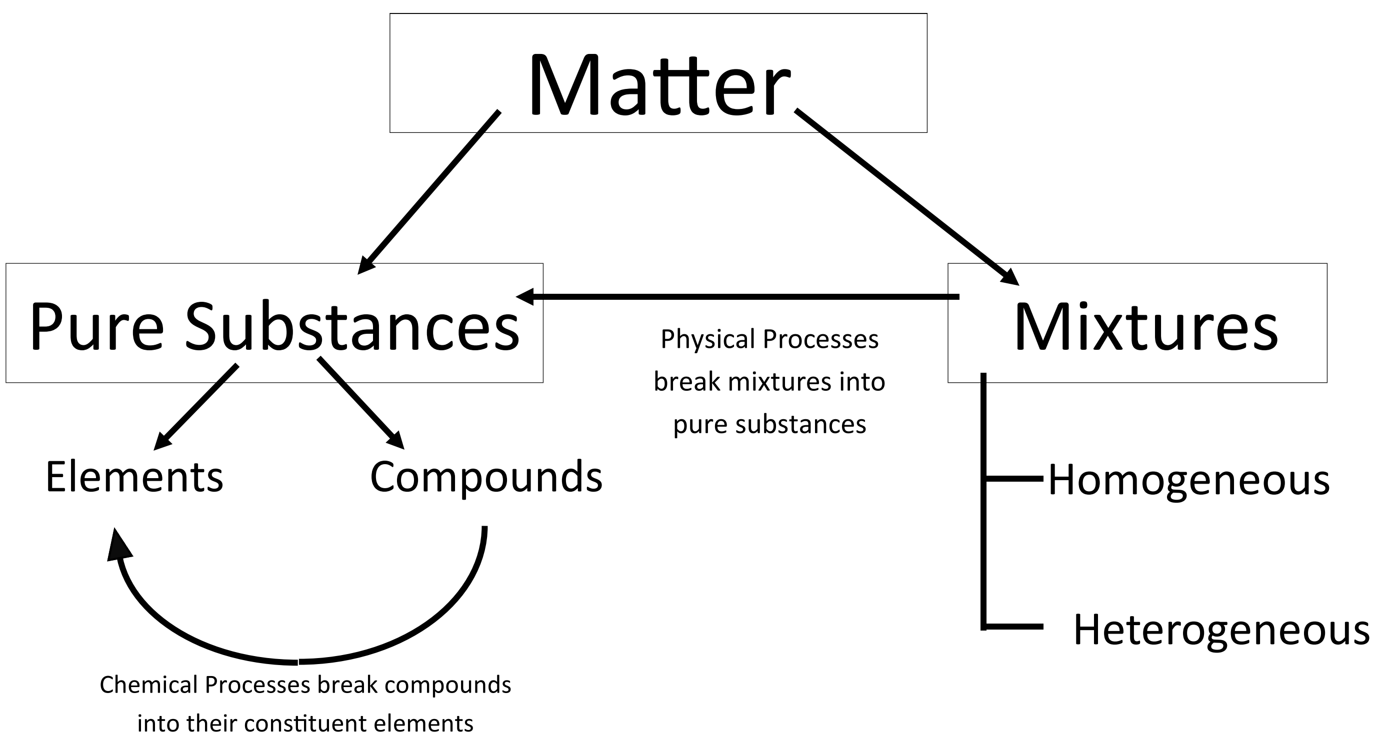
Solutions are mixtures where one part is dissolved into a liquid. The liquid part of this kind of mixture is called the solvent. The dissolved part is the solute. Water is a common solvent, although any liquid could be a solvent. With salty water, salt is the solute, dissolved into the solvent which is water.

Solutions are homogeneous, which means they are the same throughout.

Not all solutes dissolve into all solvents. Solvents all have limits to how much solute they can hold as well. You can only put a certain amount of sugar in a cup of coffee before solid sugar falls out to the bottom of the cup. Solvents can become "maxed out", or saturated. Adding more solute after the solvent is saturated just causes the excess solute to the bottom of the container.

Gases can mix as well. They create gaseous mixtures. Air is a mix of nitrogen, oxygen and many other gases. You could mix helium and carbon dioxide gases—if you had them in one container.

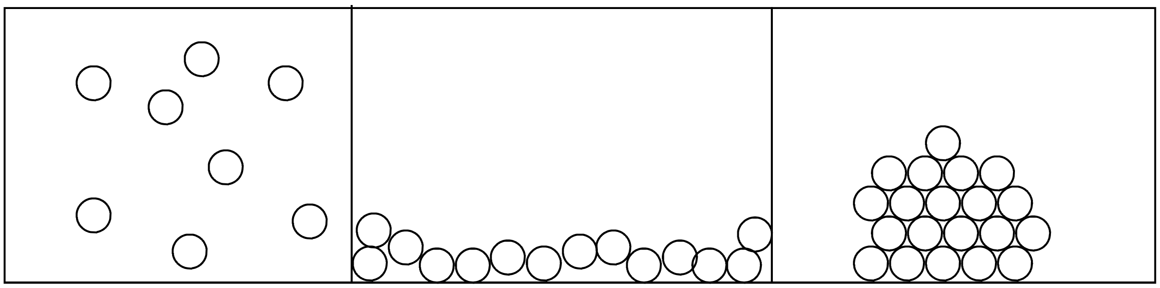
Solids can also be mixed together, but this usually requires you melt them so they can actually mix. Alloys of metals melted together include sterling silver, which is made from copper and silver melted (mixed). The proportions can change and different qualities of sterling silver can be made.
Copper and tin melted together make bronze, while copper and zinc melted together make brass.
Carbon with melted iron creates steel. All of these are homogeneous mixtures.



The study of matter will be our work all year. This chart, similar to the one we drew in our notes, shows the relationship between all the different kinds of matter. Make sure you understand these boxes and arrows, and that you could draw it from memory, with examples for each box.

Particle diagrams

Because our particles, our atoms and molecules, are much too small to see, there is a technique called particle diagramming that allows us to “cartoon” to create diagrams showing elements, compounds, and mixtures. Using different shapes, or colors, we’ll use pictures to express the relationships between atoms and molecules. These diagrams will also show solid, liquid, and gas phases.



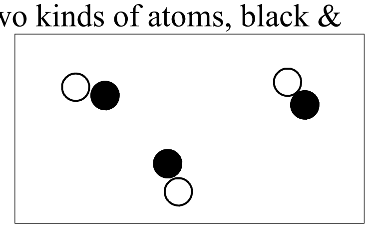
Above are little circles which represent one kind of particle. At left the particles are not touching, and are all “up” in the box, which represents gas particles, which have NO definite volume and NO definite shape.

At center, the particles all are touching, and conform to the bottom of a container. This represents a liquid made up of the same kind of particles as the gas is. The particles are “sticky but not stuck”. Liquids have a definite volume but indefinite shape.

At right, the exact kind of particles but they stacked tightly, they have a definite shape. This represents a solid of the same kind of particles. Particles are stuck, in a uniform, lattice structure. Definite shape and definite volume.

If the particles (little circles) were water molecules, at left is steam, in the middle is water, and at right is ice. If the particles are iron atoms, at left is very hot iron gas, center is molten iron, and at right is the “normal” metallic solid iron.

In this particle diagram we have a lot more going on. Each particle is made up of two kinds of atoms, black & white circles, which are touching.
This means that the white circle is chemically bonded to a black circle.

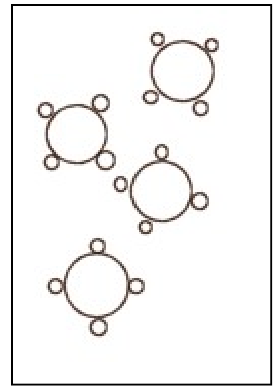


This represents 3 particles called molecules. If the white circles are oxygen, and the black are carbon, this shows a 1:1 ratio of carbon bonded to oxygen, which is called carbon monoxide (CO gas). There are 3 molecules of $CO_{(G)}$. This is a pure substance, not a mixture.

If you imagined the white circle to be sodium, and the black as chlorine, this could also represent 3 particles of sodium chloride which has a formula of NaCl and a 1:1 ratio as well. It would be unlikely that the NaCl would be a gas though, it has a very high boiling point.

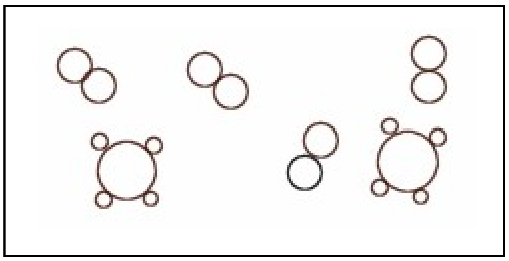
If this diagram had a key to show you which atoms are represented by the shapes and colors, you could KNOW what it showed. Otherwise it could represent a variety of compounds.

In this next particle diagram we have a different situation. Here we have a big circle with four little circles attached to it. This could represent four molecules in a 1:4 ratio, for example, methane gas with a CH_4 chemical formula. I could be CBr_4 as well.



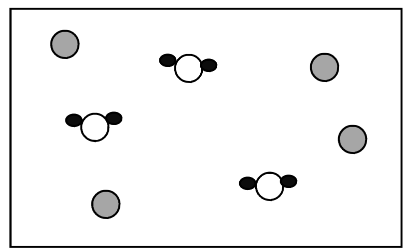
This particle diagram can't represent atoms, because different shapes are touching, therefore it must be a compound. All the molecules are the same, so it is a pure substance, not a mixture. The particles are not in any definite shape, rather they're floating around, so it's a gas as well. It is methane in the gas phase.
Solid or liquid methane would not be "floating" in the box.

At left we have two methane molecules mixed together with four diatomic molecules. Diatomic means 2 of the same atoms, and we remember that seven of the elements on the Periodic Table usually are in twin, or pairs at normal temperatures. Maybe they're oxygen as O_2, or nitrogen as N_2, or even that beautiful purple iodine gas we saw in lab: I_2.

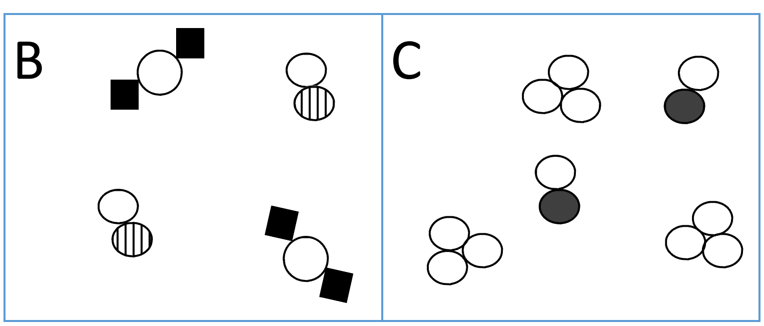


Use your imagination. The 2 little touching circles could NOT be carbon monoxide, C + O are different atoms, they would have to be different colors or shapes.

At right our particle diagram shows one kind of an atom (grey dots) mixed with one kind of compound (the triple circles). This could represent any one kind of atom, with CO_2 or maybe NO_2 which is nitrogen dioxide. Without a key it could be any atom and many different molecules. The diagram "represents" one kind of atom, and one kind of molecule in a 1:2 ratio.



Below is a challenge. What is represented in the "B" and "C" boxes?
Don't peek below until you try to figure this out!



"B" is two kinds of molecules, both in a 1:1 ratio, so this is a mixture.

"C" is one diatomic element, with one kind of molecule in a 1:1 ratio, so this is a mixture too.

Chemical Symbols

The symbols of the atoms of the periodic table of elements come from a variety of languages, and therefore do not always seem to match the common names of the elements. Hydrogen is H, helium is He, simple enough, but then sodium is Na, tin is Sn, and the famous mercury is Hg. Don't try to memorize these, use table S whenever you have any concerns.

The rules are easy. All element symbols are capitalized. If the symbol has more than one letter (many do) the second letter is never capitalized.

When compounds form, only certain ratios of atoms:atoms are possible. We'll learn later in the year how to figure that out, but for now we can still learn to count how many atoms are present in a molecule.

H_2O is water. The two indicates that there are 2 hydrogen atoms. The lack of a number next to the oxygen (O) means that only one atom of oxygen is present. So, H_2O has a total of three atoms.

NH_3 is ammonia. That's 1 nitrogen atom is chemically bonded with 3 hydrogen atoms. 4 total atoms.

Methane gas is CH_4, which is 1 carbon atom, with 4 hydrogen atoms, for a total of five atoms.

$C_{12}H_{22}O_{11}$ is a much bigger molecule of sucrose (table sugar). A dozen carbons, twenty-two hydrogen atoms and eleven oxygen atoms for a total of 45 atoms!

$NH_4S_2O_3$ is ammonium thiosulfate. It's got one N, four H, two S, and three O atoms, for a total of 10.

$Ca(OH)_2$ is calcium hydroxide. Here the OH is in parenthesis, so we double that part.
This has one Ca, and two OH's, for five total atoms.

Later in the year we'll learn all the naming rules, the ratio making rules, and the proper ways to deal with this. For now we want just to understand the subscript numbers and the elemental symbols.

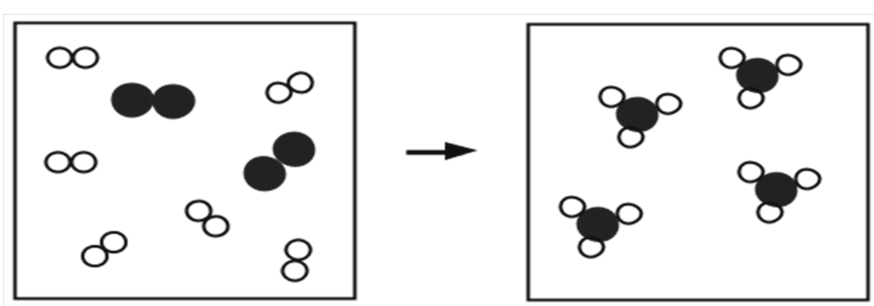
The Law of Conservation of Matter (or Mass)

Matter cannot be created or destroyed in a chemical reaction or physical change. Matter is conserved.
A physical change is a phase change, like solids melting into liquid, or a gas condensing into a liquid.

If you start with 100 grams of reactants, you will end up with 100 grams of products. This is the law.

6 grams hydrogen react completely with 28 grams of nitrogen and form exactly 34 grams of ammonia.
There can never be a loss of mass, or a gain of mass in a chemical reaction (or any physical change).

The cartoon shows 6 molecules of H_2 and 2 molecules of N_2. They react and form 4 molecules of NH_3.
Count the little ones, and the big ones. They are reorganized, but they are all there!



Chemical vs. Physical Changes

Physical changes are the result of a rearrangement of the atoms or molecules present, but not in the formation of new substances with new properties. They include changing the phase in any directions from S, L, G or AQ.

Chemical changes are the result of a rearrangement of atoms or molecules whereby new substances form, new properties form, and the original substances and their properties disappear. These are chemical reactions.

When methane gas reacts with oxygen, it releases much heat, carbon dioxide and water gas. The methane and oxygen are recombined into new molecules, they oxygen + methane "disappear" as pure substances, forming into the water & carbon dioxide. No loss of mass, but big changes have happened.

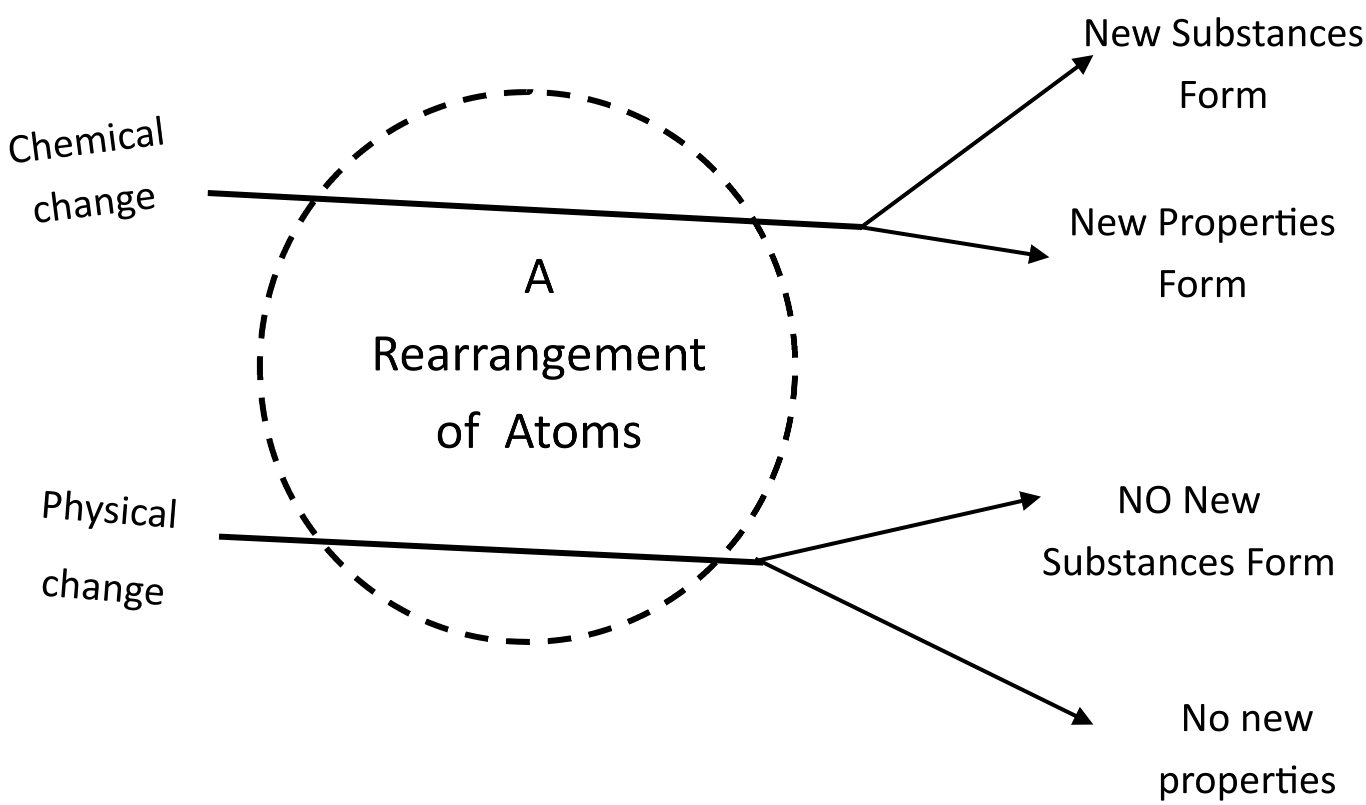
Some likely indicators that a chemical reaction has taken place (these are not always definite) are easily remembered with the acronym TOPIC-B.

T	Temperature changes. Often a chemical reaction will release energy or heat, or the opposite, will absorb energy, making the immediate environment cold. Heat release is an exothermic reaction, heat absorption is an endothermic reaction.
O	Odor release. New smells usually indicate something new has formed from the reactants at hand. Many kinds of matter have an odor, a different odor makes you think something different is present.
P	Precipitates in solutions. Sometimes we mix solutions and form new compounds that cannot dissolve in the solvent. These insoluble compounds "fall out" of solutions as solids. Two solutions can just mix together, but if a solid falls out is a good indicator that something chemical changed.
I	I stands for irreversibility, which needs some explaining. All chemical reaction can be reversed, but to do so would require some chemistry knowledge and the input of energy. Once a chemical reaction occurs it will not spontaneously reverse itself. Chemical reactions tend to go one way and stay done. To reverse a chemical reaction takes another chemical reaction.
C	For is for color changes. Matter is fairly stable, color is directly connected to the atoms or molecules present. A change in color often indicates a change in the particles, new particles formed.
B	Bubbles that were not there before also indicates that something has chemically changed. Opening up a warm can of soda means someone gets sprayed, which is funny, but these are not new bubbles, so it is not a chemical reaction. When new bubbles form (like new odors), something new formed.

Physical vs. Chemical Changes

In a chemical change, there is a rearrangement of atoms or particles in a substance. This rearrangement includes the formation of new substances with their own new properties.
Examples include all chemical reactions, with the TOPIC B indicators.

Physical changes also have a rearrangement of atoms or particles, but no new substances form, so all the original properties remain. Examples include all phase changes, bending of metals, shattering of crystals, ripping of paper, or stirring paint colors together.



This diagram is one of many that will “show” the meaning of concepts of chemistry. Think hard when you look at it, make sure you understand what it shows. If you don’t understand, that is both okay and normal, as long as you come to your teacher and ask for clarification.

If you sit and think that overlooking this will work out for you, that is a big mistake.

It’s okay to need more explaining, but it’s not okay to make believe everything is cool when it’s not.

Do you get this diagram, or are you asking for more? Be smart.

Fill in the phase change names *(them memorize them)*	
Solid → liquid	
Liquid → gas	
Solid → gas	
Liquid → solid	
Gas → liquid	
Gas → solid	

Vocabulary words (or else)	
Substance	A pure substance (element or compound) has a constant composition and constant properties throughout a given sample, and from sample to sample.
Element	Elements are substances that are composed of atoms that have the same atomic number. Elements cannot be broken down by chemical change.
Compound	A compound is a substance composed of two or more different elements that are chemically combined in a fixed proportion. A chemical compound can be broken down by chemical means. A chemical compound can be represented by a specific chemical formula and assigned a name based on the IUPAC system
IUPAC	International Union of Physical and Applied Chemists, the rule making body for naming compounds and new elements on the periodic table, and to make any (small) changes to the Periodic Table numbers
Mixture	Mixtures are composed of two or more different substances that can be separated by physical means. When different substances are mixed together, a homogeneous or heterogeneous mixture is formed.
Phase	The three phases of matter (solids, liquids, and gases) have different properties. Which phase a substance is in depends upon temperature and pressure that they exist at. Phase changes occur at the melting/freezing point, and boiling/condensing points. Some substances can “jump” from solid to gas or reverse.
Homogeneous	When a substance, or a mixture is the same throughout.
Heterogeneous	When a mixture is not the same throughout.

<table>
<tr><td colspan="2">Draw particle diagrams
for the three phases
(once you know how)</td><td>In last column, write one of these lines…

Definite Volume & Indefinite Shape,
Definite Volume & Definite Shape, or
Indefinite Volume & Indefinite Shape</td></tr>
<tr><td>S</td><td></td><td></td></tr>
<tr><td>L</td><td></td><td></td></tr>
<tr><td>G</td><td></td><td></td></tr>
<tr><td colspan="3"><u>Define aqueous</u></td></tr>
</table>