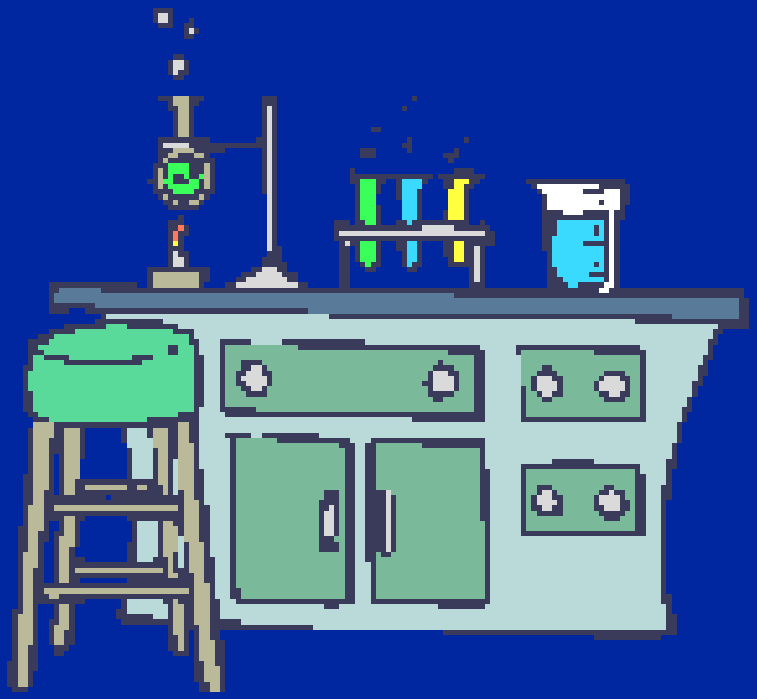


Chapter 2
"Matter and Change"

Section 2.1
Properties of Matter

- OBJECTIVES:
  - Identify properties of matter as extensive or intensive.

Section 2.1
Properties of Matter

- OBJECTIVES:
  - Define physical property, and list several common physical properties of substances.

Section 2.1
Properties of Matter

- OBJECTIVES:
  - Differentiate among three states of matter.

Section 2.1
Properties of Matter

- OBJECTIVES:
  - Describe a physical change.

Matter

- Matter is anything that: a) has mass, and b) takes up space
- Mass = a measure of the amount of “stuff” (or material) the object contains (don’t confuse this with weight, a measure of gravity)
- Volume = a measure of the space occupied by the object

Describing Matter

- Properties used to describe matter can be classified as:

1) Extensive – depends on the *amount* of matter in the sample

   - Mass, volume, calories are examples

2) Intensive – depends on the *type* of matter, not the amount present

   - Hardness, Density, Boiling Point

Properties are…

- Words that describe matter (adjectives)
- Physical Properties- a property that can be observed and measured without changing the material's composition.
- Examples- color, hardness, m.p., b.p.
- Chemical Properties- a property that can only be observed by changing the composition of the material.
- Examples- ability to burn, decompose, ferment, react with, etc.

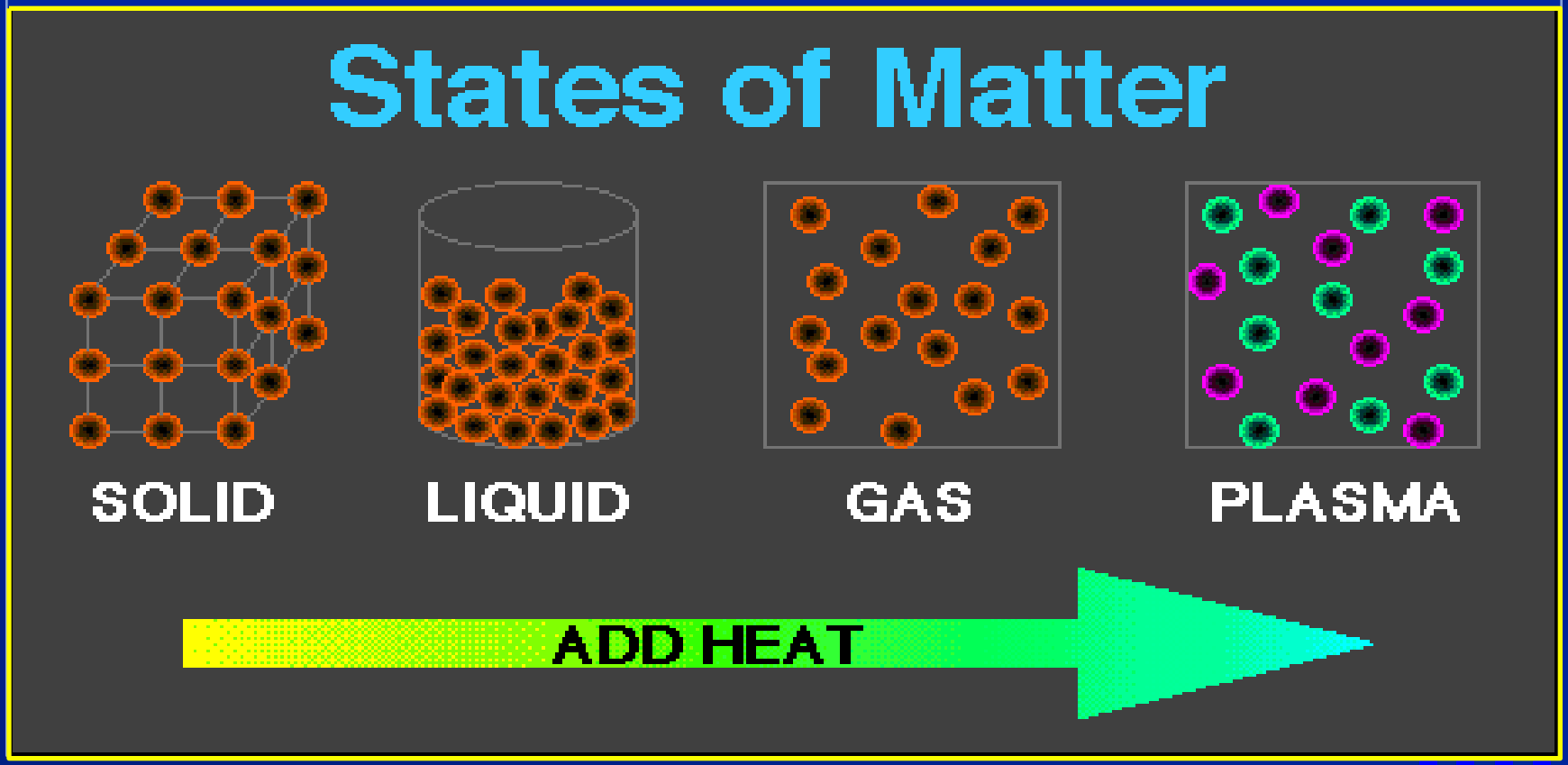
States of matter

1) Solid- matter that can not flow (definite shape) and has definite volume.
2) Liquid- definite volume but takes the shape of its container (flows).
3) Gas- a substance without definite volume or shape and can flow.
   - Vapor- a substance that is currently a gas, but normally is a liquid or solid at room temperature. (Which is correct: “water gas”, or “water vapor”?)

States of Matter

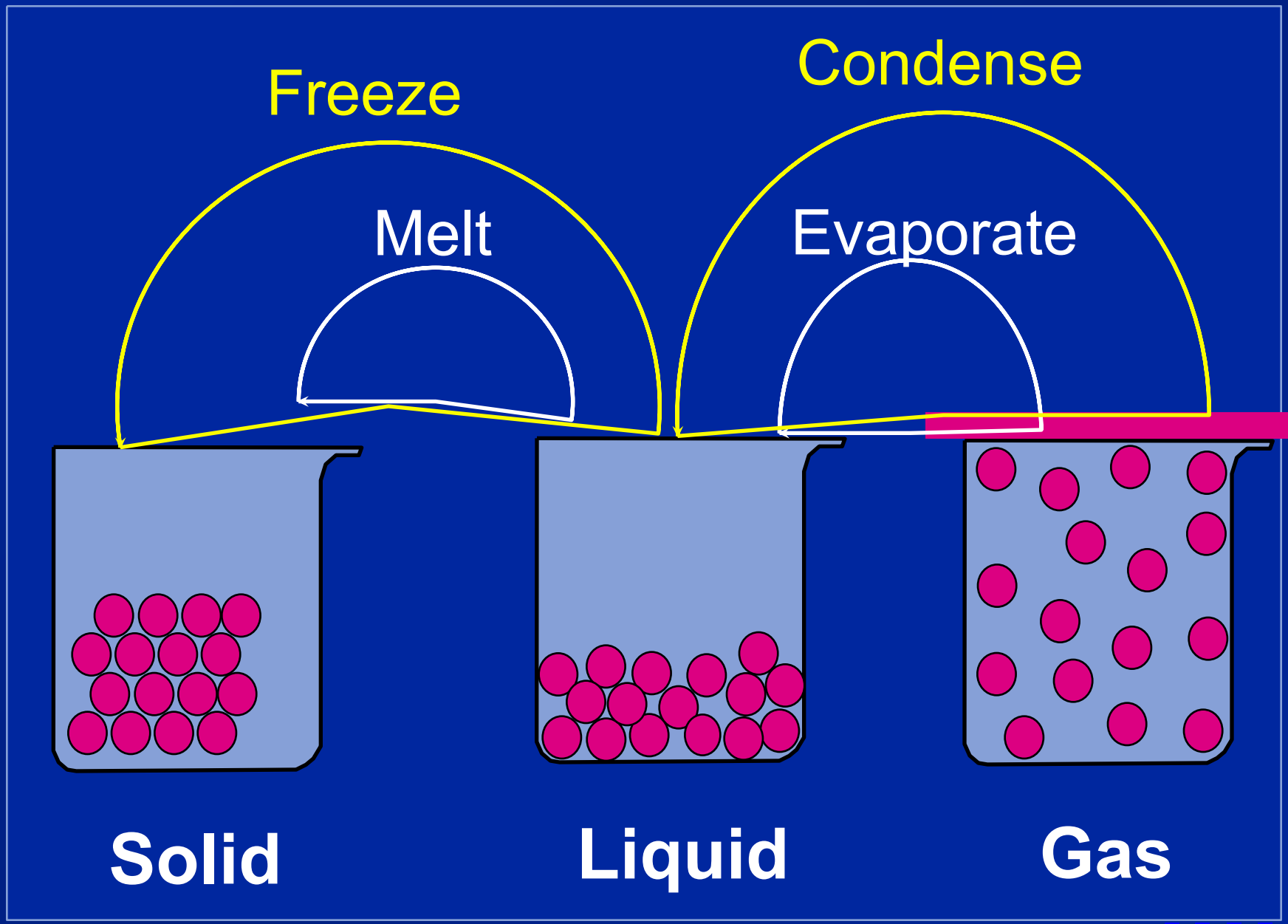
	Definite Volume?	Definite Shape?	Result of a Temperature Increase?	Will it Compress?
Solid	YES	YES	Small Expans.	NO
Liquid	YES	NO	Small Expans.	NO
Gas	NO	NO	Large Expans.	YES

4th state: Plasma - formed at high temperatures; ionized phase of matter as found in the sun

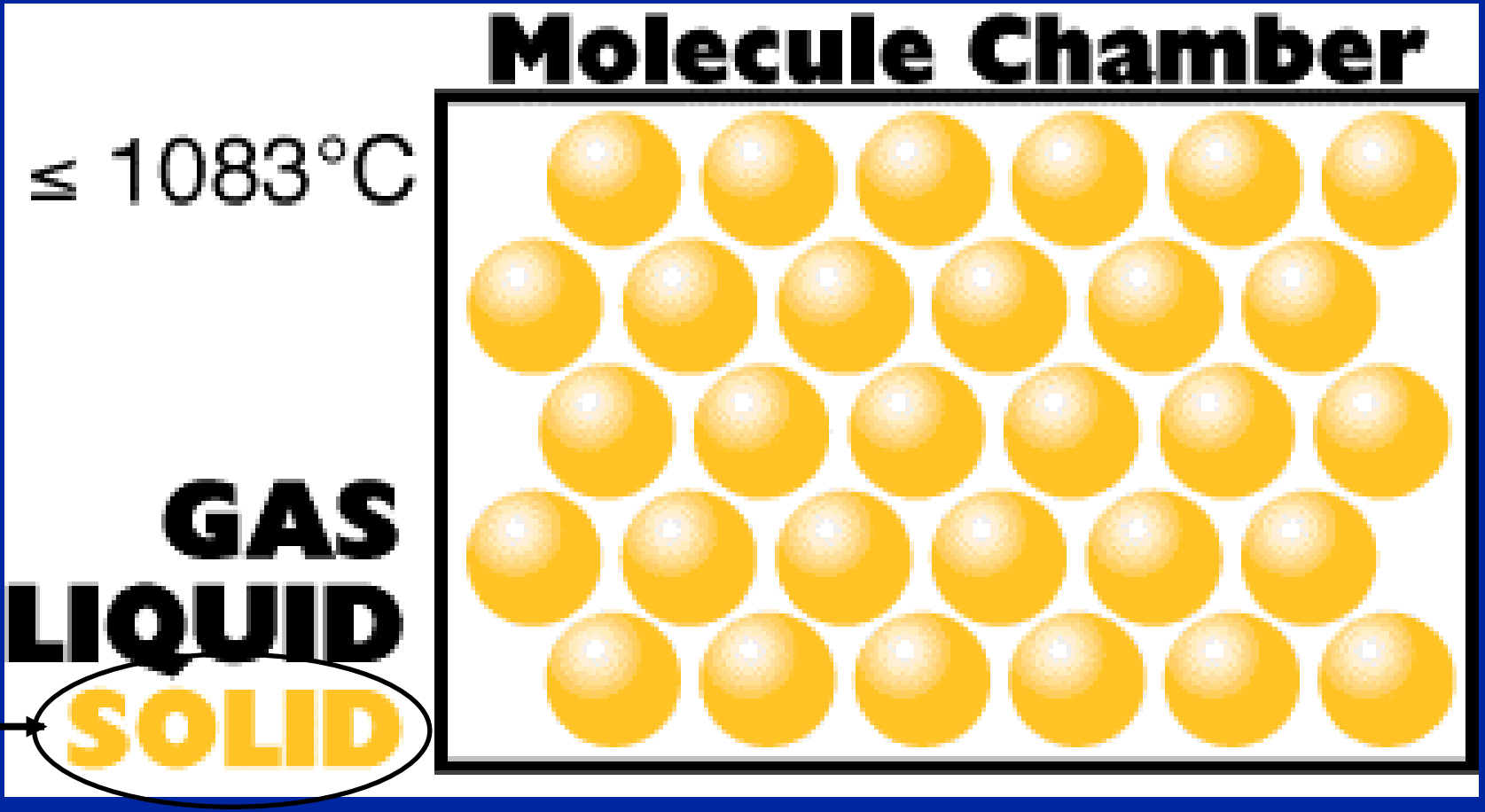


Three Main Phases – page 41

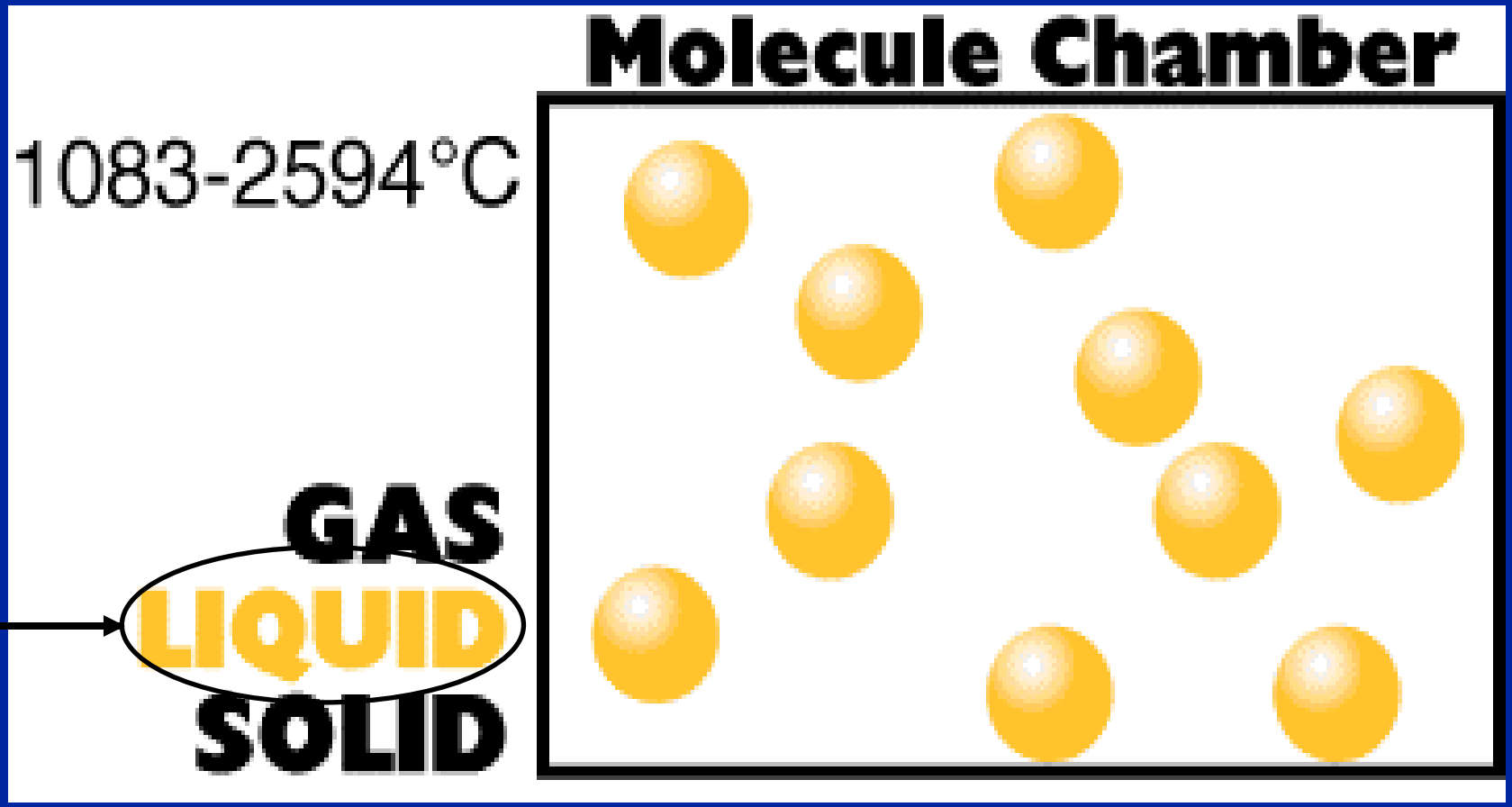
(a) Particles in a solid (b) Particles in a liquid (c) Particles in a gas


Freeze
Condense
Melt
Evaporate
Solid
Liquid
Gas

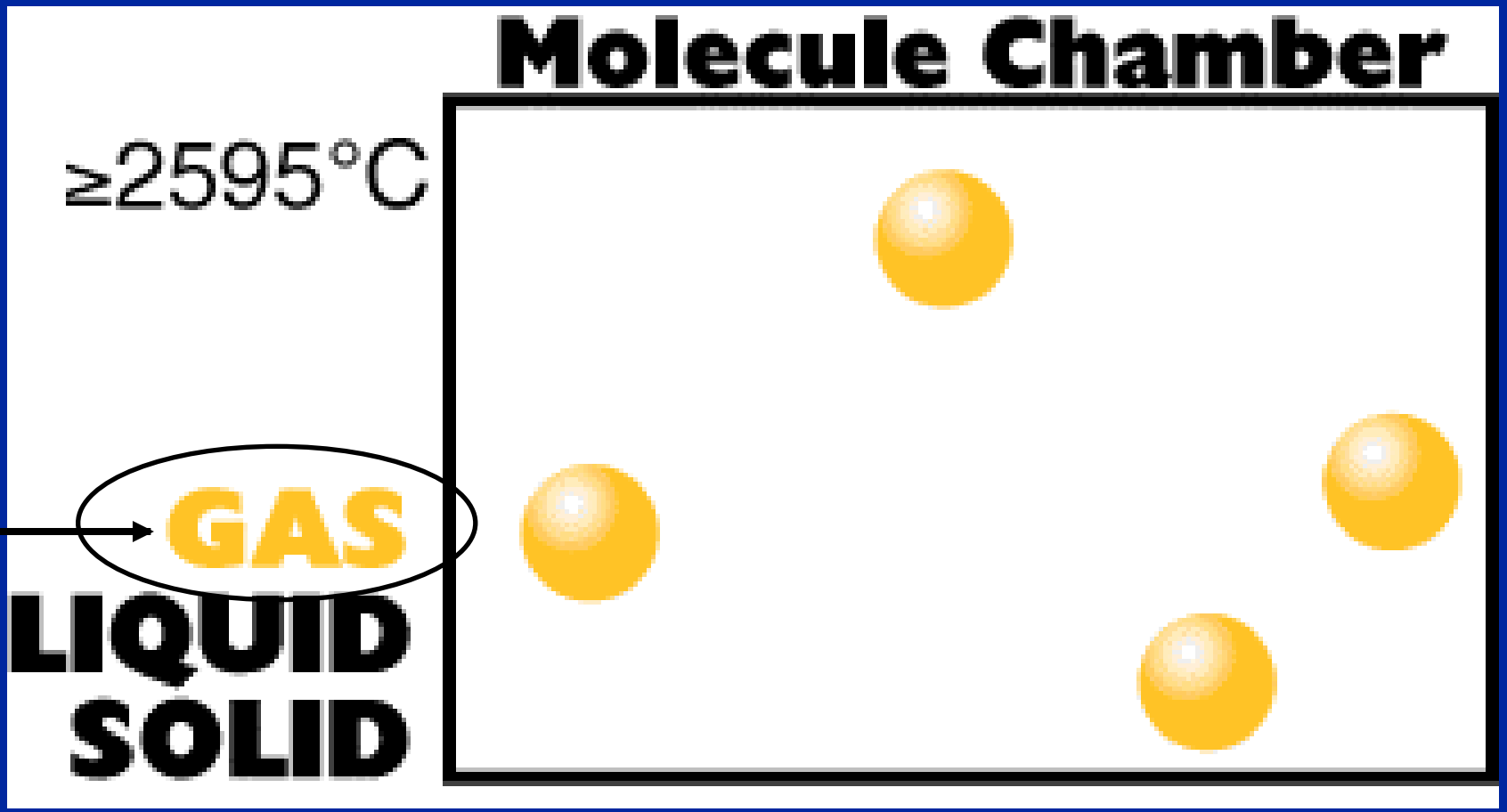
Copper Phases - Solid



Copper Phases - Liquid



Copper Phases – Vapor (gas)



Physical vs. Chemical Change

- Physical change will change the visible appearance, without changing the composition of the material.
  - Boil, melt, cut, bend, split, crack
  - Is boiled water still water?
- Can be **reversible**, or **irreversible**
- Chemical change - a change where a new form of matter is formed.
  - Rust, burn, decompose, ferment

2.1 Section Quiz.

- 1.Which of the following would be described as an extensive property of matter?
  - »temperature
  - »color
  - »mass
  - »hardness

2.1 Section Quiz.

–2. Which properties can be observed without changing the composition of a substance?

- » all properties of a substance
- » intensive properties
- » chemical properties
- » physical properties

2.1 Section Quiz.

–3. Match the states of matter with the following descriptions:

(1) takes the volume and shape of its container

(2) has a definite shape and volume

(3) has a definite volume but an indefinite shape

» (1) liquid, (2) solid and (3) gas
» (1) gas, (2) solid, and (3) liquid
» (1) gas, (2) liquid, and (3) solid

Section 2.2
Mixtures

- OBJECTIVES:
  - Categorize a sample of matter as a substance or a mixture.

Section 2.2
Mixtures

- OBJECTIVES:
  - Distinguish between homogeneous and heterogeneous samples of matter.

Section 2.2
Mixtures

- OBJECTIVES:
  - Describe two ways that components of mixtures can be separated.

- Mixtures are a physical blend of at least two substances; have variable composition. They can be either:

1) Heterogeneous – the mixture is not uniform in composition
   - Chocolate chip cookie, gravel, soil.

2) Homogeneous - same composition throughout; called "solutions"
   - Kool-aid, air, salt water

- Every part keeps it's own properties.

Solutions are homogeneous mixtures

- Mixed molecule by molecule, thus too small to see the different parts
- Can occur between any state of matter: gas in gas; liquid in gas; gas in liquid; solid in liquid; solid in solid (alloys), etc.
- Thus, based on the distribution of their components, mixtures are called homogeneous or heterogeneous.

Phase?

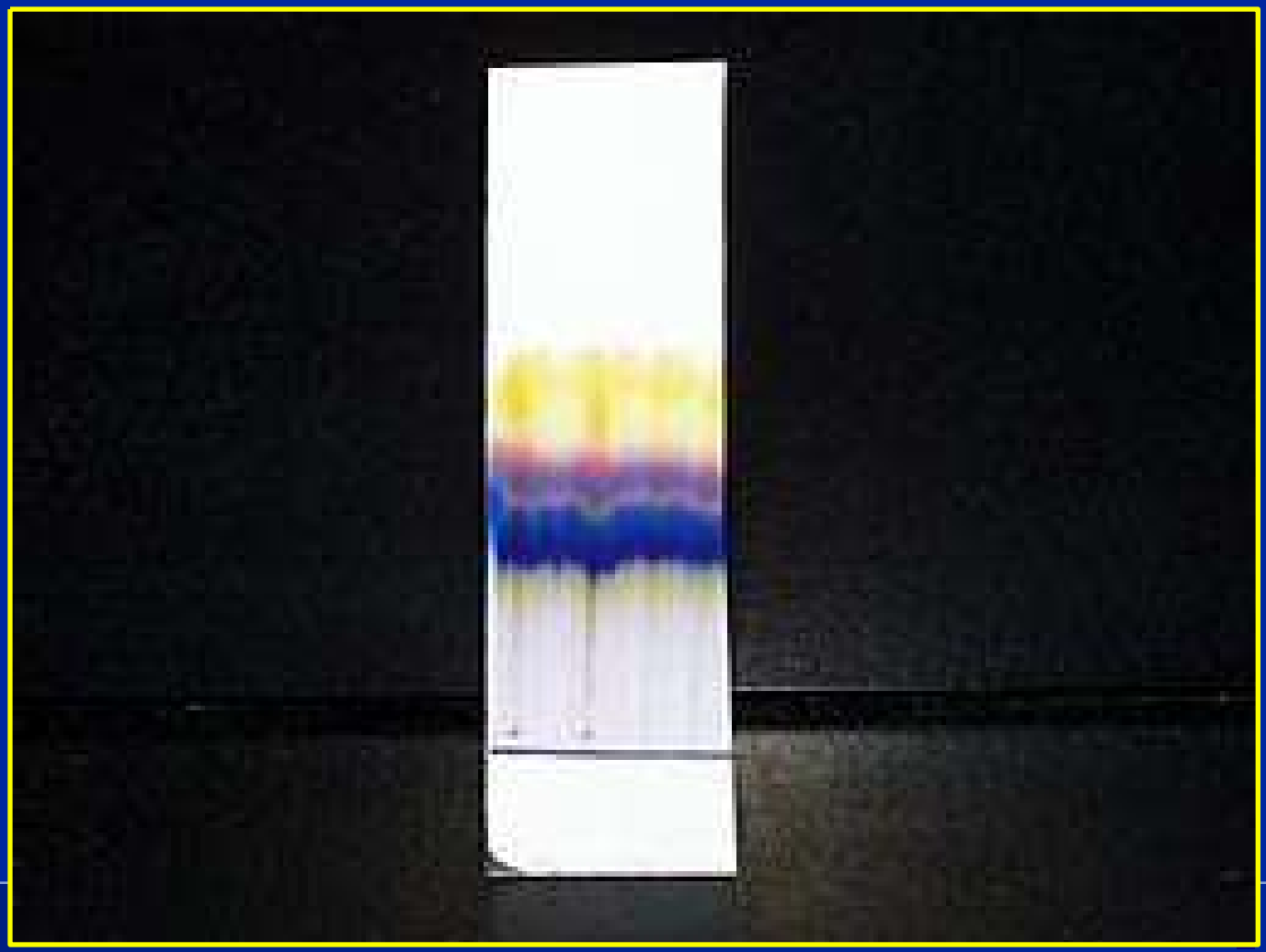
- The term “phase” is used to describe any part of a sample with uniform composition of properties.
- A homogeneous mixture consists of a single phase
- A heterogeneous mixture consists of two or more phases.
- Note Figure 2.6, page 45

Separating Mixtures

- Some can be separated easily by physical means: rocks and marbles, iron filings and sulfur (use magnet)
- Differences in physical properties can be used to separate mixtures.
- Filtration - separates a solid from the liquid in a heterogeneous mixture (by size) – Figure 2.7, page 46

Separation of a Mixture

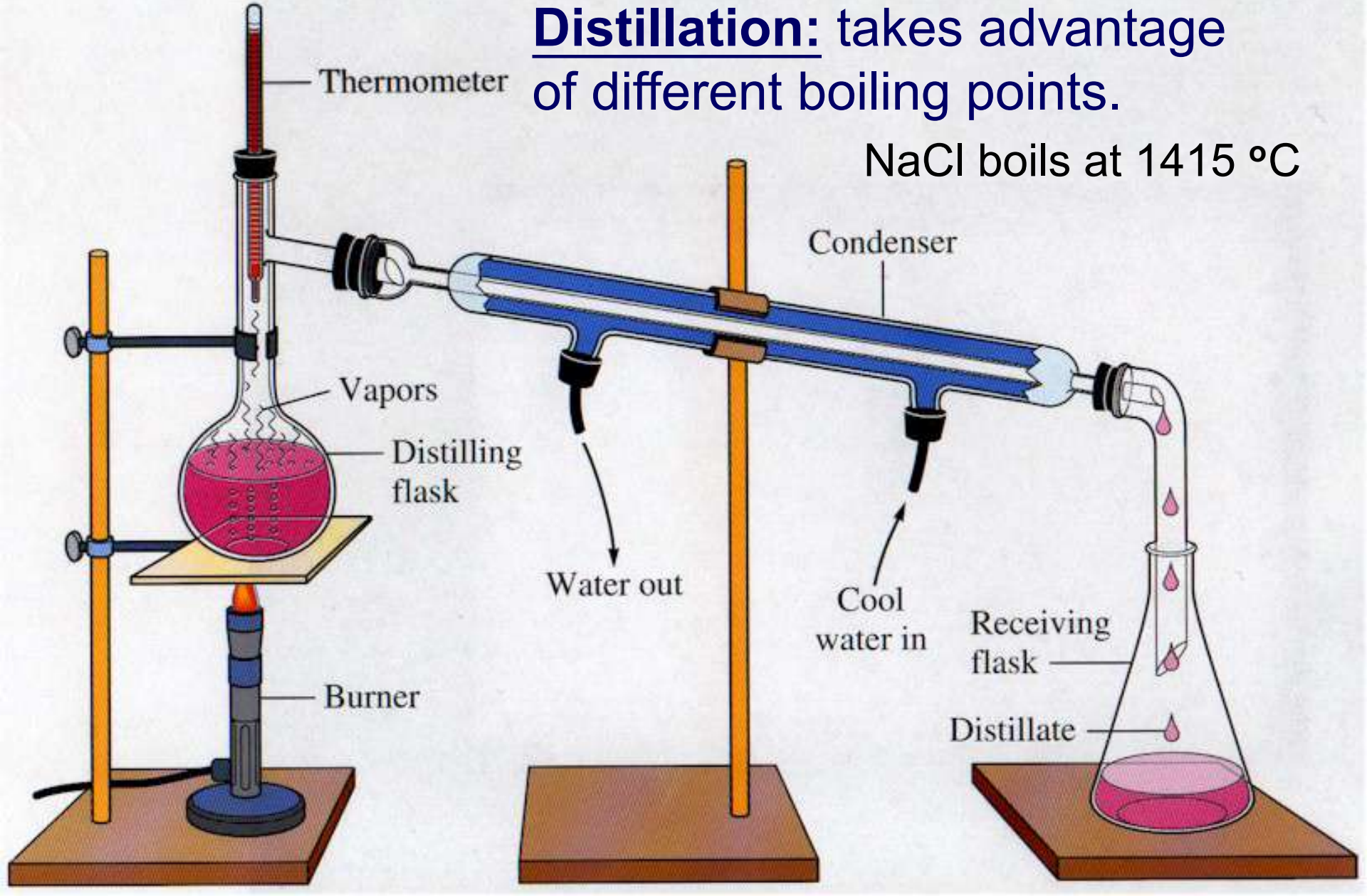
Components of dyes such as ink may be separated by paper chromatography.



Separation of a Mixture

Distillation: takes advantage of different boiling points.

NaCl boils at 1415 °C



2.2 Section Quiz.

- 1. Which of the following is a homogeneous mixture?
  - »vinegar
  - »iron filings in sand
  - »chicken noodle soup
  - »muddy water

2.2 Section Quiz.

- 2. Which technique is used to separate homogeneous mixtures?
  - »filtration
  - »distillation
  - »magnetism
  - »dissolving

Section 2.3
Elements and Compounds

- OBJECTIVES:
  - Explain the differences between an element and a compound.

Section 2.3
Elements and Compounds

- OBJECTIVES:
  - Distinguish between a substance and a mixture.

Section 2.3
Elements and Compounds

- OBJECTIVES:
  - Identify the chemical symbols of elements, and name elements given their symbols.

Substances are either:

a) elements, or

b) compounds

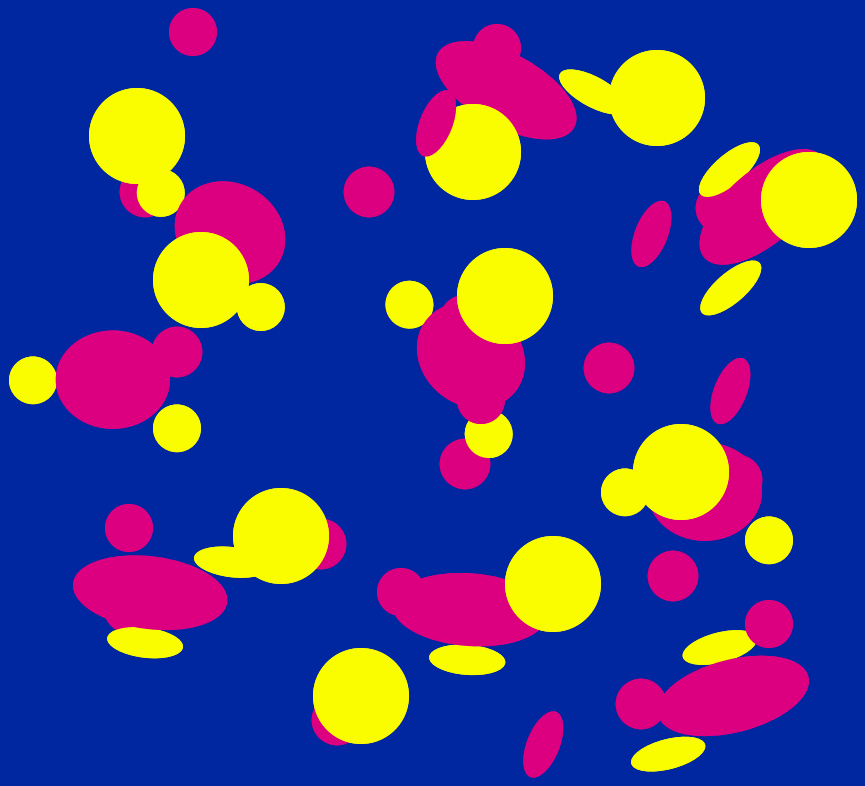
Substances: element or compound

- Elements- simplest kind of matter
  - cannot be broken down any simpler and still have properties of that element!
  - all one kind of atom.
- Compounds are substances that can be broken down only by chemical methods
  - when broken down, the pieces have completely different properties than the original compound.
  - made of two or more atoms, chemically combined (not just a physical blend!)

Compound vs. Mixture

Compound	Mixture
Made of one kind of material	Made of more than one kind of material
Made by a chemical change	Made by a physical change
Definite composition	Variable composition

Which is it?



Element

Mixture

Compound

Elements vs. Compounds

- Compounds **can** be broken down into simpler substances by chemical means, but elements **cannot**.
- A "*chemical change*" is a change that produces matter with a **different composition** than the original matter.

Chemical Change

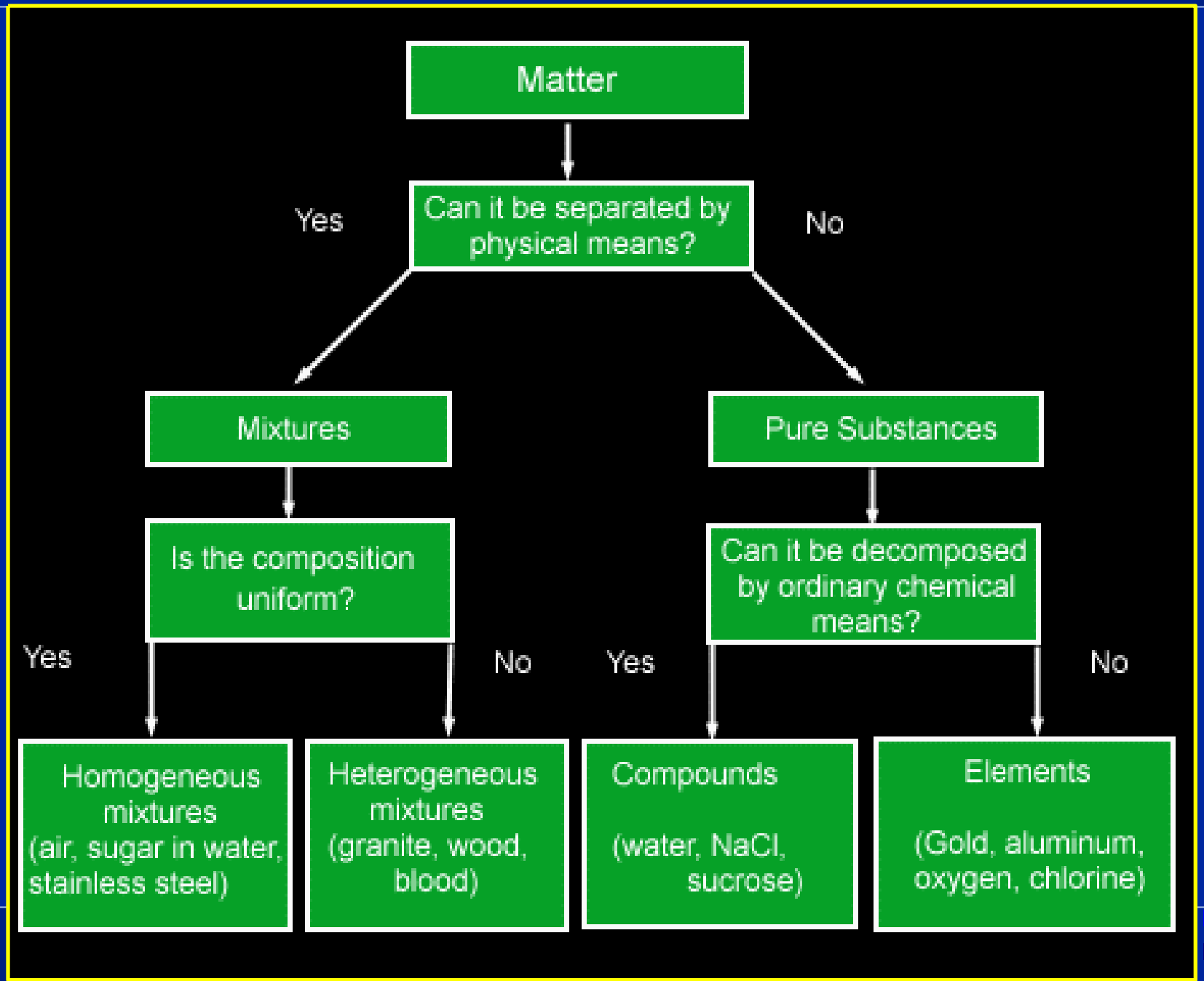
A change in which one or more substances are converted into different substances.

Heat **and** ***light*** **are often evidence of a chemical change.**

Properties of Compounds

- Quite different properties than their component elements.
- Due to a CHEMICAL CHANGE, the resulting compound has new and different properties:
  - Table sugar – carbon, hydrogen, oxygen
  - Sodium chloride – sodium, chlorine
  - Water – hydrogen, oxygen

Classification of Matter



Symbols & Formulas

- Currently, there are ***117*** elements
- Elements have a 1 or two letter symbol, and compounds have a formula.
- An element's first letter always capitalized; if there is a second letter, it is written lowercase: B, Ba, C, Ca, H, He
- ***Start learning*** the elements names and symbols listed in Table B.7 on page R53
- Some names come from Latin or other languages; note Table 2.2, page 52

Determine whether each of the following is an element, compound, homogeneous mixture or heterogeneous mixture.

- air
- wood
- chlorine
- granite
- aluminum
- sugar in water
- blood
- sucrose
- stainless steel
- sodium chloride
- brass
- whole milk
- apple
- table salt
- soft drinks
- vinegar
- concrete
- sodium
- baking soda ($NaHCO_3$)
- gravel

2.3 Section Quiz

– 1. Passing an electric current through a certain substance produces oxygen and sulfur. This substance cannot be a(n)
  - » compound.
  - » mixture.
  - » element.
  - » solution.

2.3 Section Quiz

– 2. Which of the following is a mixture?
  - » sodium chloride
  - » carbon dioxide
  - » sucrose
  - » air

2.3 Section Quiz.

–3. The symbol for the element potassium is
  - »K.
  - »Po.
  - »P.
  - »Pt.

Section 2.4
Chemical Reactions

- OBJECTIVES:
  - Describe what happens during a chemical change.

Section 2.4
Chemical Reactions

- OBJECTIVES:
  - Identify four possible clues that a chemical change has taken place.

Section 2.4
Chemical Reactions

- OBJECTIVES:
  - Apply the law of conservation of mass to chemical reactions.

Chemical Changes

- The ability of a substance to undergo a specific chemical change is called a chemical property.
  - iron plus oxygen forms rust, so the ability to rust is a chemical property of iron
- During a chemical change (also called chemical reaction), the composition of matter always changes.

Chemical Reactions are…

- When one or more substances are changed into new substances.
- Reactants- the stuff you start with
- Products- what you make
- The products will have NEW PROPERTIES different from the reactants you started with
- Arrow points from the reactants **to** the new products

Recognizing Chemical Changes

1) **Energy** is absorbed or released (temperature changes hotter or colder)
2) **Color** changes
3) **Gas** production (bubbling, fizzing, or odor change; smoke)
4) formation of a **precipitate** - a solid that separates from solution (won't dissolve)
5) **Irreversibility** - not easily reversed

But, there are examples of these that are not chemical – boiling water bubbles, etc.

Conservation of Mass

- During any chemical reaction, the mass of the products is always equal to the mass of the reactants.
- All the mass can be accounted for:
  - Burning of wood results in products that appear to have less mass as ashes; where is the rest?
- **Law of conservation of mass**

19 **Figure 2.15 Conservation of Mass**

- Page 55

43.43 g Original mass = 43.43 g Final mass

reactants = product

Physical or Chemical?

1) Iron metal is melted
2) Iron combines with oxygen to form rust
3) Wood burns in air
4) A rock is broken into smaller pieces

Physical or Chemical?

- 5) Milk turns sour
- 6) Wax is melted over a flame then catches fire and burns
- 7) You make scrambled eggs

Physical or Chemical

- 8) You step on a piece of chalk and it becomes powdered
- 9) You light a candle when the electricity goes out
- 10) Steam from your hot shower condenses on a cold mirror

2.4 Section Quiz.

- 1.Which of the following is a chemical reaction?

a)melting of lead

b)dissolving sugar in water

c)rusting of iron

d)crushing of stone

2.4 Section Quiz.

- 2.Which of the following is NOT a possible clue that a chemical change is taking place?

a) a change of state

b) a change in color

c) production of a gas

d) formation of a precipitate

2.4 Section Quiz.

3.During any chemical change, the mass of the products is

a) always equal to the mass of the reactants.

b) always greater than the mass of the reactants.

c) always less than the mass of the reactants.

d) sometimes different than the mass of the reactants.

End of Chapter 2

Matter and Change