Ch. 13 & 14 Matter and Building Blocks of Matter

Ch. 13 & 14 Vocab

- Mass: the amount of matter in an object
- Volume: the amount of space something takes up
- Weight: a measure of the pull of gravity on an object
- Density: the amount of mass in a certain volume of matter

Vocab

- Physical Property: properties of matter that can be seen or measured without changing the substance into something else
- Chemical Property: a characteristic that determines how a substance reacts with other substances
- Condensation: the change of state from a gas to a liquid
- Physical Change: the change in the appearance of a substance while its properties stay the same
- Chemical Change: the changing of a substance into a completely new substance with different properties

Vocab

- Element: a substance made of only one kind of atom
- Periodic Table: a chart in which all the elements are arranged according to the repeating pattern of their properties
- Compound: a substance composed of two or more elements that are chemically combined to form a new substance
- Mixture: a combination of substances in which the atoms of the substances are not chemically combined
- Solution: one substance dissolved into another

Vocab

- Solute: a substance that has been dissolved
- Solvent: a substance in which a solute is dissolved
- Concentration: a measure of the amount of solute dissolved in a solvent
- Solubility: the maximum amount of solute that can be dissolved in a solvent at a particular temperature, usually expressed in grams per milliliter of solvent

Ch. 13.1 What is matter?

Measuring Matter

- Matter is anything that has mass
- Mass is a property of matter that can be measured
- Mass is measured in grams
- Mass does not depend on shape
- Volume is another property
- Volume of a liquid measured in milliliters (mL) Solid is measured in cubic centimeters (cm^3)
- Volume can be found by by multiplying the length X width X height

Mass and Weight

- Mass is a measure of the amount of matter in an object
- It stays the same no matter where it is at in the universe
- You can find the mass by using a balance
- Weight can change if the object moves to a place with a different force of gravity
- Weight can be measured with a spring scale and in units called newtons
  - A newton is about a quarter of a pound
- Your mass would be the same on Earth as it is the moon, but your weight on Earth is 6 times greater than on the moon

Density

- Density is mass per unit volume
- To find the density of a substance use the following formula
  - Density= mass/volume or m/v

Using Density to Identify Substances

- The density of an object is the same no matter what its size
- Each substance has a particular density

Solids (at 25°C)	Density (g/cm^3 or g/mL)	Liquids (at 25°C)	Density (g/mL)	Gases (at 0°C)	Density (g/L)
Cork	0.26	Gasoline	0.66	Hydrogen	0.090
Ice	0.92	Ethyl alcohol	0.785	Helium	0.179
Sugar	1.59	Olive oil	0.92	Methane	0.714
Salt (NaCl)	2.16	Water (at 4°C)	1.000	Neon	0.90
Aluminum	2.70	Milk	1.04	Nitrogen	1.25
Diamond	3.52	Mercury	13.6	Air (dry)	1.29
Copper	8.92			Oxygen	1.43
Silver	10.5			Carbon dioxide	1.96
Lead	11.3				
Gold	19.3				

Physical Properties of Matter

- Density is an example of a physical property
- Physical properties can be seen or measured without changing the substance into something else
- Examples of physical properties
  - State of matter
  - Shiny or dull
  - Conduct heat and electricity
  - Can be dissolved in other substances
  - Magnetic
  - Temperature at which it freezes or boils
- Physical properties are the same no matter how much of the substance there is

Chemical Properties of Matter

- Chemical properties tell how the substance forms new substances when it reacts with something else

Substance	Physical Property	Chemical Property
Wood	Does not conduct electricity	Flammable
Iron	Malleable	Combines with oxygen to form rust
Water	Colorless and odorless	Does not burn
Copper	Conducts electricity	Combines with oxygen to

Ch. 13.2 How can matter change?

States of Matter

- All matter is made of tiny moving particles
- The particles constantly move and bump into each other
- The speed of the particles and how strongly they are attracted to each other determine its state of matter

Solids

- A solid has a definite shape and volume
- Its particles are very close together and they don’t move very fast
- A strong attraction for each other holds the particles together
- If you move a solid from place to place it will still have the same shape and volume

Liquids

- Has a definite volume but not a definite shape
- The particles move fast enough to break through some of the attraction between them
- Allows the particles to slide past each other
- Liquids take the shape of the container that holds it

Gases

- Has no particular shape or volume
- Particles move fast enough to break away from one another and they move in many different directions
- A gas will spread out and take the shape of the container it is in

Plasma

- Does not have a definite shape or volume
- Has some properties of gases
- The particles have electric charges
- Found in lightening, fire, welding arcs, and fluorescent and neon light tubes
- Not common on Earth
- Scientists believe that 99% of the known matter in the universe is made of plasma

Changes of State

- Particles that make up matter have different forces of attraction between them
- Some are stronger than others
  - Iron particles have a stronger force of attraction than the particles of water
- Temperature can affect the force of attraction between particles
- If you heat a substance its particles will gain energy and move faster
- Add enough heat and they will break some of the force of attraction between them

Melting and Freezing

- Melting is the process in which a solid becomes a liquid
- It becomes a liquid when it is heated to its melting point
- When a liquid loses heat it becomes a solid
- This is its freezing point
- A substance freezes and melts at the same temperature
- Each substance has a particular melting and freezing point

The Freezing and Boiling Points of Some Substances				
Substance	Freezing/Melting Point		Boiling Point	
	°F	°C	°F	°C
water	32	0	212	100
aluminum	1,220	660	4,473	2,467
iron	1,762	961	4,014	2,212
alcohol	–202	–130	173	78

Boiling

- When a liquid reaches its boiling point it becomes a gas
- The particles heat up and spread apart
- When the particles cool the particles slow down and move closer together
- When they get close enough their attraction causes them to form a liquid

Physical Changes

- Melting, freezing, and boiling points are physical properties of a substance
- The size, shape, or state of the substance changes
- It may look completely different, but it is still the same substance

Chemical Changes

- A substance changes into a new substance during a chemical change
- These new substances have different properties from the original
- Chemical changes often give clues they are happening
  - Heat
  - Light
  - Sound
  - Permanent color change
  - fizzing

Ch. 14.1 How did we learn about atoms?

Measuring Matter

- An atom is the smallest whole piece of matter
- Everything is made from tiny atoms joined together
- Since atoms are so small, scientists have used models to study them
- The one used today is the electron cloud model
  - Atom has 2 distinct regions
  - The nucleus
    - Center of the atom
    - Made of protons (positive charge) and neutrons (no charge)
  - The electron cloud
    - Surrounds the nucleus
    - Contains electrons (negative charge) and empty space

History of the Atom

- 5th century B.C.: Democritus, a Greek philosopher, proposed that all matter was made of indivisible particles called atoms.
- 1803: John Dalton found proof that atoms exist. Proposed that atoms were small solid spheres. Model of the atom resembled a billiard ball
- 1897: Joseph John Thomson proposed that atoms were positively charged spheres with negatively charged particles embedded into them. This model is often called the plum pudding model. Credited with discovering the electron

History of the Atom

- 1911: Ernest Rutherford found that most of the mass of the atom was located in the center of the atom. He called the center a nucleus. His model resembled the solar system. In in his model, negatively charged electrons orbit a dense positively charged nucleus
- 1913: Niels Bohr proposed that electrons traveled in fixed orbits called shells. Electrons cannot move from one shell to another without gaining or losing energy.
- 1920s: Erwin Schrodinger and Werner Heisenberg proposed the electron cloud model for the atom

Ch. 14.2 How are elements grouped?

Elements

- Most things are made of more than one type of atom
  - Water: oxygen and hydrogen atoms
- Elements are made up of only one type
- Elements can’t be separated into simpler substances by physical or chemical means
- Because they are made of only one type of atom, they are called pure substances
- Less than 100 different elements occur naturally on Earth
- All matter on Earth and in space is made of these elements

Elements and Their Atoms

- The atoms for each element are different from atoms of all the other elements
- Each element can be identified by the number of protons in its nucleus
- Atoms of elements have no electrical charge because they have the same number of protons and electrons

Symbols for Elements

- Each element has its own unique chemical symbol
- Chemical symbols are 1, 2, or 3 letter combinations
- Usually the first letter in the name
- If another element has that letter, another letter may be added
- If the element was discovered in ancient times, the symbols come from their old name
- Newly discovered elements are given a temporary 3 letter name based on the Latin name for the number of protons

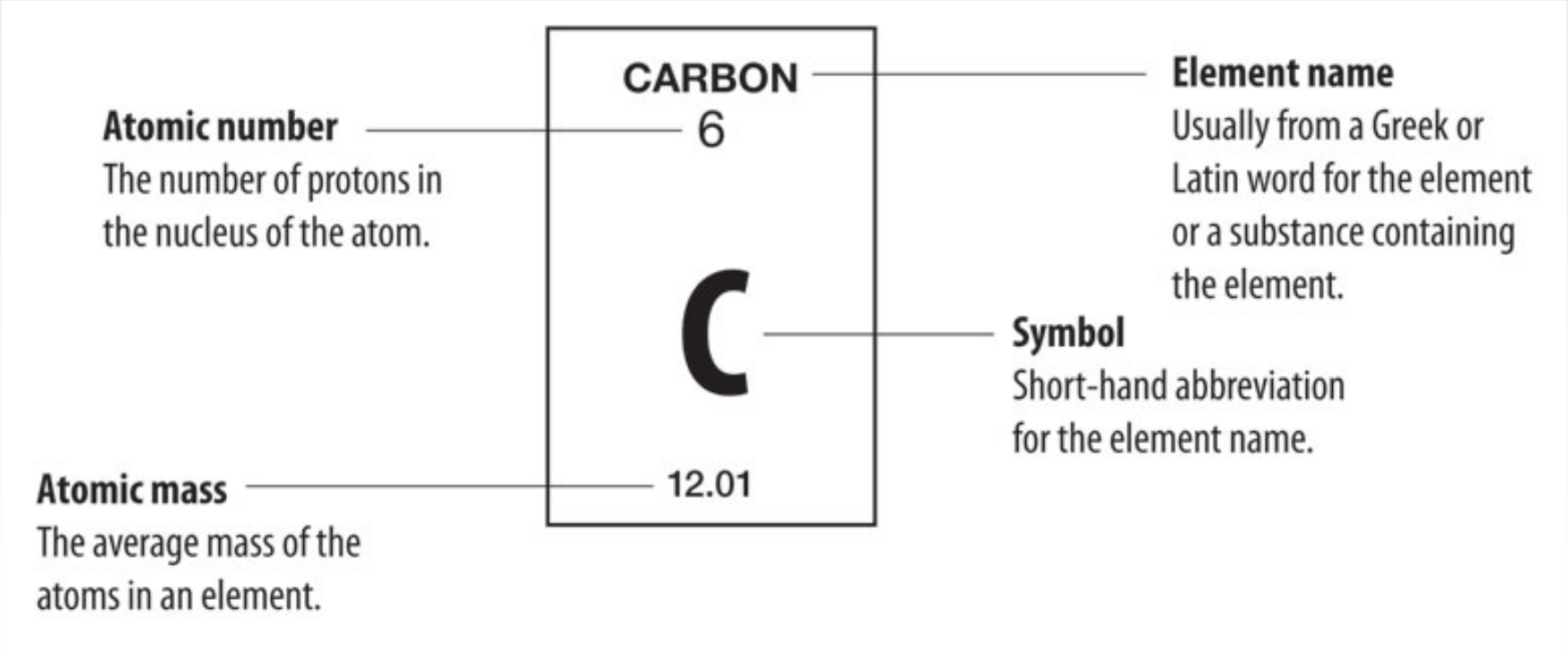
Classifying Elements

- Each element has a unique number of electrons and protons
- This gives the element a unique set of properties
- These properties determine what group the element is placed in
  - Metals: usually hard, good conductors of heat and electricity, capable of being drawn into wires and hammered into sheets
  - Nonmetals: usually brittle, poor conductors of heat and electricity, cannot be hammered into sheets or made into wires
  - Metalloids: elements that have properties of both metals and nonmetals

The Periodic Table

- Way to organize the elements
- Lists them in order of increasing atomic number
- Elements on the left are metals, right is nonmetals, metalloids are on each side of the zig-zag line between metals and nonmetals. Aluminum is the exception
- At the bottom of the table are two series of elements called the Lanthanide and Actinide series
- Lanthanide starts at 57 and Actinide starts at 89
- Pulled to the bottom for convenience so table isn't too wide
- Color tells what phase the element is in at room temperature

Information on the Periodic Table



Columns and Rows

- The periodic table has 18 columns
  - Called groups or families
  - Resemble each other
  - React with other substances in similar ways
  - Elements in Group 1 are metals that react strongly with water, exception is Hydrogen (atomic structure same, chemical properties different)
  - Group 18 barely reacts with all other elements, called inactive elements
- Groups are numbered 1-18
- The seven rows are called periods
  - Elements in a period have very different properties
  - In Period 4 change from very active metal to less active metal to metalloids to nonmetals
  - First element always reacts violently, last is always inactive

Ch. 14.3 What are compounds and mixtures?

Atoms Together

- Most atoms found in nature are not found as elements but as compounds
- Many components of your body are made of compounds
- Water is a compound and so are the proteins that make up your skin
- Each particle of a compound is made of exactly the same ratio of elements
  - Water: 2 parts Hydrogen 1 part Oxygen
- Properties of the element differ from those of the elements that form it
  - Chlorine is a greenish yellow, poisonous gas; Sodium a silvery white metal
  - When the combine they make sodium chloride which is table salt

Chemical Formulas

- Use symbols for compounds
- A chemical formula contains 2 parts
  - Chemical symbol: shows what elements are present in the compound
  - Subscript: tells how many atoms of each element is present
  - Water: H2O
- The subscript 1 is never written
  - If nothing is written then there is only one part of that element

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Separating Mixtures

- Mixtures can be easily separated
- They can be separated using their physical properties

Solutions

- Solutions form when one substance dissolves in another
- Salt water is a solution
- Has two components
  - Solute
  - Solvent
- When a substance dissolves, it breaks down into very small particles
- The solute particles mix evenly with the solvent particles
- That's why a solution appears to be a single substance
- Particles in a solution are so small, they can't even be seen with a microscope
- Solutions can be combinations of solids, liquids, or gases

Concentration

- All solutions do not contain the same amounts of solute and solvent
- The measure of the amount of solute dissolved in a solvent is concentration
- Solubility is the maximum amount of solute that can be dissolved in a solvent at a particular temperature
  - Adding sugar into iced tea after adding ice to the glass
- Expressed in grams of solute per millimeter of solvent
- The speed at which a substance dissolves is improved by mixing or stirring
- Increasing temperature of the solvent and crushing the solute into smaller pieces also helps

Acids and Bases

- Acids and bases are found every where
- Acids are found in foods and in your body cells
- You should never touch or eat something to find out if it is acid
- You can use blue litmus paper to check for an acid. It will turn red if there is
- Bases can be just as strong as acids
- Found in a lot of cleaners
- Bases turn red litmus paper blue

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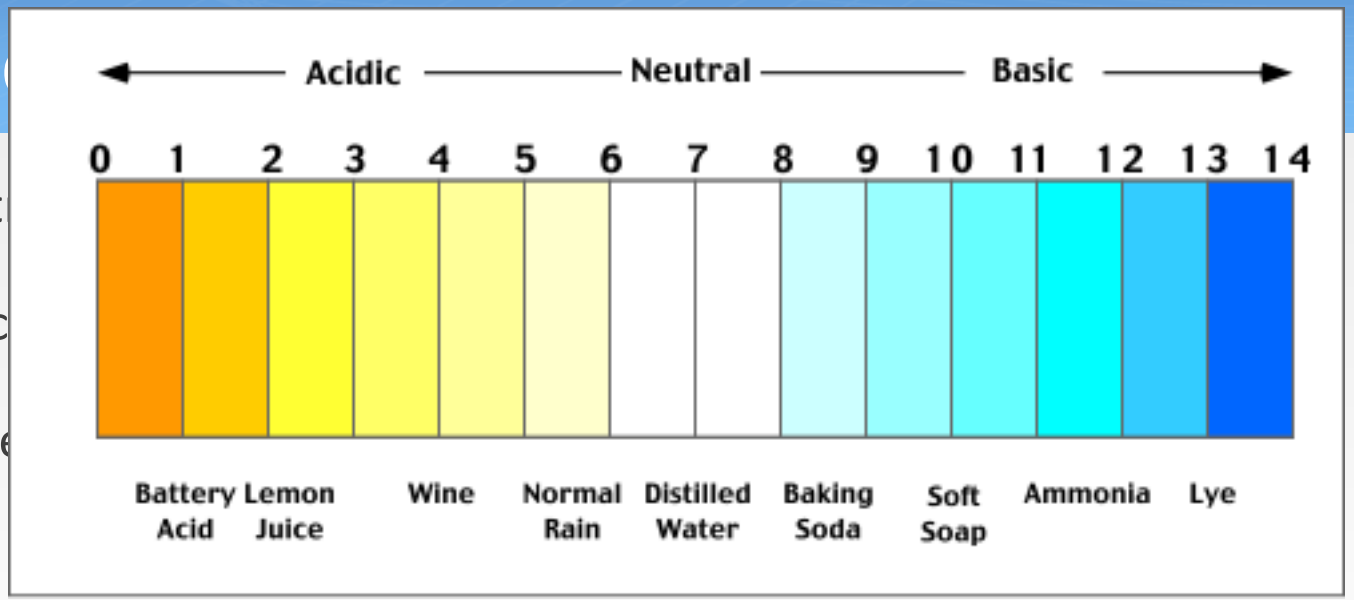

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- 0-7 ar
- Bases
- A pH of exactly 7 is neutral

Sources

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