Welcome to the Supercharged Science

Chemistry Teleclass Webinar!

You can fill out this worksheet as we go along to get the most out of time together, or you can use it as a review exercise at the end of the class to see where your strengths are.

What we're going to cover today:

- States of matter
- Atomic and molecular structure
- Chemical reaction rates
- Catalysts
- Polymers
- Supercooling
- Acids and Bases
- Endothermic and exothermic reactions

Write down two things you really want to know about chemistry.

1._____

2. _____

Do this NOW: Write down WHY you want to learn about the things you mentioned above. What will it give you, or provide you with, or make possible for you if you now understand these things that you wanted to learn?

_____

_____

IMPORTANT: During class, you can either fill out the worksheet, OR if that's too stressful or a hassle, just set it aside and fill it out after class is over so you can enjoy watching the class.

Answer key is on the last page, so put it in a place where you won't be tempted to peek at the answers until after you've given it your best shot.

Material List for Experiments in Lesson 3 (Teleclass Video):

- Aluminum pie plate
- Bowl
- Clear glue or white glue
- Disposable cups
- Goggles & gloves
- Hydrogen peroxide
- OPTIONAL: Instant reusable hand warmer (containing sodium acetate)
- Liquid soap
- Popsicle sticks
- Scissors or pliers
- Sodium tetraborate (also called “Borax”)
- Water bottle
- Yeast
- Yellow highlighter

During the Lesson:

You can look over the worksheet so you know what to listen for as you go through the class with me, or you can go through it along with me during class. OR… flip it over and forget about it and just enjoy the class. When class is over, flip it back over and fill it out and be amazed at how much you've picked up and learned!

1. A chemist _____new compounds and materials in a lab.

2. A chemical engineer deals with _____ reactions and factory scale equipment.

3. Chemistry is the study of _____ and how matter _____ with other matter and energy.

4. Chemists want to control the _____ of a reaction AND the _____ of a reaction.

5. A _____ changes the rate of the reaction but doesn't get involved in the reaction itself.

6. Matter is made of _____.

7. _____ are built from atoms.

8. The number of _____determines the type of atom.

9. Five elements needed for life: _____

   _____ _____

   _____ _____

10. Five states of matter are: _____

    _____ _____

    _____ _____

11. A _____ is a long chain of molecules, like the glue we used in our second experiment.

12. _____ happens when you cool a liquid very slowly past its freezing point.

13. _____ contains anthocyanin, which changes colors depending if it's exposed to acidic or basic solutions.

14. What I didn't know about chemistry until class today was:

    _____

    _____

Vocabulary Words:

Acids are sour (like a lemon), react with metals, and can burn your skin. They register between 1 and 7 on the pH scale.

An **acid-base reaction** deals with reactions that involve hydrogen (protons).

Atoms are made of a core group of neutrons and protons, with an electron cloud circling the nucleus.

Avogadro's constant is 6.022×10^{23}, and since "mole" is a lot easier to write than 6.022×10^{23}, chemists like to use it to help keep track of the particles in a chemical reaction. It's a handy way to convert between atoms and grams, or even molecules and grams.

Balancing Chemical Reactions Learning how to figure out whether a chemical reaction will occur and what comes out the other end is found by writing a balanced chemical equation to describe a chemical reaction.

Bases are bitter (like baking soda), slippery, and can also burn your skin. They measure between 7 and 14 on the pH scale.

Bose-Einstein condensate is atoms at such a low state of energy that the atoms actually blend together. Bose-Einstein condensate occurs only in laboratories under outrageously cold conditions.

The electrons in the outermost shell are the ones that form the **bonds** with other atoms. When one atom accepts or donates an electron to another atom, an **ionic bond** is formed. When the atoms share the electron(s), a **covalent bond** is formed. Usually an electron is more attracted to one atom than another, which forms **polar covalent** bond between atoms.

By knowing the value of the **bond energy**, we can predict if a chemical reaction will be exothermic or endothermic.

A **chemical change** rearranges the molecules and atoms to create new molecule combinations (like a campfire).

Chemists study **chemical kinetics** when they want to control the speed of a reaction as well as what gets generated from the process (the products of the reaction). Several factors affect the speed of a chemical reaction, including catalysts, surface area, temperature, and concentration.

A **combustion reaction** gives off energy, usually in the form of heat and light.

Atoms in a solid have a tendency to form **crystals**. Since the molecules are pulled close together and tightly, they form specific patterns.

A **decomposition** reaction breaks a complicated molecule into simpler ones

A **double displacement** (metathesis) reaction has two compounds exchanging bonds to form new compounds

The chemical reaction inside **electrochemical cells** is also a redox reaction. Batteries (also known as galvanic or voltaic cells) use a spontaneous chemical reaction inside to create energy. Non-spontaneous cells require an energy source (like a battery) in order for the chemical reaction to occur, called electrolysis.

Splitting the water molecule into parts (hydrogen and oxygen) requires power (**electrolysis**) to break the bonds.

Electronegativity is how attracted an electron is to an atom.
Thin layers of metal can be moved from one object to another using the **electroplating** technique.

Elements A substance made up of only one particular kind of atom is called a chemical element, and you can find a whole slew of these on the periodic table. The number assigned to the chemical element refers to the number of protons in the nucleus.

Endothermic reactions are reactions that absorb heat when they react (like a cold compresses).

Energy is the ability to do work. Energy can be transferred, in other words it can be changed from one form to another and from one object to another.

Exothermic reactions release energy in the form of heat, light, and sound (think fireworks).

Gases have no bonds between the molecules.

The jiggling motion in atoms is called **heat**.

Ideal Gas Law Pure substances all behave about the same when they are gases. The Ideal Gas Law relates temperature, pressure, and volume of these gases in one simple statement: $PV = nRT$ where P = pressure, V = volume, T = temperature, n = number of moles, and R is a constant.

Different **indicators** are used for specific ranges of acids and bases. Phenolphthalein changes from clear to pink when added to a base.

Atoms that have an electrical charge are called **ions**, as they have a different number of electrons than protons.

Ionization energy (measured in electronvolts, *eV*) is the amount of energy needed to completely remove an electron from gaseous atom or ion.

Le Chatelier's Principle predicts how changes in pressure, temperature, volume, or concentration will cause a reaction to shift and compensate for these changes.

Liquids have loose, stringy bonds between molecules that hold molecules together but allow them some flexibility.

Mass is a measure of how much matter (how many atoms) make up an object.

Matter is anything that has mass (anything that is affected by gravity). Most matter on our planet is made up of atoms and ions. Not all matter is made up of atoms, but all matter is made up of some kind of particle.

Changing from a solid to a liquid is called **melting**. Melting point is the temperature at which a material changes from solid to liquid. Objects absorb heat as they melt.

Moles A mole is a unit of measurement, just like inches or meters. One mole is the amount of a substance that has the same number of particles as found in 12 grams of carbon C-12, which is 6.022×10^{23} particles.

A **molecule** is the smallest unit of a compound that still has the compound's properties attached to it. Molecules are made up of two or more atoms held together by covalent bonds.

Nuclear reactions deal with changes inside the nucleus of an atom.

Neutralization Reaction (Hydrolysis) When acids and bases react with each other, they sometimes form a salt and water.

A periodic chart has a bunch of boxes, each representing one element. In each box is a ton of information about each element. In the upper left hand corner of each box is what's called the atomic number. The atomic number is the same as the number of protons in the atom.

pH stands for "power of hydrogen" and is a measure of how acidic a substance is.

A **physical change** happens when the molecules stay the same, but the volume and/or shape change (like wadding up tissue).

Plasma is basically a very high-energy gas. It is not very common on Earth but is the most common state of matter in the universe.

Polymers are long chains of slippery molecules. Coagulation happens when you cross-linking the chains into a fishnet-looking design.

Different factors affect the **rate of reaction**, or speed of the chemical reaction, including temperature, pressure, surface area, catalysts, and more. The main idea is that the more collisions between particles, the faster the reaction will take place.

Salt doesn't necessarily mean table salt (NaCl), but rather an ionic compound formed from acid-base combinations. Salts are held together by electrical charges (that's what makes it an ionic bond), as they are formed between cations (positive ions, like Na^+) and anions (negative ions, like Cl^-).

Quarks make up the nucleus of the atom. They are subatomic particles that you can arrange in certain ways to get protons and neutrons.

Redox reactions involve an exchange of electrons between compounds. Redox stands for oxidation-reduction. **Oxidation** happens when a compound loses electrons (increases oxidation state) and **reduction** occurs when a compound gains electrons (decrease in oxidation state).

Solids are the lowest energy form of matter on Earth. Solids are generally tightly packed molecules that are held together in such a way that they cannot change their positions. The atoms in a solid can wiggle and jiggle (vibrate) but they cannot move from one place to another. The typical characteristics that solids tend to have are that they keep their shape unless they are broken and they do not flow.

Materials change from one **state** to another depending on the temperature and these bonds. All materials have given points at which they change from state to state. As objects change state they do not change temperature. The heat that goes into something as its changing phases is used to change the "bonds" between molecules. Freezing points, melting points, boiling points and condensation points are the "speed limits" of the phases. Once the molecules reach that speed they must change state.

Synthesis Reaction happens when simple compounds come together to form a more complicated compound

Answer Key:

1. A chemist develops new compounds and materials in a lab.
2. A chemical engineer deals with large scale reactions and factory scale equipment.
3. Chemistry is the study of matter and how matter interacts with other matter and energy.
4. Chemists want to control the speed of a reaction AND the products of a reaction.
5. A catalyst changes the rate of reaction without getting involved in the reaction.
6. Matter is made of atoms.
7. Molecules are built from atoms.
8. The number of protons determines the type of atom.
9. Five elements needed for life are: carbon, hydrogen, oxygen, nitrogen, calcium.
10. The five states of matter are: solid, liquid, gas, plasma, Bose-Einstein Condensate.
11. A polymer is a long chain of molecules, like the glue we used in our experiment.
12. Supercooling happens when you cool a liquid very slowly past its freezing point.
13. Red cabbage juice contains anthocyanin, which changes colors depending if it's exposed to acidic or basic solutions.