

Metals, Nonmetals and Metalloids Lab

NAME: _____ DATE: _____ PERIOD: _____

Background:

The periodic table can be classified into metals, nonmetals and metalloids. The characteristics of these groups vary greatly. Metals tend to be ductile, malleable, have a metallic luster and are conductors of heat and electricity. Nonmetals tend to be non-lustrous, brittle and poor conductors of heat and electricity. Ductile means that an element has the ability to be drawn into a wire. Copper is used in wiring because it is both ductile and conductive. Malleable means that an element has the ability to be hammered into thin sheets while luster means the element is shiny. Silver and gold are both malleable and lustrous, excellent properties for using these elements in jewelry. Metalloids share some characteristics of both metals and nonmetals. For example, silicon has luster and looks like a metal but does not conduct heat or electricity like a metal. Silicon is classified as a semi-conductor since it will conduct electricity better than a nonmetal. The properties of silicon make it an excellent choice for use in electronic devices.

Table 1: Lead, Tin, Carbon, Silicon

- 1) Take a magnet and pass over each element. Record results into table below.
- 2) Take a conductivity tester and test each element. Record results into table.
- 3) Take the strips of lead and tin. Gently bend each. Do not break them! Which is more malleable: lead or tin? _____

| Element | Color | State (S,L,G) | Metal, Metalloid Nonmetal | Magnetic Yes or No | Conductive Yes or No |
|---------|-------|---------------|---------------------------|--------------------|----------------------|
| Lead | | | | | |
| Tin | | | | | |
| Carbon | | | | | |
| Silicon | | | | | |

Table 2: Iron, Zinc, Nickel, Copper

- 1) Take a magnet and pass over each element. Record results into table below.
- 2) Take a conductivity tester and test each element. Record results into table.
- 3) Take the strips of iron and zinc. Gently bend each. Do not break them! Which is more malleable: iron or zinc? _____

| Element | Color | State (S,L,G) | Metal, Metalloid Nonmetal | Magnetic Yes or No | Conductive Yes or No |
|---------|-------|---------------|---------------------------|--------------------|----------------------|
| Iron | | | | | |
| Zinc | | | | | |
| Nickel | | | | | |
| Copper | | | | | |

- 4) What is meant by the word "ductile"? _____

- 5) Which element appears to be very ductile? _____
- 6) Are the elements in the same period or family? _____
- 7) Which element appears prone to rusting? _____

Table 3: Sulfur, Aluminum, Silicon, Magnesium

- 1) What is meant by "luster"? _____
- 2) Which element has a high degree of luster? _____
- 3) Which element appears to be most nonmetallic? _____
- 4) Carefully run a magnetic across the outside of the container. Check if the element follows the magnet. Record results into table below. Do not open the containers. Observe and record color and state of element. Classify.

| Element | Color | State (S,L,G) | Magnetic Yes or No | Metal, Nonmetal, Metalloid? |
|-----------|-------|---------------|-----------------------|-----------------------------------|
| Sulfur | | | | |
| Aluminum | | | | |
| Silicon | | | | |
| Magnesium | | | | |

Table 4: Cadmium, Mercury, Zinc

- 1) Which element is liquid at room temperature? _____
- 2) Are these elements in the same period or same family? _____
- 3) Would these elements be classified as metals or metalloids? _____
- 4) Which element appears to be most lustrous? _____

Table 5: Helium, Nitrogen, Oxygen

- 1) Would these elements be classified as metals or nonmetals? _____
- 2) Which of these elements are in the same period? _____
- 3) What state are these elements in at room temperature? _____

Table 6: Hydrogen, Nickel, Argon, Gallium

- 1) Which elements appear to be metals? _____
- 2) Which elements appear to be nonmetals? _____

Conclusion:

- 1) An element is _____ if it can be drawn into a wire.
- 2) Elements that are _____ can be hammered into thin sheets.
- 3) What two properties of copper make it desirable for use in wiring?
_____ and _____
- 4) What two properties of silver and gold are desirable for use in making jewelry?
_____ and _____
- 5) What class of elements are brittle and poor conductors of heat? _____
- 6) All metals are magnetic. Circle your choice: True or False _____
- 7) Most metals are _____ (solids, liquids or gases) at room temperature.
- 8) Most nonmetals are _____ (solids, liquids or gases) at room temperature.
- 9) Copper is sometimes coated on the bottom of cookware. What property of copper makes it desirable for this use? _____

Teacher Notes: Metals, Nonmetals and Metalloids

Teaching Notes:

This lab is used as an introduction to terminology and general differences between metals and nonmetals. No lecture or discussion is needed before doing this activity. I prefer sample bottles with screw on lids. I then place the label around the container / lid area to detour opening of the sample bottles.

Lab Day: Approximately 30 minutes

Students read background then answer conclusion questions 1-5. Students are then dismissed to lab. Students walk to each lab station and answer questions or complete chart for that table. Students turn in paper before leaving class.

Table 1:

Magnet and Conductivity Tester

(The testers used in this lab were the student conductivity testers from Flinn Scientific.)

Test tube or sample bottle containing: Lead, Tin, Carbon, Silicon

Metal strips of: Lead and Tin

Petri dish of: Silicon pieces and carbon

(Carbon can be used as a conductor as in a rod in a dry cell. Carbon used here nonconductive.)

Table 2:

Magnet and Conductivity Tester

Test tube or sample bottle containing: Iron, Zinc, Nickel, Copper

Metals strips of: Iron, Zinc, Nickel, Copper

If strips are not labeled, take a black permanent marker and write names on strips.

Table 3:

Magnet

Test tube or sample bottle containing: Sulfur, Aluminum, Silicon, Magnesium

(The sulfur bottle should be tightly sealed. Be aware of any student with a sulfur allergy.)

Table 4:

Test tube or sample bottle containing: Cadmium, Mercury, Zinc

The Mercury used here is one drop sealed in an acrylic block.

Table 5:

Test tube or sample bottle: Helium, Nitrogen, Oxygen

Confession: They are empty sample bottles labeled Helium, Nitrogen and Oxygen!

Table 6:

Test tube or sample bottle: Hydrogen, Nickel, Argon, Gallium

Confession:

Argon and Hydrogen are empty sample bottles labeled Argon and Hydrogen!

If a student asks if hydrogen and argon are actually in there I reply "If you can tell me a test to identify each gas, then I will answer". This gets them thinking and often to a discussion about hydrogen and oxygen tests using wooden splints.

Metals, Nonmetals and Metalloids Lab

NAME: _____ DATE: _____ PERIOD: _____

Background:

The periodic table can be classified into metals, nonmetals and metalloids. The characteristics of these groups vary greatly. Metals tend to be ductile, malleable, have a metallic luster and are conductors of heat and electricity. Nonmetals tend to be non-lustrous, brittle and poor conductors of heat and electricity. Ductile means that an element has the ability to be drawn into a wire. Copper is used in wiring because it is both ductile and conductive. Malleable means that an element has the ability to be hammered into thin sheets while luster means the element is shiny. Silver and gold are both malleable and lustrous, excellent properties for using these elements in jewelry. Metalloids share some characteristics of both metals and nonmetals. For example, silicon has luster and looks like a metal but does not conduct heat or electricity like a metal. Silicon is classified as a semi-conductor since it will conduct electricity better than a nonmetal. The properties of silicon make it an excellent choice for use in electronic devices.

Table 1: Lead, Tin, Carbon, Silicon

- 1) Take a magnet and pass over each element. Record results into table below.
- 2) Take a conductivity tester and test each element. Record results into table.
- 3) Take the strips of lead and tin. Gently bend each. Do not break them! Which is more malleable: lead or tin? Lead

| Element | Color | State (S,L,G) | Metal, Metalloid Nonmetal | Magnetic Yes or No | Conductive Yes or No |
|---------|-------------------|---------------|---------------------------|--------------------|----------------------|
| Lead | <i>SilverGray</i> | <i>S</i> | <i>Metal</i> | <i>No</i> | <i>Yes</i> |
| Tin | <i>ShinyGray</i> | <i>S</i> | <i>Metal</i> | <i>No</i> | <i>Yes</i> |
| Carbon | <i>Black</i> | <i>S</i> | <i>Nonmetal</i> | <i>No</i> | <i>No</i> |
| Silicon | <i>DarkGray</i> | <i>S</i> | <i>Metalloid</i> | <i>No</i> | <i>Yes</i> |

Table 2: Iron, Zinc, Nickel, Copper

- 1) Take a magnet and pass over each element. Record results into table below.
- 2) Take a conductivity tester and test each element. Record results into table.
- 3) Take the strips of iron and zinc. Gently bend each. Do not break them! Which is more malleable: iron or zinc? Zinc

| Element | Color | State (S,L,G) | Metal, Metalloid Nonmetal | Magnetic Yes or No | Conductive Yes or No |
|---------|------------------|---------------|---------------------------|--------------------|----------------------|
| Iron | <i>GrayBlack</i> | <i>S</i> | <i>Metal</i> | <i>Yes</i> | <i>Yes</i> |
| Zinc | <i>LightGray</i> | <i>S</i> | <i>Metal</i> | <i>No</i> | <i>Yes</i> |
| Nickel | <i>Silver</i> | <i>S</i> | <i>Metal</i> | <i>Yes</i> | <i>Yes</i> |
| Copper | <i>Copper</i> | <i>S</i> | <i>Metal</i> | <i>No</i> | <i>Yes</i> |

- 4) What is meant by the word "ductile"? drawn into a wire

- Which element appears to be very ductile? copper
- Are the elements in the same period or family? period
- Which element appears prone to rusting? iron

Table 3: Sulfur, Aluminum, Silicon, Magnesium

- What is meant by "luster"? shiny
- Which element has a high degree of luster? aluminum
- Which element appears to be most nonmetallic? sulfur
- Carefully run a magnetic across the outside of the container. Check if the element follows the magnet. Record results into table below. Do not open the containers. Observe and record color and state of element. Classify.

| Element | Color | State (S,L,G) | Magnetic Yes or No | Metal, Nonmetal, Metalloid? |
|-----------|--------------------|---------------|-----------------------|-----------------------------------|
| Sulfur | <i>Yellow</i> | <i>S</i> | <i>No</i> | <i>Nonmetal</i> |
| Aluminum | <i>Silver</i> | <i>S</i> | <i>No</i> | <i>Metal</i> |
| Silicon | <i>Silver Gray</i> | <i>S</i> | <i>No</i> | <i>Metalloid</i> |
| Magnesium | <i>Silver Gray</i> | <i>S</i> | <i>No</i> | <i>Metal</i> |

Table 4: Cadmium, Mercury, Zinc

- Which element is liquid at room temperature? mercury
- Are these elements in the same period or same family? family
- Would these elements be classified as metals or metalloids? metals
- Which element appears to be most lustrous? mercury

Table 5: Helium, Nitrogen, Oxygen

- Would these elements be classified as metals or nonmetals? nonmetals
- Which of these elements are in the same period? nitrogen, oxygen
- What state are these elements in at room temperature? gas

Table 6: Hydrogen, Nickel, Argon, Gallium

- Which elements appear to be metals? nickel, gallium
- Which elements appear to be nonmetals? hydrogen, argon

Conclusion:

- An element is ductile if it can be drawn into a wire.
- Elements that are malleable can be hammered into thin sheets.
- What two properties of copper make it desirable for use in wiring?
conducts electricity and ductile (any order)
- What two properties of silver and gold are desirable for use in making jewelry?
malleable and lustrous (any order)
- What class of elements are brittle and poor conductors of heat? nonmetals
- All metals are magnetic. Circle your choice: True or **False**
- Most metals are solids (solids, liquids or gases) at room temperature.
- Most nonmetals are gases (solids, liquids or gases) at room temperature.
- Copper is sometimes coated on the bottom of cookware. What property of copper makes it desirable for this use? conducts heat

Metals, Nonmetals and Metalloids Lab Quiz

NAME: _____ DATE: _____ PERIOD: _____

- 1) _____ can be drawn into a wire.
- 2) _____ can be hammered into thin sheets.
- 3) What two properties of copper make it desirable for use in wiring?
_____ and _____
- 4) What two properties of silver and gold are desirable for use in making jewelry?
_____ and _____
- 5) _____ elements are typically malleable and lustrous.
- 6) _____ elements are typically colorful and exists in various states.
- 7) Most metals are _____ (solids, liquids or gases) at room temperature.
- 8) Most nonmetals are _____ (solids, liquids or gases) at room temperature.
- 9) Copper is sometimes coated on the bottom of cookware. What property of copper makes it desirable for this use? _____

Word Bank:

Malleable

Ductile

Conducts Heat

Conducts Electricity

Brittle

Lustrous

Dull

Nonconductive

Metallic

Nonmetallic

Metalloids

May use word more than once!

Metals, Nonmetals and Metalloids Lab Make-up

NAME: _____ DATE: _____ PERIOD: _____

Background:

The periodic table can be classified into metals, nonmetals and metalloids. The characteristics of these groups vary greatly. Metals tend to be ductile, malleable, have a metallic luster and are conductors of heat and electricity. Nonmetals tend to be non-lustrous, brittle and poor conductors of heat and electricity. Ductile means that an element has the ability to be drawn into a wire. Copper is used in wiring because it is both ductile and conductive. Malleable means that an element has the ability to be hammered into thin sheets while luster means the element is shiny. Silver and gold are both malleable and lustrous, excellent properties for using these elements in jewelry. Metalloids share some characteristics of both metals and nonmetals. For example, silicon has luster and looks like a metal but does not conduct heat or electricity like a metal. Silicon is classified as a semi-conductor since it will conduct electricity better than a nonmetal. The properties of silicon make it an excellent choice for use in electronic devices.

Table 1: Lead, Tin, Carbon, Silicon

- 1) Take a magnet and pass over each element. Record results into table below.
- 2) Take a conductivity tester and test each element. Record results into table.
- 3) Take the strips of lead and tin. Gently bend each. Do not break them! Which is more malleable: lead or tin? Lead

| Element | Color | State (S,L,G) | Metal, Metalloid Nonmetal | Magnetic Yes or No | Conductive Yes or No |
|---------|-------------------|---------------|---------------------------|--------------------|----------------------|
| Lead | <i>SilverGray</i> | | | <i>No</i> | <i>Yes</i> |
| Tin | <i>ShinyGray</i> | | | <i>No</i> | <i>Yes</i> |
| Carbon | <i>Black</i> | | | <i>No</i> | <i>No</i> |
| Silicon | <i>DarkGray</i> | | | <i>No</i> | <i>Yes</i> |

Table 2: Iron, Zinc, Nickel, Copper

- 1) Take a magnet and pass over each element. Record results into table below.
- 2) Take a conductivity tester and test each element. Record results into table.
- 3) Take the strips of iron and zinc. Gently bend each. Do not break them! Which is more malleable: iron or zinc? Zinc

| Element | Color | State (S,L,G) | Metal, Metalloid Nonmetal | Magnetic Yes or No | Conductive Yes or No |
|---------|------------------|---------------|---------------------------|--------------------|----------------------|
| Iron | <i>GrayBlack</i> | | | <i>Yes</i> | <i>Yes</i> |
| Zinc | <i>LightGray</i> | | | <i>No</i> | <i>Yes</i> |
| Nickel | <i>Silver</i> | | | <i>Yes</i> | <i>Yes</i> |
| Copper | <i>Copper</i> | | | <i>No</i> | <i>Yes</i> |

- 4) What is meant by the word "ductile"? _____

- Which element appears to be very ductile? copper
- Are the elements in the same period or family? _____
- Which element appears prone to rusting? iron

Table 3: Sulfur, Aluminum, Silicon, Magnesium

- What is meant by "luster"? _____
- Which element has a high degree of luster? aluminum
- Which element appears to be most nonmetallic? _____
- Carefully run a magnetic across the outside of the container. Check if the element follows the magnet. Record results into table below. Do not open the containers. Observe and record color and state of element. Classify.

| Element | Color | State (S,L,G) | Magnetic Yes or No | Metal, Nonmetal, Metalloid? |
|-----------|--------------------|---------------|-----------------------|-----------------------------------|
| Sulfur | <i>Yellow</i> | | <i>No</i> | |
| Aluminum | <i>Silver</i> | | <i>No</i> | |
| Silicon | <i>Silver Gray</i> | | <i>No</i> | |
| Magnesium | <i>Silver Gray</i> | | <i>No</i> | |

Table 4: Cadmium, Mercury, Zinc

- Which element is liquid at room temperature? _____
- Are these elements in the same period or same family? _____
- Would these elements be classified as metals or metalloids? _____
- Which element appears to be most lustrous? mercury

Table 5: Helium, Nitrogen, Oxygen

- Would these elements be classified as metals or nonmetals? _____
- Which of these elements are in the same period? _____
- What state are these elements in at room temperature? _____

Table 6: Hydrogen, Nickel, Argon, Gallium

- Which elements appear to be metals? nickel , gallium
- Which elements appear to be nonmetals? hydrogen , argon

Conclusion:

- An element is _____ if it can be drawn into a wire.
- Elements that are _____ can be hammered into thin sheets.
- What two properties of copper make it desirable for use in wiring?
_____ and _____
- What two properties of silver and gold are desirable for use in making jewelry?
_____ and _____
- What class of elements are brittle and poor conductors of heat? _____
- All metals are magnetic. Circle your choice: True or False _____
- Most metals are _____ (solids, liquids or gases) at room temperature.
- Most nonmetals are _____ (solids, liquids or gases) at room temperature.
- Copper is sometimes coated on the bottom of cookware. What property of copper makes it desirable for this use? _____

Types of Chemical Reactions Lab

NAME: _____ DATE: _____ PERIOD: _____

Background:

A chemical reaction often gives visible clues. The release of a gas, formation of a solid, and changes in heat or color sometimes indicate that a reaction has occurred.

| Reaction Type | Reaction Class | Description |
|-------------------------------|------------------------------------|--|
| Double Replacement "DR" | Acid – Base OR Precipitation | "Compound + Compound" |
| Single Replacement "SR" | Redox | "Element + Compound" |
| Complete Combustion "CC" | Redox | " $C_xH_y + O_2 \rightarrow CO_2 + H_2O$ " Blue flame |
| Incomplete Combustion "IC" | Redox | " $C_xH_y + O_2 \rightarrow CO + H_2O$ " Yellow flame |
| Decomposition "D" | Redox | "one reactant" |
| Synthesis "S" | Redox | "one product" |

Complete a balanced equation for each of the following stations. Give reaction type & class and the evidence for each reaction. Evidence Choices: heat, light, bubbles, solid.

1) Add a few drops of potassium iodide, KI, to a few drops of lead (II) nitrate,
Pb(NO₃)₂.

Type _____ Evidence _____ Class _____

Balanced equation: _____KI + _____Pb(NO₃)₂ →

2) Add a few drops of vinegar (5% HC₂H₃O₂) to a pea size amount of chalk, (CaCO₃).

Type _____ Evidence _____ Class _____

Balanced equation: _____HC₂H₃O₂ + _____CaCO₃ →

3) Using crucible tongs, place a small strip of magnesium ribbon (Mg) into a flame. DO NOT LOOK DIRECTLY INTO THE FLAME WHEN THE REACTION OCCURS!

Type _____ Evidence _____ Class _____

Balanced equation: _____Mg + _____O₂ →

4) Light a Bunsen burner and adjust the barrel so that there is insufficient oxygen.

Observe and write the balanced equation for the burning of methane (CH₄) gas.

Type _____ Evidence _____ Class _____

Balanced equation: _____CH₄ + _____O₂ →

5) Light a Bunsen burner and adjust the barrel so that there is sufficient oxygen.
Observe and write the balanced equation for the burning of the methane gas.

Type _____ Evidence _____ Class _____

Balanced equation: $\text{CH}_4 + \text{O}_2 \rightarrow$

6) Add a pea size amount of Alka-Seltzer into a small test tube and add 3 milliliters of water. The water only acts as a medium in which the reaction between the two ingredients can occur. Alka-Seltzer is made of sodium bicarbonate (NaHCO_3) and citric acid ($\text{HC}_6\text{H}_7\text{O}_7$).

Type _____ Evidence _____ Class _____

Balanced equation: $\text{NaHCO}_3 + \text{HC}_6\text{H}_7\text{O}_7 \rightarrow$

7) Add a few drops of sodium hydroxide, NaOH , with a few drops of cupric nitrate, $\text{Cu}(\text{NO}_3)_2$.

Type _____ Evidence _____ Class _____

Balanced equation: $\text{NaOH} + \text{Cu}(\text{NO}_3)_2 \rightarrow$

8) Add several drops of hydrochloric acid, HCl , to a small strip of magnesium ribbon.

Type _____ Evidence _____ Class _____

Balanced equation: $\text{HCl} + \text{Mg} \rightarrow$

9) Add a few drops of silver nitrate, AgNO_3 , to a few drops of sodium chloride, NaCl .

Type _____ Evidence _____ Class _____

Balanced equation: $\text{AgNO}_3 + \text{NaCl} \rightarrow$

10) Add several drops of sulfuric acid, H_2SO_4 , to a few small pieces of zinc metal.

Type _____ Evidence _____ Class _____

Balanced equation: $\text{H}_2\text{SO}_4 + \text{Zn} \rightarrow$

11) Place a pea size amount of baking soda, NaHCO_3 , in a test tube and add 1-2 milliliters of vinegar (5% $\text{HC}_2\text{H}_3\text{O}_2$).

Type _____ Evidence _____ Class _____

Balanced equation: $\text{NaHCO}_3 + \text{HC}_2\text{H}_3\text{O}_2 \rightarrow$

12) Observe the Hoffman apparatus, which splits water using electric current.

Type _____ Evidence _____ Class _____

Balanced equation: $\text{H}_2\text{O} \rightarrow$

Study the gas collecting in tube #1 and the gas collecting in tube #2, using the balanced equation written above which tube is collecting oxygen and which is collecting hydrogen. Explain your reasoning.

Teacher Notes: Types of Reactions

This lab is a variation of the Types of Reactions Lab in Volume 3. The reason for the modification was to have a form that is user friendly to lower levels of chemistry.

Set-up:

There are 12 stations for this lab and the lab will take approximately an hour to set up the first time through. The following year the lab should only take 15-25 minutes to set up. The dropping bottles could be made and stored as a kit for the following year. The equipment and glassware are standard items in a chemistry room and should be easy to obtain and set out. Instead of beakers containing the substances plastic chemical bottles could be used instead. This will allow for all the chemicals to be in either a dropping bottle or a plastic bottle and could be stored as a kit.

Station 1

Test tube rack, test tube, waste beaker, dropper bottles of KI and $\text{Pb}(\text{NO}_3)_2$

Station 2

Test tube rack, test tube, waste beaker, dropper bottle of vinegar and beaker containing calcium carbonate and a spatula

Station 3

Small beaker with pre-cut Mg strips, tongs, striker, waste beaker, Bunsen burner

Station 4

Striker, Bunsen burner

Station 5

Striker, Bunsen burner

Station 6

Test tube rack, test tube, waste beaker, 10 mL graduated cylinder and beaker containing a mixture of baking soda/citric acid and a spatula

Making the mixture using chemicals from the storeroom cuts down on the cost of using actual Alka-Seltzer[®] tablets.

Station 7

Test tube rack, test tube, waste beaker, dropper bottles of NaOH and $\text{Cu}(\text{NO}_3)_2$

Station 8

Test tube rack, test tube, waste beaker, dropper bottle of HCl and small beaker containing pre-cut strips of Mg ribbon

Station 9

Test tube rack, test tube, waste beaker, dropper bottles of AgNO_3 and NaCl

Station 10

Test tube rack, test tube, waste beaker, dropper bottle of H_2SO_4 and small beaker containing small pieces of mossy zinc

Station 11

Test tube rack, test tube, waste beaker, dropper bottle of vinegar and small beaker containing baking soda and a spatula

Station 12

Hoffman Apparatus with tubes labeled #1 and #2

Teaching Tips:

This lab should be done after students have determined reaction types, predicted products and written balanced equations.

The students enjoy this lab since there are many things to see. The students should be very familiar with lighting and adjusting a Bunsen burner before doing this lab. Students must be warned about looking directly into the burning of the magnesium ribbon. This could be done instead as a demonstration for the students. If not done as a demonstration, be sure you are monitoring this station closely. Students should also be told not to touch the Hoffman Apparatus and to only observe the reaction.

At the end of the period collect the gases from the apparatus and demonstrate the test for hydrogen and oxygen gas. Holding the hydrogen test tube inverted and placing a lit splint under the mouth should demonstrate to students that the gas is lighter than air and that it pops when it reacts with the oxygen in the air. Holding the oxygen test tube upright and placing a glowing splint into the test tube should demonstrate to students that the oxygen is heavier than air and that the splint bursts into a flame when in the presence of pure oxygen gas.

For simplicity the citric acid in the reaction is treated like a monoprotic acid. Further discussion on polyprotic acids and the actual number of ionizable hydrogen ions from citric acid could be done as a follow up.

Although some of the test tubes could have been flushed down a sink, a waste container at each station provides consistency in disposal and cleaning up.

Types of Chemical Reactions Lab

NAME: _____ DATE: _____ PERIOD: _____

Background:

A chemical reaction often gives visible clues. The release of a gas, formation of a solid, and changes in heat or color sometimes indicate that a reaction has occurred.

| Reaction Type | Reaction Class | Description |
|-------------------------------|------------------------------------|---|
| Double Replacement "DR" | Acid – Base OR Precipitation | "Compound + Compound" |
| Single Replacement "SR" | Redox | "Element + Compound" |
| Complete Combustion "CC" | Redox | "C _x H _y + O ₂ → CO ₂ + H ₂ O" Blue flame |
| Incomplete Combustion "IC" | Redox | "C _x H _y + O ₂ → CO + H ₂ O" Yellow flame |
| Decomposition "D" | Redox | "one reactant" |
| Synthesis "S" | Redox | "one product" |

Complete a balanced equation for each of the following stations. Give reaction type & class and the evidence for each reaction. Evidence Choices: heat, light, bubbles, solid.

- Add a few drops of potassium iodide, KI, to a few drops of lead (II) nitrate, Pb(NO₃)₂.
Type DR Evid solid Class P
2 KI + Pb(NO₃)₂ → PbI₂ + 2 KNO₃
- Add a few drops of vinegar (5% HC₂H₃O₂) to a pea size amount of chalk, (CaCO₃).
Type DR/D Evid gas Class AB/RD
2 HC₂H₃O₂ + CaCO₃ → H₂CO₃ + Ca(C₂H₃O₂)₂
H₂CO₃ → H₂O + CO₂
- Using crucible tongs, place a small strip of magnesium ribbon (Mg) into a flame. DO NOT LOOK DIRECTLY INTO THE FLAME WHEN THE REACTION OCCURS!
Type S Evid light/heat Class RD
2 Mg + O₂ → 2 MgO
- Light a Bunsen burner and adjust the barrel so that there is insufficient oxygen. Observe and write the balanced equation for the burning of methane (CH₄) gas.
Type IC Evid light/heat Class RD
2 CH₄ + 3 O₂ → 2 CO + 4 H₂O

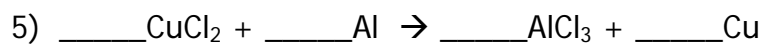
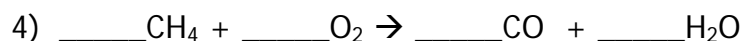
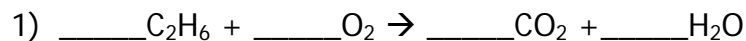
- 5) Light a Bunsen burner and adjust the barrel so that there is sufficient oxygen. Observe and write the balanced equation for the burning of the methane gas.
Type CC Evid light/heat Class RD
 $\text{CH}_4 + 2 \text{O}_2 \rightarrow \text{CO}_2 + 2 \text{H}_2\text{O}$
- 6) Add a pea size amount of Alka-Seltzer into a small test tube and add 3 milliliters of water. The water only acts as a medium in which the reaction between the two ingredients can occur. Alka-Seltzer is made of sodium bicarbonate (NaHCO_3) and citric acid ($\text{HC}_6\text{H}_7\text{O}_7$).
Type DR/D Evid gas Class AB/RD
 $\text{NaHCO}_3 + \text{HC}_6\text{H}_7\text{O}_7 \rightarrow \text{H}_2\text{CO}_3 + \text{NaC}_6\text{H}_7\text{O}_7$
 $\text{H}_2\text{CO}_3 \rightarrow \text{H}_2\text{O} + \text{CO}_2$
- 7) Add a few drops of sodium hydroxide, NaOH , with a few drops of cupric nitrate, $\text{Cu}(\text{NO}_3)_2$.
Type DR Evid solid Class P
 $2 \text{NaOH} + \text{Cu}(\text{NO}_3)_2 \rightarrow \text{Cu}(\text{OH})_2 + 2 \text{NaNO}_3$
- 8) Add several drops of hydrochloric acid, HCl , to a small strip of magnesium ribbon.
Type SR Evid gas Class RD
 $2 \text{HCl} + \text{Mg} \rightarrow \text{MgCl}_2 + \text{H}_2$
- 9) Add a few drops of silver nitrate, AgNO_3 , to a few drops of sodium chloride, NaCl .
Type DR Evid solid Class P
 $\text{AgNO}_3 + \text{NaCl} \rightarrow \text{AgCl} + \text{NaNO}_3$
- 10) Add several drops of sulfuric acid, H_2SO_4 , to a few small pieces of zinc metal.
Type SR Evid gas Class RD
 $\text{H}_2\text{SO}_4 + \text{Zn} \rightarrow \text{ZnSO}_4 + \text{H}_2$
- 11) Place a pea size amount of baking soda, NaHCO_3 , in a test tube and add 1-2 milliliters of vinegar (5% $\text{HC}_2\text{H}_3\text{O}_2$).
Type DR/D Evid gas Class AB/RD
 $\text{NaHCO}_3 + \text{HC}_2\text{H}_3\text{O}_2 \rightarrow \text{H}_2\text{CO}_3 + \text{NaC}_2\text{H}_3\text{O}_2$
 $\text{H}_2\text{CO}_3 \rightarrow \text{H}_2\text{O} + \text{CO}_2$
- 12) Observe the Hoffman apparatus, which splits water using electric current.
Type D Evid gas Class RD
 $2 \text{H}_2\text{O} \rightarrow 2 \text{H}_2 + \text{O}_2$

The tube with the greatest amount of gas produced is the tube containing hydrogen because in the balanced equation 2 moles of hydrogen is produced to every 1 mole of oxygen.

Types of Chemical Reactions Lab Quiz

NAME: _____ DATE: _____ PERIOD: _____

Balance the following reactions by placing the appropriate stoichiometric coefficient into each blank.



Give the reaction type by placing one of the following choices into the blank.

DR Double Replacement

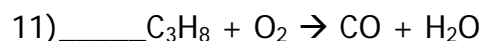
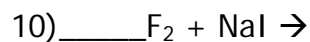
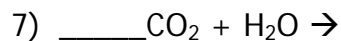
SR Single Replacement

D Decomposition

S Synthesis

IC Incomplete Combustion

CC Complete Combustion

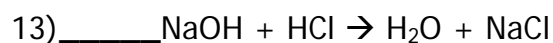
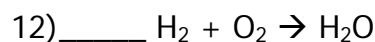


Give the class by placing one of the following choices into the blank.

A-B Acid-Base

Prec Precipitation

Redox Reduction-Oxidation



Types of Chemical Reactions Lab Make-up

NAME: _____ DATE: _____ PERIOD: _____

Background:

A chemical reaction often gives visible clues. The release of a gas, formation of a solid, and changes in heat or color sometimes indicate that a reaction has occurred.

| Reaction Type | Reaction Class | Description |
|-------------------------------|------------------------------------|--|
| Double Replacement "DR" | Acid – Base OR Precipitation | "Compound + Compound" |
| Single Replacement "SR" | Redox | "Element + Compound" |
| Complete Combustion "CC" | Redox | " $C_xH_y + O_2 \rightarrow CO_2 + H_2O$ " Blue flame |
| Incomplete Combustion "IC" | Redox | " $C_xH_y + O_2 \rightarrow CO + H_2O$ " Yellow flame |
| Decomposition "D" | Redox | "one reactant" |
| Synthesis "S" | Redox | "one product" |

Complete a balanced equation for each of the following stations. Give reaction type & class and the evidence for each reaction. Evidence Choices: heat, light, bubbles, solid.

- 1) Add a few drops of potassium iodide, KI, to a few drops of lead (II) nitrate, $Pb(NO_3)_2$.

Type _____ Evidence _____ Class _____ *A yellow solid forms.*

Balanced equation: _____KI + _____ $Pb(NO_3)_2 \rightarrow$

- 2) Add a few drops of vinegar (5% $HC_2H_3O_2$) to a pea size amount of chalk, ($CaCO_3$).

Type _____ Evidence _____ Class _____ *Many bubbles are produced.*

Balanced equation: _____ $HC_2H_3O_2 +$ _____ $CaCO_3 \rightarrow$

- 3) Using crucible tongs, place a small strip of magnesium ribbon (Mg) into a flame. DO NOT LOOK DIRECTLY INTO THE FLAME WHEN THE REACTION OCCURS!

Type _____ Evidence _____ Class _____ *The Mg burns with a bright light.*

Balanced equation: _____Mg + _____ $O_2 \rightarrow$

- 4) Light a Bunsen burner and adjust the barrel so that there is insufficient oxygen.

Observe and write the balanced equation for the burning of methane (CH_4) gas.

Type _____ Evidence _____ Class _____ *Gas burns producing a yellow flame.*

Balanced equation: _____ $CH_4 +$ _____ $O_2 \rightarrow$

5) Light a Bunsen burner and adjust the barrel so that there is sufficient oxygen.

Observe and write the balanced equation for the burning of the methane gas.

Type _____ Evidence _____ Class _____ *Gas burns producing a blue flame.*

Balanced equation: _____CH₄ + _____O₂ →

6) Add a pea size amount of Alka-Seltzer into a small test tube and add 3 milliliters of water. The water only acts as a medium in which the reaction between the two ingredients can occur. Alka-Seltzer is made of sodium bicarbonate (NaHCO₃) and citric acid (HC₆H₇O₇).

Type _____ Evidence _____ Class _____ *Many bubbles form.*

Balanced equation: _____NaHCO₃ + _____HC₆H₇O₇ →

7) Add a few drops of sodium hydroxide, NaOH, with a few drops of cupric nitrate, Cu(NO₃)₂.

Type _____ Evidence _____ Class _____ *A precipitate forms.*

Balanced equation: _____NaOH + _____Cu(NO₃)₂ →

8) Add several drops of hydrochloric acid, HCl, to a small strip of magnesium ribbon.

Type _____ Evidence _____ Class _____ *Many bubbles form.*

Balanced equation: _____HCl + _____Mg →

9) Add a few drops of silver nitrate, AgNO₃, to a few drops of sodium chloride, NaCl.

Type _____ Evidence _____ Class _____ *A white precipitate forms.*

Balanced equation: _____AgNO₃ + _____NaCl →

10) Add several drops of sulfuric acid, H₂SO₄, to a few small pieces of zinc metal.

Type _____ Evidence _____ Class _____ *Many bubbles form.*

Balanced equation: _____H₂SO₄ + _____Zn →

11) Place a pea size amount of baking soda, NaHCO₃, in a test tube and add 1-2 milliliters of vinegar (5% HC₂H₃O₂).

Type _____ Evidence _____ Class _____ *Many bubbles form.*

Balanced equation: _____NaHCO₃ + _____HC₂H₃O₂ →

12) Observe the Hoffman apparatus, which splits water using electric current.

Type _____ Evidence _____ Class _____

Tube #1 has 15 mL. Tube #2 has 30mL of gas.

Balanced equation: _____H₂O →

Study the gas collecting in tube #1 and the gas collecting in tube #2, using the balanced equation written above which tube is collecting oxygen and which is collecting hydrogen. Explain your reasoning.

Gluep

Place 20 mL of glue and 10 mL of borax into a paper cup. Stir with a wooden stick. If available, 2 drops of food coloring may be added to the cup while stirring.

Observation: _____

Understanding Gluep:

Glue contains long chains of the polymer polyvinyl acetate which slip past each other while in glue, when Borax (sodium borate) is added to glue the sodium borate links the polyvinyl acetate chains together. The chains are now unable to slip past each other and the Gluep behaves more like a solid.

Slime

Obtain 2 graduated cylinders. Measure 5 mL of 4% sodium borate solution into one cylinder and 25 mL of 4% polyvinyl alcohol solution into the other cylinder. Pour both solutions into a paper cup and stir with a wooden stick. If available, 2 drops of food coloring may be added to the cup while stirring.

Pull the slime apart. Will the slime stretch? _____

Roll the slime into a ball. Will the slime bounce? _____

Place the slime onto a table. Hit the slime with your hand. Does it splatter? _____

Leave the slime on the table for several minutes. Does some of the slime start to flow like a liquid? _____

A Non-Newtonian fluid is a fluid that will stretch under low pressure, break under high pressure, bounces off of hard surfaces and flows like a liquid when left alone. Does slime behave like a non-Newtonian fluid? _____

Understanding Slime:

The sodium borate cross-links the long chains of polyvinyl alcohol. The borate acts like a rung on a ladder.

Conclusion:

- 1) What word means many repeating units? _____
- 2) Cellulose, starch and protein are examples of _____ polymers.
- 3) Teflon, polyester, and nylon are examples of _____ polymers.
- 4) Adding ethylene units together to make polyethylene chains is an example of an/a _____ reaction.
- 5) Adding monomers together to make a polymer chain and a water molecule is an example of an/a _____ reaction.
- 6) The addition of a molecule or element to link polymer chains together is an example of _____.
- 7) _____ is produced when polyvinyl acetate is linked by sodium borate.
- 8) _____ is produced when PVA chains are linked by sodium borate.

Teacher Notes: Fun with Polymers Lab

At each lab station:

2 50-mL graduated cylinders
Brush to clean graduated cylinders

At a central location:

4 Liter plastic bottles of 4% sodium borate solution
4 Liter plastic bottles of 4% PVA solution
Glue Gallon size container or several smaller containers for each lab table
Large box of Wood tongue depressors
Small paper cups 4-5 Boxes depending on number of students
Food coloring 2-3 Boxes depending on number of students
Small plastic zip close bags (If you decide to allow students to take their product.)

Teaching Tips:

This lab is intended to introduce polymers and the types of polymer reactions. The student should read the background and answer conclusion questions #1-6 before being dismissed back to the lab area.

Remind students that the lab area should be thoroughly cleaned when they are finished. Marking one graduated cylinder PVA and the other cylinder borate will cut down on the use of pouring both solutions into the same cylinder and forming slime inside the cylinder which can be a little messy.

The glue, food coloring, plastic bags and paper cups could be placed onto an extra credit lab supply list and collected during the year in order to have some of the supplies for this lab activity.

This is a very fun day for both the teacher and the students.

Gluep

Place 20 mL of glue and 10 mL of borax into a paper cup. Stir with a wooden stick. If available, 2 drops of food coloring may be added to the cup while stirring.

Observation: The gluep made without water is a little more rigid. Answers vary.

Understanding Gluep:

Glue contains long chains of the polymer polyvinyl acetate which slip past each other while in glue, when Borax (sodium borate) is added to glue the sodium borate links the polyvinyl acetate chains together. The chains are now unable to slip past each other and the Gluep behaves more like a solid.

Slime

Obtain 2 graduated cylinders. Measure 5 mL of 4% sodium borate solution into one cylinder and 25 mL of 4% polyvinyl alcohol solution into the other cylinder. Pour both solutions into a paper cup and stir with a wooden stick. If available, 2 drops of food coloring may be added to the cup while stirring.

Pull the slime apart. Will the slime stretch? Yes, too far it pulls apart.

Roll the slime into a ball. Will the slime bounce? Yes, but sometimes sticks.

Place the slime onto a table. Hit the slime with your hand. Does it splatter? No

Leave the slime on the table for several minutes. Does some of the slime start to flow like a liquid? Yes, around the edges.

A Non-Newtonian fluid is a fluid that will stretch under low pressure, break under high pressure, bounces off of hard surfaces and flows like a liquid when left alone. Does slime behave like a non-Newtonian fluid? Yes

Understanding Slime:

The sodium borate cross-links the long chains of polyvinyl alcohol. The borate acts like a rung on a ladder.

Conclusion:

- 1) What word means many repeating units? polymer
- 2) Cellulose, starch and protein are examples of natural polymers.
- 3) Teflon, polyester, and nylon are examples of synthetic (man-made) polymers.
- 4) Adding ethylene units together to make polyethylene chains is an example of an/a addition reaction.
- 5) Adding monomers together to make a polymer chain and a water molecule is an example of an/a condensation reaction.
- 6) The addition of a molecule or element to link polymer chains together is an example of cross-linking.
- 7) Gluep is produced when polyvinyl acetate is linked by sodium borate.
- 8) Slime is produced when PVA chains are linked by sodium borate.

Fun with Polymers Lab Quiz

NAME: _____ DATE: _____ PERIOD: _____

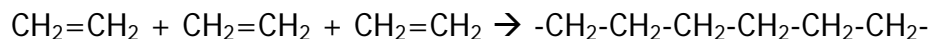
Fill in the blank. Use the word bank below, not all words will be used.

- 1) _____ occurs when an atom or molecule holds two polymer chains together.
- 2) A _____ reaction produces a polymer chain and a small molecule or water molecule.
- 3) A _____ reaction produces polymer chains by combining monomer units.
- 4) _____ is produce when polyvinyl alcohol is cross-linked with sodium borate.
- 5) _____ is produced when polyvinyl acetate is cross-linked with sodium borate.
- 6) Wool, silk and cellulose are examples of _____ polymers.
- 7) Plastic, nylon and polystyrene are examples of _____ polymers.
- 8) Reaction A is an example of a _____ reaction.
- 9) Reaction B is an example of a _____ reaction.
- 10) Reaction C is an example of a _____ reaction.

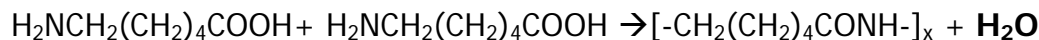
Word Bank: May use word more than once.

condensation
addition
subtraction
cross-linking
gluep
slime
play-dough
natural
synthetic

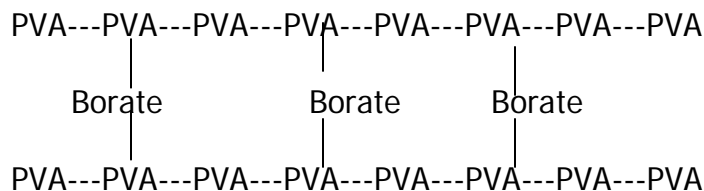
Reaction A:



Reaction B:



Reaction C:



Gluep

Place 20 mL of glue and 10 mL of borax into a paper cup. Stir with a wooden stick. If available, 2 drops of food coloring may be added to the cup while stirring.

Observation: The gluep made without water is a little more rigid.

Understanding Gluep:

Glue contains long chains of the polymer polyvinyl acetate which slip past each other while in glue, when Borax (sodium borate) is added to glue the sodium borate links the polyvinyl acetate chains together. The chains are now unable to slip past each other and the Gluep behaves more like a solid.

Slime

Obtain 2 graduated cylinders. Measure 5 mL of 4% sodium borate solution into one cylinder and 25 mL of 4% polyvinyl alcohol solution into the other cylinder. Pour both solutions into a paper cup and stir with a wooden stick. If available, 2 drops of food coloring may be added to the cup while stirring.

Pull the slime apart. Will the slime stretch? Yes until it pulls apart.

Roll the slime into a ball. Will the slime bounce? Yes

Place the slime onto a table. Hit the slime with your hand. Does it splatter? No

Leave the slime on the table for several minutes. Does some of the slime start to flow like a liquid? Yes, especially around the edges.

A Non-Newtonian fluid is a fluid that will stretch under low pressure, break under high pressure, bounces off of hard surfaces and flows like a liquid when left alone. Does slime behave like a non-Newtonian fluid? _____

Understanding Slime:

The sodium borate cross-links the long chains of polyvinyl alcohol. The borate acts like a rung on a ladder.

Conclusion:

- 1) What word means many repeating units? _____
- 2) Cellulose, starch and protein are examples of _____ polymers.
- 3) Teflon, polyester, and nylon are examples of _____ polymers.
- 4) Adding ethylene units together to make polyethylene chains is an example of an/a _____ reaction.
- 5) Adding monomers together to make a polymer chain and a water molecule is an example of an/a _____ reaction.
- 6) The addition of a molecule or element to link polymer chains together is an example of _____.
- 7) _____ is produced when polyvinyl acetate is linked by sodium borate.
- 8) _____ is produced when PVA chains are linked by sodium borate.