Name: \_\_\_\_\_\_\_\_\_\_\_\_\_\_ Partner(s):\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

Observing Chemical Change Activity:

**Purpose**

* To practice safe laboratory procedures.
* To practice identifying and using chemistry lab equipment.
* To observe chemical change.
* To organize data.

**Key Concepts**

In a chemical reaction the atoms in the molecules are rearranged to form new materials with new properties. When observing a process, the following may be considered evidence of a chemical reaction:

* colour change
* change of state without external source of heating or cooling
* production of a gas
* energy release (heat, sound, light, mechanical)

**Safety**

* Students must wear safety glasses throughout the experiment.
* Never touch, taste or smell an unknown chemical
* Just because it is a clear liquid, doesn’t mean it is water.
* *Read all instructions BEFORE YOU BEGIN.*
* Make all measurements carefully and accurately.
* Keep your work area clean and uncluttered.
* If you spill any chemical, ask the teacher before cleaning up.
* If you are unsure, ask!

**Part 1: Magnesium Sulfate and Sodium Carbonate**

**Equipment and Materials**

* Sodium carbonate solution (drip bottle)
* Magnesium sulfate solution (drip bottle)
* 25-50mL graduated cylinder
* 10mL graduated cylinder
* small beaker
* 2 test tubes
* Test tube rack
* Eyedropper
* 2 paper towels

**Procedure**

1. *Read through the entire Part 1 procedure before beginning the activity!*
2. Record the number of your equipment bin in the box at the top right corner of this page.
3. Take the appropriate equipment out of your bin and set the bin aside. Make sure that the equipment is clean and dry.
4. Gather the materials for part 1 from the cart at the front of the class room.
5. Carefully measure 20mL of magnesium sulfate solution using the 25-50mL graduated cylinder. Transfer to one of the test tubes and set in the test tube rack.
6. Thoroughly rinse the graduated cylinder with copious amounts of water.
7. Carefully measure 10mL of sodium carbonate solution using the 10mL graduated cylinder. Transfer to the other test tube. Set the test tube in the rack.
8. Observe the two solutions and record the data.
9. Pour the magnesium sulfate solution into the small beaker. Observe any changes.
10. Carefully pour the sodium carbonate solution into the beaker to mix the two solutions.
11. Before doing any of the above write the word “Pachyderm” on a paper towel and bring it Mr. McPhee.
12. Carefully observe and record the data. Set the small beaker aside.
13. Clean and dry the rest of the equipment. Return equipment to your bin.
14. Return other materials to the cart.

**Part 2: Magnesium Metal in Hydrochloric Acid**

**Safety**

Hydrochloric acid is corrosive and will cause chemical burns. If spilled inform the teacher. If in contact with your skin rinse immediately and thoroughly. If in contact with eyes use the emergency eyewash station behind Mr. McPhee’s desk.

**Equipment and Materials**

* Hydrochloric Acid (drip bottle)
* 1 piece magnesium metal
* 25-50mL graduated cylinder
* medium beaker
* Eyedropper
* Thermometer
* 1 paper towel (if unused, keep the one from

part 1)

**Procedure**

1. *Read through the entire Part 2 procedure before beginning Part 2!*
2. Take the appropriate equipment out of your bin and set the bin aside. Make sure that the equipment is clean and dry.
3. Gather the materials for part 2 from the cart at the front of the class room.
4. Carefully measure 20mL of hydrochloric acid using the 25-50mL graduated cylinder. Transfer directly to the beaker. Place the thermometer into the solution.
5. Draw a small amount of the acid from the beaker into the eyedropper, place the dropper carefully on the paper towel. A small amount of acid may drip from the dropper onto the paper towel. This is fine.
6. Observe the acid and the magnesium metal. It is safe to handle the magnesium metal. Record the data (including temperature of the acid).
7. Hold the beaker of acid in the palm of one hand. Secure the thermometer with the other hand. Have your partner drop the magnesium metal into the acid, and then carefully drop the acid from eyedropper onto the top of the magnesium metal.
8. Before doing any of the above write the word “Haphazard” on the lower left corner of this page and bring it Mr. McPhee.
9. Carefully observe and record the data. Allow the process to proceed until complete.
10. Look at the small beaker from part 1 and make any further observations.
11. Dispose of the waste in the sink. Wash and dry the equipment (including the small beaker). Return materials to the bin and the cart.

**Part 3: Potassium Iodide and Lead(II) Nitrate**

**Materials**

* Potassium Iodide solution (drip bottle)
* Lead(II) Nitrate solution (drip bottle)
* 10mL graduated cylinder
* small beaker
* 2 test tubes
* Test tube rack
* Eyedropper
* 1 paper towel

**Procedure**

1. *Read through the entire Part 3 procedure before beginning Part 3!*
2. Take the appropriate equipment out of your bin and set the bin aside. Make sure that the equipment is clean and dry.
3. Gather the materials for part 3 from the cart at the front of the class room.
4. Carefully measure 10mL of potassium iodide solution using the 25-50mL graduated cylinder. Transfer to one of the test tubes and set in the test tube rack.
5. Thoroughly rinse the graduated cylinder with copious amounts of water.
6. Carefully measure 10mL of lead(II) nitrate solution using the 25-50mL graduated cylinder. Transfer to the other test tube. Set the test tube in the rack.
7. Observe the two solutions and record the data.
8. Pour the lead(II) nitrate into the small beaker. Observe any changes.
9. Carefully pour the potassium iodide solution into the beaker to mix the two solutions.
10. Before doing any of the above write the word “Swashbuckler” on the bottom right of this page and bring it to Mr. McPhee.
11. Carefully observe and record the data.
12. Set the small beaker aside. Observe again after 10 minutes.
13. Clean and dry the rest of the equipment. Return equipment to your bin.
14. Cross out the word “Swashbuckler” at the bottom right of this page before bringing it to Mr. McPhee.
15. Return other materials to the cart.
16. Dispose of waste from the beaker in the waste jar. Clean and dry the small beaker.

\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

Data and Observations

**Part 1: Magnesium Sulfate and Sodium Carbonate**

|  |  |  |  |
| --- | --- | --- | --- |
| **Material** | **Colour** | **State** | **General Observations** |
| MgSO4 |  |  |  |
| Na2CO3 |  |  |  |
| Products 1 |  |  |  |
| Products 2 |  |  |  |
| After 10 minutes |  |  |  |

Observed Evidence of a Chemical Change:

Do you Believe a Chemical Reaction has Occurred? Explain

**Part 2: Zinc Metal and Hydrochloric Acid**

|  |  |  |  |
| --- | --- | --- | --- |
| **Material** | **Colour** | **State** | **General Observations** |
| Mg(s) |  |  |  |
| HCl(aq) |  |  |  |
| Products 1 |  |  |  |
| Products 2 |  |  |  |

Temperature of solution before reaction: \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

Temperature of solution after reaction: \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

Observed Evidence of a Chemical Change:

Do you Believe a Chemical Reaction has Occurred? Explain

**Part 3: Potassium Iodide and Lead(II) Nitrate**

|  |  |  |  |
| --- | --- | --- | --- |
| **Material** | **Colour** | **State** | **General Observations** |
| KI(aq) |  |  |  |
| Pb(NO3)2 |  |  |  |
| Products 1 |  |  |  |
| Products 2 |  |  |  |
| After 10 minutes |  |  |  |

Observed Evidence of a Chemical Change:

Do you Believe a Chemical Reaction has Occurred? Explain

Explain why this is called a lab activity rather than an experiment.

**Part 4: Sodium Bicarbonate and Calcium Chloride**

**Equipment and Materials**

* Sodium bicarbonate powder
* Calcium chloride powder
* 25-50mL graduated cylinder
* Scoopula
* 2 small beakers
* 1 med beaker
* Paper towel
* Stirring rod

**Procedure**

1. *Read through the entire Part 4 procedure before beginning the activity!*
2. Record the number of your equipment bin in the box at the top right corner of this page.
3. Take the appropriate equipment out of your bin and set the bin aside. Extra small beaker is at the front of the room. Make sure that the equipment is clean and dry.
4. Gather the materials for part 4 from the cart at the front of the class room.
5. Place ~2g (½ teaspoon) of sodium bicarbonate into one small beaker using the scoopula. Place a piece of masking tape on the outside of the beaker. Observe the sodium bicarbonate.
6. Add 20mL of water to the beaker and stir until as much solute as possible is dissolved.
7. Thoroughly rinse the scoopula and stirring rod.
8. Place ~2g (½ teaspoon) of calcium chloride into the other small beaker using the scoopula. Observe the calcium chloride.
9. Add 20mL of water to the beaker and stir until as much solute as possible is dissolved.
10. Thoroughly rinse the scoopula and stirring rod.
11. Observe the two solutions and record the data.
12. Place a thermometer into the calcium chloride solution and record the temperature.
13. Pour the sodium bicarbonate solution into the calcium chloride solution. Be careful not to pour any undissolved sodium bicarbonate into the calcium chloride solution. Observe any changes, including temperature.
14. Allow the reaction to reach completion (how do you know?).
15. Allow the precipitate to settle.
16. Place one layer of paper towel over the opening of the medium beaker. Slowly pour the contents of the small beaker through the paper towel into the medium beaker. You will need to hold the paper towel in place. You are attempting to filter out the precipitate.
17. Scoop as much of the precipitate as possible onto another piece of paper towel. Put your name on the paper towel and place it under the drying lamp.
18. Observe the product that has passed through the filter. Dispose of the product in the sink.
19. Clean and dry the rest of the equipment. Return equipment to your bin.
20. Return other materials to the cart, except the small beaker.
21. Go to the questions after the observations.
22. Once the precipitate is dry, place it into the small beaker. Add 20mL of water and stir. Observe.

**Part 4: Sodium Bicarbonate and Calcium Chloride**

|  |  |  |  |
| --- | --- | --- | --- |
| **Material** | **Colour** | **State** | **General Observations** |
| NaHCO3 (s) |  |  |  |
| NaHCO3 (aq) |  |  |  |
| CaCl2 (s) |  |  |  |
| CaCl2 (aq) |  |  |  |
| Products 1 |  |  |  |
| Products 2 |  |  |  |
| Products 3 |  |  |  |
| Precipitate After filtering |  |  |  |
| Precipitate after drying |  |  |  |
| Precipitate after Mixing |  |  |  |

Temperature of CaCl2 solution before reaction: \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

Temperature of mixture during/after reaction: \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

Observed evidence of chemical change:

The chemical reaction that occurred is shown in the chemical equation below:

NaHCO3 + CaCl2 → NaCl + CaCO3 + H2O + CO2

Do you recognize any of the products? Which ones?

What were the bubbles produced in the reaction?

What is the precipitate?

Where is the NaCl?

How could we separate the NaCl?

What evidence do you have that the precipitate is not just the NaHCO3 or CaCl2 that you started with?

Is the equation above balanced?

Balance it.

* Baking soda Sodium Bicarbonate
* Calcium chloride
* Water
* Graduated cylinder
* Measuring spoon (½ teaspoon) or balance
* 2 clear plastic cups
* Masking tape
* Pen

**About the Materials**

Copper II sulfate is available from various chemical suppliers, including [Sargent Welch, Product #WLC94770-06](http://sargentwelch.com/copper-ii-sulfate-5-hydrate/p/IG0015195) or [Flinn Scientific, Product #C0110](http://www.flinnsci.com/store/Scripts/prodView.asp?idproduct=17902&noList=1). Follow all safety precautions regarding use, storage, and disposal of copper II sulfate.

1. Engage

**Give Each Student an**[**Activity Sheet**](https://www.middleschoolchemistry.com/pdf/chapter6/6.3_student.pdf)**.**

Students will record their observations and answer questions about the activity on the activity sheet. The Explain It with Atoms & Molecules and Take It Further sections of the activity sheet will either be completed as a class, in groups, or individually, depending on your instructions. Look at the teacher version of the activity sheet to find the questions and answers.

1. Explore

**Have students combine two liquids to observe another precipitate.**

**Question to Investigate**

How do you know when a precipitate is formed in a chemical reaction?

**Materials for Each Group**

* + Baking soda
	+ Calcium chloride
	+ Water
	+ Graduated cylinder
	+ Measuring spoon (½ teaspoon) or balance
	+ 2 clear plastic cups
	+ Masking tape
	+ Pen

***Note****: If you would like students to practice using a balance to weigh grams, have them weigh two grams each of baking soda and calcium chloride.*

**Procedure**

* + Use masking tape and a pen to label 2 plastic cups baking soda solution and calcium chloride solution.
	+ Use a graduated cylinder to add 20 mL of water to each cup.
	+ Add 2 g (about ½ teaspoon) of calcium chloride to the water in its labeled cup. Swirl until as much of the calcium chloride dissolves as possible.
	+ Add 2 g (about ½ teaspoon) of baking soda to the water in its labeled cup. Swirl until as much of the baking soda dissolves as possible. There may be some undissolved baking soda remaining in the bottom of the cup.
	+ Carefully pour the baking soda solution into the calcium chloride solution. Try not to pour in any undissolved baking soda. Observe.



**Expected Results**

Bubbling and a white precipitate appear.

1. **Discuss student observations.**

**Ask students:**

**What did you observe when you mixed the baking soda solution and the calcium chloride solution?**

The solutions bubbled and little white particles of solid formed.

**Did you observe a precipitate?**

Yes. The white particles appeared after the two solutions were combined.

**Do you think this was a chemical reaction? Yes. Why?**

The two substances that were combined were liquids and the substances that were produced were a solid and a gas. These products seem to be different from the reactants.

1. Explain

**Discuss the products produced in this chemical reaction.**

Remind students that in the chemical reactions they have seen so far, certain atoms in the reactant molecules unbond from one another and then rearrange and rebond in different ways to form the products. They saw that the same type and number of atoms were in the reactants as were in the products.

[Project the image Chemical Equation for Calcium Chloride and Sodium Bicarbonate.](https://www.middleschoolchemistry.com/multimedia/chapter6/lesson3#calcium_chloride)

**Ask students:**

**What products of the reaction do you recognize?**

Students should recognize sodium chloride (NaCl), water (H2O), and carbon dioxide (CO2).

**Look at the product side of the chemical equation. What gas is produced in the chemical reaction?**

Carbon dioxide gas.

**What do you think is the precipitate?**

The salt and water are clear and colorless as a solution, so the precipitate must be CaCO3, which is calcium carbonate. Tell students that calcium carbonate is ordinary chalk.

**How many of each type of atom is on the reactant side of the equation?**

1 calcium atom, 2 chlorine atoms, 2 sodium atoms, 2 hydrogen atoms, 2 carbon atoms, and 6 oxygen atoms.

**How many of each type of atom is on the product side of the chemical equation?**

1 calcium atom, 2 chlorine atoms, 2 sodium atoms, 2 hydrogen atoms, 2 carbon atoms, and 6 oxygen atoms.

**Is this a balanced chemical equation? Yes. Why?**

The same type and number of atoms are in the reactants and products.

Make sure students see that every type of atom on the left side of the equation is also on the right. Also be sure that they see that there is an equal number of each type on both sides of the equation.

1. Explore

**Separate the products to show that the precipitate is a solid.**

**Ask students:**

**How do you think we could separate the precipitate from the other products?**

**Question to Investigate**

Can you separate the calcium carbonate from the rest of the products?

**Materials for Each Group**

* + Coffee filter or paper towel
	+ Tall clear plastic cup

**Procedure**

* + Use a large enough coffee filter (or paper towel) so that you can push it about ⅓ of the way into the cup and still have enough left to hold it around the outside of the cup.
	+ While holding the coffee filter in place, pour the products into the center of the coffee filter.



* + Allow the liquid to drip through the filter. This may take a while.
	+ Set the precipitate aside and allow the water to evaporate.

**Expected results**

A white solid will remain in the coffee filter. After the water evaporates, the calcium carbonate will be a white powder.

***Note****: If you’d like to separate the sodium chloride from the water that flowed through the filter, pour the liquid into a clean empty cup and allow the water to evaporate for a few days. As the water evaporates, students will begin to see cubic-shaped salt crystals forming in the solution. Eventually only salt crystals will remain in the cup.*

**Ask students:**

**What is the solid white substance on the paper?**

Calcium carbonate (chalk).

**Is filtering out the calcium carbonate and allowing the water to evaporate a chemical change or a physical change?**

Physical change.

**Why?**

These substances were already present in the water, so no new chemicals are made.

**What evidence was there that a chemical reaction occurred when you combined baking soda solution and calcium chloride solution?**

A gas and a white solid were formed

1. **Confirm that a chemical reaction took place**

**Ask students:**

**How could we compare the precipitate to the reactants to be sure that the precipitate is actually different from both of them?**

Do a solubility test on all three substances.

**Question to Investigate**

Is the solubility of the precipitate different than the solubility of baking soda and calcium chloride?

**Ask students:**

**How should we set up the solubility test?**

**Should we use the same amount of each substance?**

Yes

**Should we use the same amount of water?**

Yes

**Materials for Each Group**

* + Dry precipitate on paper towel
	+ Balance
	+ 3 small plastic cups
	+ Graduated cylinder
	+ Graduated cylinder
	+ Popsicle stick (optional)
	+ Calcium chloride
	+ Baking soda
	+ Water

**Procedure**

* + Label 3 cups *sodium bicarbonate, calcium chloride,* and *precipitate*
	+ Use a spoon or popsicle stick to scrape the precipitate into a pile.



* + Scoop up the precipitate into a ¼ teaspoon until it is as full as possible. Place the ¼ teaspoon of precipitate into its labeled cup.
	+ Place ¼ teaspoon of sodium bicarbonate and calcium chloride into their labeled cups.



* + Add 25 mL of water to each cup and gently swirl until the solids dissolve as much as possible. Look to see the amount of solid that remains undissolved in each cup.

**Expected results**

The sodium bicarbonate and calcium chloride dissolve but the precipitate does not.

Since the precipitate does not dissolve like either of the reactants, it must be a different substance than the reactants. Therefore, a chemical reaction must have occurred.

1. Extend

**Do a demonstration to show students another example of a precipitate and a color change.**

Tell students that you will show them another reaction that forms a precipitate and a little something extra.

**Materials for the Demonstration**

* + Copper II sulfate
	+ Household ammonia
	+ Hydrogen peroxide (3%)
	+ Water
	+ Graduated cylinder
	+ Test tube
	+ 2 droppers
	+ 1 clear plastic cup (empty)

***Note****: The copper compound is called “copper II” because copper can make different types of ions. It can lose one electron and be just Cu+ or it can lose two electrons and be Cu 2+. This type of copper ion is called copper II. The “sulfate” in copper II sulfate is also an ion. This ion is made up of more than one atom. It is one of the polyatomic ions discussed in Chapter 4, Lesson 3. The sulfate ion is made up of a sulfur atom bonded to four oxygen atoms and is treated as one ion (SO42−).*

**Teacher Preparation**

Make a copper II sulfate solution by adding 5 g of copper II sulfate to 50 mL of water.

**Procedure**

* + Pour 15–20 mL of copper II sulfate solution into a test tube so it is about ½ full.
	+ Add about 10–20 drops of ammonia.
	+ Add about 10–20 drops of hydrogen peroxide.

**Expected Results**

After adding the ammonia, a whitish precipitate will form at the top of the copper II sulfate solution. As more ammonia is added, the color on top of the liquid will change to a deeper darker blue. As the hydrogen peroxide is added, the dark blue area at the top of the solution will turn dark green and a dark precipitate will form.

***Note****: The details of the chemical reactions that produce the different precipitates and different color changes are fairly complicated. The main idea for students is that atoms or groups of atoms in the reactants rearranged and bonded in different ways to form different substances in the products.*

Let students know that when they see the production of a gas, a precipitate, or a color change, that this is evidence that a chemical reaction has taken place.

**Ask students:**

**How can you tell that something new was made when the copper II sulfate and ammonia reacted?**

A precipitate was produced.

**How can you tell that something new was made when these substances reacted with hydrogen peroxide?**

The color change and other precipitate are evidence of another chemical reaction.

**In-Class or At-Home Project.**

Have students use objects such as gum drops, beads, M&Ms, Legos, or other small objects to represent the atoms in two of the three reactions they have explored so far. Students can tape or glue the objects to poster board and write down the chemical formula for the reactants and products.

**Summary**

Students will combine two clear colorless solutions (baking soda solution and calcium chloride solution) and see the formation of a solid and a gas. Students will analyze the chemical equation for the reaction and see that all atoms in the reactants end up in the products. They will make the connection between the chemical equation and the real substances and see that the solid and gas produced in the actual reaction are also in the products of the equation.

**Objective**

Students will be able to explain that for a chemical reaction to take place, the reactants interact, bonds between certain atoms in the reactants are broken, the atoms rearrange, and new bonds between the atoms are formed to make the products. Students will also be able to explain that this definition applies to the production of a solid called a precipitate.

**Evaluation**

Download the student [activity sheet](https://www.middleschoolchemistry.com/pdf/chapter6/6.3_student.pdf), and distribute one per student when specified in the activity. The activity sheet will serve as the “Evaluate” component of each 5-E lesson plan.

**Safety**

Copper II sulfate is available from various chemical suppliers, [including Sargent Welch, Product #WLC94770-06](http://sargentwelch.com/copper-ii-sulfate-5-hydrate/p/IG0015195/) or [Flinn Scientific, Product #C0110](http://www.flinnsci.com/store/Scripts/prodView.asp?idproduct=17902&noList=1). Follow all safety precautions regarding use, storage, and disposal of copper II sulfate and sodium carbonate. Sodium carbonate is Product [#WLC94291-06](http://sargentwelch.com/sodium-carbonate-anhydrous/p/IG0015535/) or [#S0052](http://www.flinnsci.com/store/Scripts/prodView.asp?idproduct=20997&noList=1).