

Names: _____

HOW DO WE KNOW THERE WAS REALLY A CHEMICAL REACTION?

There are 5 observations of a chemical reaction having occurred that we will:

Observation	Example (Something You've Seen Before)
Presence of bubbles	
Gives Off Heat/Cold	
Color Change	
Precipitate Forms	
Light is Released	

****NOTE:** The presence of these observations is NOT ALWAYS proof that a chemical reaction has occurred.

If the chemical properties of the reactants are _____ from the products, then you can be sure a chemical reaction has taken place.

Activity 1 (Temperature Change)

Materials:

- Beaker (100 mL)
- 1 Baking Soda (NaHCO_3)(8g)
- Vinegar ($\text{HC}_2\text{H}_3\text{O}_2$) (30 mL)
- 1 Temperature sensor

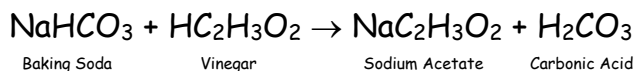
Instructions: Connect your temperature sensor to pin #6 on your MakAR Board. Turn on your MakAR Board and select "Laboratory." Now, select "Temperature" and select pin #6. You should see the temperature being shown on the screen of your MakAR Board. Pour 30 mL of vinegar into your beaker. Place the temperature sensor inside your beaker of vinegar and record the starting temperature of the vinegar.

Starting Temperature	Final Temperature	Temperature Change (Final - Starting)

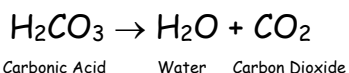
Add 1 spoonful of baking soda to the beaker of 30 mL of vinegar and record the temperature of your mixture after it stops changing. The chemical reaction actually occurs in two steps:

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1. There is a _____ reaction where acetic acid in the vinegar reacts with sodium bicarbonate to form sodium acetate and carbonic acid:



2. Carbonic acid is unstable and undergoes a _____ reaction to produce carbon dioxide gas and water:



*****Be sure to wipe off your temperature sensor and beaker with clean water and a paper towel before moving on to Activity 2*****

Activity 2 (Temperature Change)

Materials:

- Beaker (100 mL)
- Water (60 mL)
- 1 Spoonful of Calcium Oxide (CaO)
- 1 Temperature sensor

Instructions: Connect your temperature sensor to pin #6 on your MakAR Board. Turn on your MakAR Board and select "Laboratory." Now, select "Temperature" and select pin #6. You should see the temperature being shown on the screen of your MakAR Board. Place the temperature sensor inside your beaker of water and record the starting temperature of the water.

Starting Temperature	Final Temperature	Temperature Change (Final - Starting)

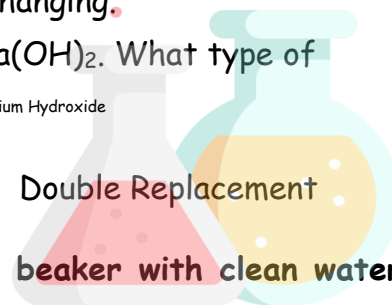
Add 1 spoonful of Calcium Oxide (CaO) to a beaker of 60 mL of water (H₂O) and record the temperature of your mixture after it stops changing.

Analyze the following chemical equation: $\text{CaO} + \text{H}_2\text{O} \rightarrow \text{Ca}(\text{OH})_2$. What type of reaction is this (circle your answer)?

Calcium Oxide Water Calcium Hydroxide

Synthesis Decomposition Single Replacement Double Replacement

*****Be sure to wipe off your temperature sensor and beaker with clean water and a paper towel before moving on to Activity 3*****



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Activity 3 (Color Change)

Materials:

- Beaker (50 mL)
- 1 Spoonful of Baking Soda (NaHCO_3)
- Vinegar (20 mL)
- Red Cabbage Juice (30 mL) x2
- Copper Sulfate (CuSO_4)(30 mL)
- 2 Iron Nails
- 1 Color Sensor

Instructions: Connect your color sensor to pin #9 on your MakAR Board. Turn on your MakAR Board and select "Laboratory." Now, select "Color" and select pin #9. You should see the values for color being shown on the screen of your MakAR Board. Fill your beaker with 30 mL of Red Cabbage Juice. Place the color sensor underneath the beaker and record the starting Red, Green, and Blue values of the Cabbage Juice.

R: _____ G: _____ B: _____

What color do you think the solution will turn when you add the Baking Soda?

Add 1 spoonful of Baking Soda to the beaker of 30 mL of Red Cabbage Juice and record the Red, Green, and Blue values of your mixture after it stops changing.

R: _____ G: _____ B: _____

What color did the solution actually turn? _____

Was your prediction correct? _____

*****Be sure to wipe off your beaker with clean water and a paper towel before moving on*****

Next, fill your beaker again with 30 mL of Red Cabbage Juice.

What color do you think the solution will turn when you add the Vinegar?

Add 20 mL of Vinegar to the beaker of 30 mL of Red Cabbage Juice and record the Red, Green, and Blue values of your mixture after it stops changing.

R: _____ G: _____ B: _____

What color did the solution actually turn? _____

Was your prediction correct? _____

*****Be sure to wipe off your beaker with clean water and a paper towel before moving on*****

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Next, fill your beaker with 30 mL of Copper Sulfate. Place the color sensor underneath the beaker and record the starting Red, Green, and Blue values of the Copper Sulfate.

R: _____ G: _____ B: _____

What color do you think the solution will turn when you add the two iron nails?

Place the two nails into the solution. To observe the reaction, you will have to wait 10 minutes. You can move on to the next activity while you wait. Record the Red, Green, and Blue values of your mixture after 10 minutes.

R: _____ G: _____ B: _____

What color did the solution actually turn? _____

Was your prediction correct? _____

Analyze the following chemical equation: $\text{Fe} + \text{CuSO}_4 \rightarrow \text{FeSO}_4 + \text{Cu}$. What type of reaction is this (circle your answer)?

Iron Copper Sulfate Ferrous Sulfate Copper

Synthesis Decomposition Single Replacement Double Replacement

*****Be sure to wipe off your beaker with clean water and a paper towel after you've completely finished with Activity 3*****

Activity 4 (Formation of Precipitate)

Materials:

- Beaker (250 mL)
- Sodium Hydroxide (NaOH) (100 mL)
- Copper Sulfate (CuSO_4) (100 mL)
- 1 Cloudiness Sensor

Instructions: Connect your cloudiness sensor to pin #6 on your MakAR Board. Turn on your MakAR Board and select "Laboratory." Now, select "Cloudy" and select pin #6. You should see the values for cloudiness being shown on the screen of your MakAR Board. Fill your 250 mL beaker with 100 mL of Copper Sulfate (CuSO_4). Place **only the clear plastic part** of the Cloudiness Sensor inside the beaker and record what you see on the MakAR Board screen.

Starting Cloudiness: _____

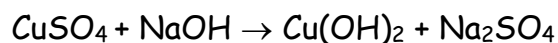
Add 100 mL of Sodium Hydroxide (NaOH) to the beaker of Copper Sulfate and record what you see on the MakAR Board screen.

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Final Cloudiness: _____

Describe what you see happening:

The Copper Sulfate and Sodium Hydroxide undergoes a _____ reaction to form Copper Hydroxide and Sodium Sulfate:



Copper Sulfate Sodium Hydroxide Copper Hydroxide Sodium Sulfate



*****Be sure to wipe off your beaker with clean water and a paper towel before moving on to Activity 5*****

Activity 5 (Release of Light)

Materials:

- Beaker (100 mL)
- Light Solution A (30 mL)
- Light Solution B (30 mL)
- Light Sensor

Instructions: Connect your light sensor to pin #6 on your MakAR Board. Turn on your MakAR Board and select "Laboratory." Now, select "Light" and select pin #6. You should see the values for light intensity being shown on the screen of your MakAR Board. Fill your 100 mL beaker with 30 mL of Light Solution A. Place the beaker on top of the light sensor and record the starting illumination value once it stops changing.

Starting Intensity	Final Intensity	Intensity Change (Final - Starting)

Add 30 mL of Light Solution B to the beaker of Light Solution A and record the final illumination value once it stops changing.

Describe what you see happening:

