Evidence of a Chemical Reaction

Vanderbilt Student Volunteers for Science

Training Presentation

2018-2019 VINSE/VSVS Rural

I. Introduction

Learning Goal: Students can name the different indicators that a chemical reaction has occurred.

- *What is the difference between a physical change and a chemical change?*
  - A **physical change** does not change the properties of a substance. No new substance is formed during a physical change.
  - Examples of physical changes include changes in size, shape, or state of matter.
- A **chemical change** does change the properties of a substance. One or more new substances are formed in a chemical change.

I. Introduction (cont.)

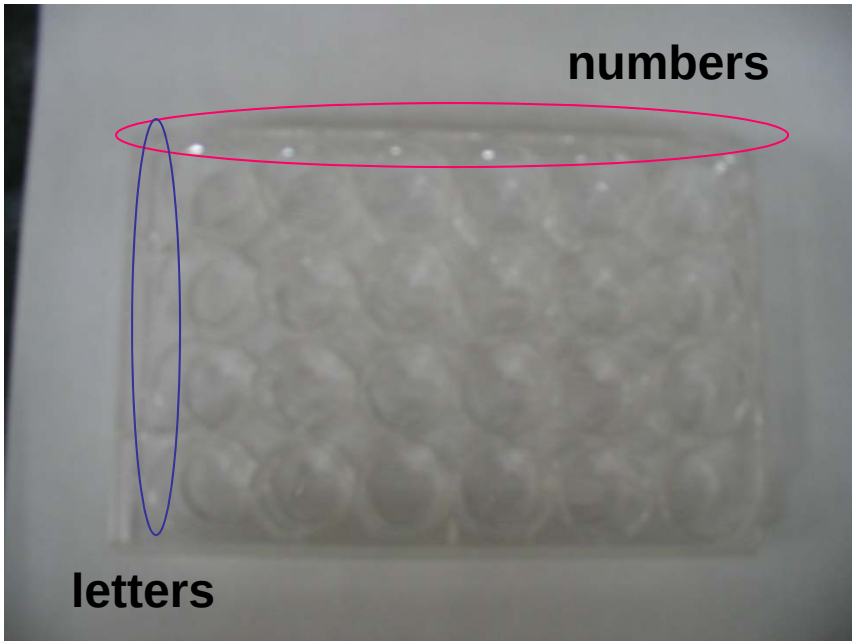
- *How can you tell when a chemical change has occurred?*
  - **Color change:** occurs when two solutions are mixed and a new color is produced (not just a paler, or more dilute color)
  - **Gas given off**: presence of bubbles or fizz (bubbles in soda is not an example of a chemical change—it is merely the release of trapped gas)
  - **Precipitate:** a solid that forms when two substances react to give a new compound that will not dissolve in water.
    - A precipitate may look like a cloudy substance, grains, a swirl, or a fluffy solid.
  - **Temperature (Energy) change:** the substances gets warmer or cooler. This may indicate either a physical or a chemical change.

II. Safety and Preparation

- Safety
  - If anyone gets any of the chemicals on their skin or in their eyes, they should flush immediately with water.
  - Remind students to put on their safety goggles and keep them on until they finish using the dropper bottles.
    - VSVS volunteers should put on their safety goggles and keep them on until students are finished mixing chemicals.
- Divide students into pairs and distribute materials

II. Preparation (cont.)

- Show students how to find the letters A, B, C, D and the numbers 1 - 6 on the 24-well plate.
- Letters are imprinted in the plastic along the left side.
- Numbers are imprinted across the top.
  - These are tiny and may be difficult to see
- Show students how to match the grid on the lab sheet to the 24-well plate.



II. Preparation (cont.)

- The formulas for the compounds used are on the student activity sheet.
  - Say the full chemical name of the chemical as well as the formula. Have students look at their activity sheet for the formulas.
  - Show students how to be careful when matching the formulas (some of the formulas are very similar)**.**

- Show students one of the bottles and demonstrate how to get drops out of the bottle.
  - When using two solutions, put a squirt of the first solution in the correct well
  - Fill the well ¼ full with the first squirt.
  - Then add one squirt of the second solution, so that the well is ½ full.

II. Preparation (cont.)

- **Dropper bottle use**
  - Do not remove the red cap from a bottle until it is to be used.
  - Apply slow, gentle pressure.
  - Put the cap back on the bottle immediately after use.

III. Determining if a Chemical Change has Occurred.

Learning Goals: Students can name the different indicators that a chemical reaction has occurred. Students can identify the specific indicators of a reaction and explain how to look for them

- Both students should record their observations on their lab sheets.
  - Students can record NR if No Reaction occurs.
  - Otherwise, they will record color change, gas given off, or precipitate formed.
- **Tell students to follow the instructions on the instruction sheet for mixing solutions.**
- Stop and discuss results with students after each row.
- Equations for the reactions that occur are given on their observation sheet.

III. Reactions that form precipitates: Row A

VSVS Volunteer Demonstration:

- Use the demonstration bag labeled: Demo A.
- Empty each of the 2 oz bottles into separate clear cups. Hold the two clear cups up so the students can see what happens, and pour one into the other.
- A white precipitate will form. Tell students the cloudiness of the solution is evidence of a precipitate forming.

Student activity:

- Tell students to place the 24-well plate on the plate.
- Partners will take turns doing the experiments as they follow the grid on the lab sheet to perform all the experiments in Row A.

III. Row A: Results

- Monitor students and offer assistance as needed.
- Ask students what evidence indicated that a chemical reaction occurred.
  - *A precipitate formed.*

Equations:

Demo: $CaCl_2\ (aq) + Na_2CO_3\ (aq) \rightarrow CaCO_3\ (s) + 2\ NaCl\ (aq)$

A1: $2\ Fe(NO_3)_3\ (aq) + 3\ Na_2CO_3\ (aq) \rightarrow Fe_2(CO_3)_3\ (s) + 6NaNO_3(aq)$

A2: $Cu(NO_3)_2\ (aq) + Na_2CO_3\ (aq) \rightarrow CuCO_3\ (s) + 2\ NaNO_3\ (aq)$

III. Reactions that Involve a Color Change: Row B

Demonstration:

- Use the Demo B bag provided to show an example of the Row B reactions.
  - Empty each of the 2 oz bottles into two separate clear plastic cups.
  - Hold the two solutions up, and ask students to notice that one is clear and colorless, while the other is clear and brown.
  - Pour the colorless solution into the brown solution, and ask students to describe what happens
  - The brown solution turns colorless, but is still clear (no precipitate formed)
- Explain to students that a chemical reaction has taken place because the brown solution changed color upon addition of the clear solution.

$I_2(aq) + 2\ Na_2S_2O_3(aq) \rightarrow 2\ NaI(aq) + Na_2S_4O_6\ (aq)$

III. Results Row B

- Monitor students and offer assistance as needed.
- Ask students what evidence indicated that a chemical reaction occurred.
  - *A color change occurred.*

B1:

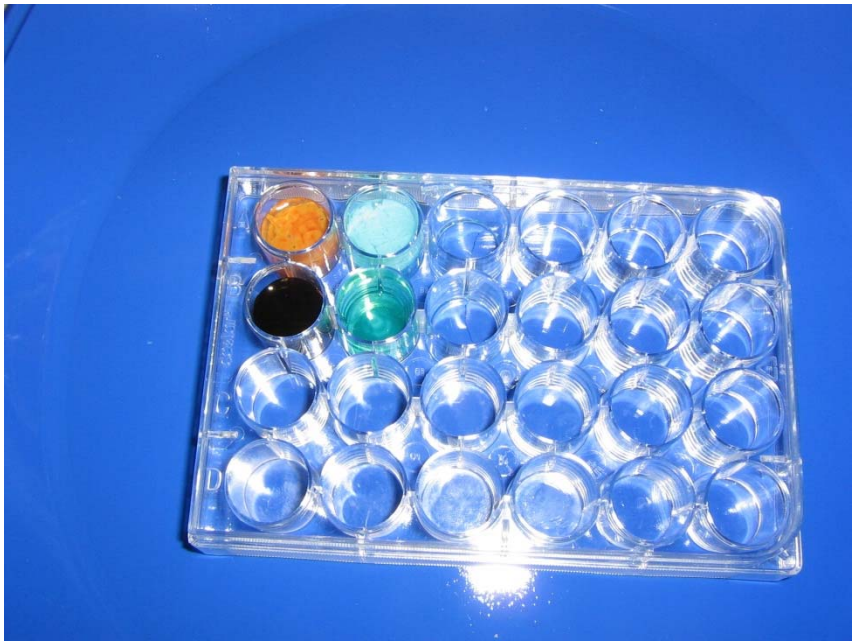
$Fe(NO_3)_3$ (aq) + KSCN (aq) → $Fe(SCN)(NO_3)_2$ (aq) + KNO_3 (aq)

intense red color

B2:

$Cu(NO_3)_2$ (aq) + KSCN (aq) → $Cu(SCN)(NO_3)$ (aq) + KNO_3 (aq)

pale green color



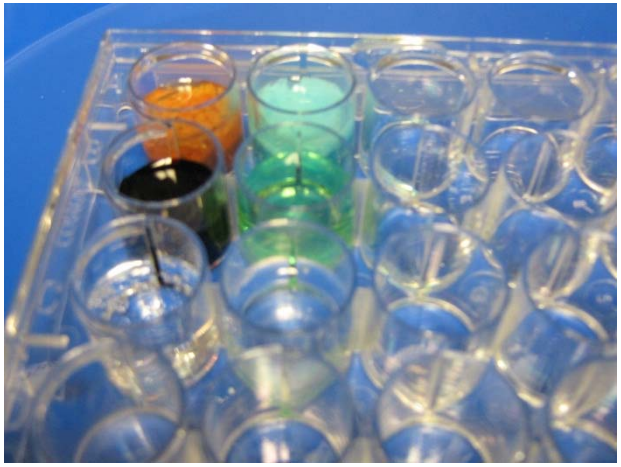
III. Chemical Reactions that Produce a Gas: Row C

Demonstration:

- Use the Demo C bag provided to show an example of the Row C reactions.
  - Hold up the cup and ask to students to watch carefully what happens.
  - Put 1 teaspoon of solid Na_2CO_3 into the cup, and empty the 2 oz bottle of HCl into it.
  - Ask students to describe what happens.
  - A bubbling up (slight foaming) which quickly subsides indicates that a gas is given off.

$$Na_2CO_3\ (s) + 2HCl\ (aq) \rightarrow 2NaCl\ (aq) + CO_2\ (g) + H_2O\ (l)$$

III. Results: Row C



C1: $NaHCO_3$ (aq) + HCl (aq) → NaCl (aq) + CO_2 (g) + H_2O(l)

C2: Na_2CO_3 (aq) + 2HCl (aq) → 2NaCl (aq) + CO_2 (g) + H_2O (l)

Student activity:

- Tell students to watch carefully for bubbles of gas because they may be difficult to see.
- Write the results and the equations of the chemical reactions on the board.
- Ask students what evidence indicated that a chemical reaction occurred.
  - *Bubbles indicated that a gas was given off.*

IV. Analyzing Results

Learning Goal: Students can analyze compounds' reactions with one another and use that data to identify an unknown compound.

- Write CO_3 and HCO_3 on the board and tell students that formulas that include CO_3 as part of the formula are **carbonates** and the formulas that include HCO_3 are **bicarbonates**.

- Ask students to identify boxes where carbonate and bicarbonate are present, <u>circle them.</u>

- Write HCl on the board. Tell students that HCl is an acid called hydrochloric acid.
  - Tell students to put a circle around HCl in row C.
- Ask students what happened in row C when an acid was added to a carbonate or bicarbonate **(A gas was given off)**
- Ask students what they can conclude about adding an acid to a carbonate or bicarbonate.
  - When an acid is added to a carbonate or bicarbonate a chemical reaction occurs. (Gas is given off)

IV. Analyzing Results

- Tell students that chalk, limestone, and marble are all calcium carbonate.
  - Ask students what they think would happen if HCl were added to marble? (It will bubble).
- Write the first half of the equation: $CaCO_3$+ HCl → … on the board, and ask students to hypothesize what will happen, and what the products would be
  - A gas would be produced: CO_2
  - In B5 add a small piece of marble and a squirt of HCl, then record observations.
  - Was their prediction correct? (Yes, bubbles should appear)
  - The full equation is: $CaCO_3 + 2HCl \rightarrow CaCl_2 + CO_2 + H_2O$
- Tell students that many statues are made of limestone and marble. What happens when acid rain falls on these statues?
  - The carbonate reacts with acid liberating a gas and causing the statue to decompose

V. Identifying an Unknown.

- Each pair uses 1 unknown.
- Follow the plan in Row D and add a squirt of your **unknown** to the 6 wells in Row D of the well plate.
- Add a **few drops** from your known dropper bottles, one well at a time.
- Write down the observation immediately after each addition.
- Look at the results in Rows A, B and C, including the demonstration reactions, to determine what the possible reactions are.
- Complete the class activity sheet.

V. Review and Clean-Up

- **Go over the vocabulary words.**
  - *What is a physical change?*
  - *What is a chemical change?*
  - *How do we know when a chemical change has occurred?*

- Collect the ziploc bags and the goggles.
- Place the lids on the 24-well plates and carefully put them in the Rubbermaid container. Place the lid on the Rubbermaid container and put it in the bottom of the box. (If you can rinse the well plates out at school, please do!)
- Place the ziploc bags and other materials in the box.
- Collect all instruction sheets in sheet protectors and put them in the box.