**Let’s Get Physical (and Chemical)!**

**Identification of Household Chemicals Using Chemical and Physical Properties**

**Teacher notes**

**Time needed to complete lab:** Approximately 2- 40 minute class periods

**Target grade level**: 9-12th grade High School Chemistry

**Objectives:** To understand the use of chemical and physical properties to help identify various chemicals using critical thinking.

**Major concepts**: Though the student may already know the chemical name/common name from their prior knowledge, they still have to prove their conclusions with information from their data tables.

* **Preparation:**
  + Barium chloride solution – 0.1M solution or stronger (place approximately 2g BaCl2 in 50 mL water)
  + Part 1: Have plastic containers/beakers with each solid, labeled with the chemical name.
  + Part 2: Have the common containers with each substance ready for them (i.e. – aspirin is crushed already) MAKE SURE YOU COVER UP THE CHEMICAL NAME FOR THIS PART!!!!

**Typical results or sample data:**

Table 1: Observations from part 1 using chemical names.

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| *SUBSTANCES*  **TESTS** | *Sodium chloride* | *O-alpha-D-glucopyranosyl- (1-2)-beta -D- fructofuranoside.* | *Sodium bicarbonate* | *Magnesium sulfate* | *Salicylic acid* |
| **Solubility in water**  \*Insoluble =I  \*Soluble = S | **S** | **S** | **S** | **S** | **I** |
| **pH**  (from probe)  Acid,Base, Neutral | Neutral | Neutral | Basic | Basic | Acidic |
| **Conductivity**  Y or N  Low, Med, High, Very High | Y  High | Y  Low-Med | Y  High | Y  High | Y  High |
| **Reactivity with BaCl2**  Solid forms = ppt  No solid = NR  **COLOR CHANGE** | NR | NR | NR  Cloudy | PPT  White | NR |

Table 2: Observations from part 2 using common household names.

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| *SUBSTANCES*  **TESTS** | *Aspirin* | *Baking Soda* | *Epsom Salts* | *Sugar* | *Table Salt* |
| **Solubility in water**  \*Insoluble =I  \*Soluble = S | I | S | S | S | S |
| **pH**  (from probe)  Acid, Base, Neutral | Acid | Base | Base | Neutral | Neutral |
| **Conductivity**  Y or N  Low, Med, High, Very High | Y  High | Y  High | Y  High | Y  Low to Med | Y  High |
| **Reactivity with BaCl2**  Solid forms = ppt  No solid = NR  **COLOR CHANGE** | NR | NR  Cloudy | PPT  WHITE | NR | NR |

**Answers to questions:** (students should fill in data tables and complete sentence using the evidence they have gathered from lab)

I believe sugar is also known as fructofuranoside because \_\_\_\_\_\_\_\_\_\_\_

\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_.

*(Fill out the chart & comment on similarities in the properties of sugar and the chemical substance.)*

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
|  | Solubility | Conductivity | pH | Reactivity with BaCl2 |
| Sugar | S | Y – low- med | Neutral | NR |
| Fructofuranoside | S | Y – low- med | Neutral | NR |

I believe table salt is also known as sodium chloride because \_\_\_\_\_\_\_\_\_\_\_

\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_.

*(Fill out the chart & comment on similarities in the properties of sugar and the chemical substance.)*

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
|  | Solubility | Conductivity | pH | Reactivity with BaCl2 |
| Table salt | S | Y – high | Neutral | NR |
| Sodium chloride | S | Y – high | neutral | NR |

I believe Epsom salts are also known as magnesium sulfate because \_\_\_\_\_\_\_\_\_\_\_

\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_.

*(Fill out the chart & comment on similarities in the properties of sugar and the chemical substance.)*

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
|  | Solubility | Conductivity | pH | Reactivity with BaCl2 |
| Epsom salts | S | Y – high | Base | PPT (white) |
| Magnesium sulfate | S | Y – high | Base | PPT (white) |

I believe baking soda is also known as sodium bicarbonate because \_\_\_\_\_\_\_\_\_\_\_

\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_.

*(Fill out the chart & comment on similarities in the properties of sugar and the chemical substance.)*

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
|  | Solubility | Conductivity | pH | Reactivity with BaCl2 |
| Baking soda | S | Y - high | basic | PPT - cloudy |
| Sodium bicarbonate | S | Y - high | basic | PPT (cloudy) |

I believe aspirin is similar to salicylic acid because \_\_\_\_\_\_\_\_\_\_\_

\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_.

*(Fill out the chart & comment on similarities in the properties of sugar and the chemical substance.)*

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
|  | Solubility | Conductivity | pH | Reactivity with BaCl2 |
| Aspirin | I | Y – high | Acidic | NR |
| Salicylic acid | I | Y - high | Acidic | NR |

1. How are physical and chemical properties useful in identifying unknown substances?

BY COMPARING DATA TABLE 1 WITH DATA TABLE 2, IT IS MUCH EASIER TO DEDUCE WHICH CHEMICAL NAME MATCHES WITH THE COMMON HOUSEHOLD CHEMICAL NAME. EVEN THOUGH MANY SUBSTANCES APPEAR TO LOOK ALIKE AND HAVE MANY SIMILAR PROPERTIES, AGAIN, NONE ARE EXACTLY THE SAME. THESE PROPERTIES ARE CONSTANT AND DO NOT CHANGE SO THEY PROVIDE A BASIS FOR IDENTIFICATION.

1. What other properties could have been used to help in matching the chemical name to the common name?

DENSITY, COLOR, MELTING POINT, BOILING POINT, ODOR (PHYSICAL)

HEAT OF COMBUSTION, FLAMMABILITY (CHEMICAL)

1. Could the solutions have been identified using only one physical or one chemical property? Why or why not?

IT COULD BE POSSIBLE, BUT NOT VERY CONCLUSIVE BECAUSE SO MANY CHEMICALS HAVE SIMILAR PROPERTIES. THEREFORE, THE MORE TESTS YOU CONDUCT ON THE CHEMICALS, THE EASIER IT IS TO DIFFERENTIATE BETWEEN VARIOUS UNKNOWNS.

**Extension:** If your students have mastered using solids, liquid cleaning products can be used as well (vinegar/rubbing alcohol/etc) and with further tests if necessary to help distinguish between the various solutions.

For more advanced students, they could create a series of tests to help them distinguish between various household chemicals.