**Activity Sheet Name Lesson 6**

**Part 1 - Temperature and Dissolving Solids Date**

# INTRODUCTION

1. **Does the temperature of water affect the amount of coating that dissolves from an M&M? Talk with your group and design an experiment to find out.**

**List three variables and how you will control them.**

**What is the only variable that should be changed?**

# ACTIVITY

## Question to Investigate

Does the temperature of water affect the amount of coating that dissolves from an M&M?

## Materials for Each Group

* 3 same-colored M&Ms
* 3 clear plastic cups
* 1 sheet of white paper
* Room temperature water
* Hot water (about 50 °C)
* Cold water (about 5 °C)

## Procedure

* 1. A close-up of a hand holding a red m's

     Description automatically generatedPour cold, room temperature, and hot water into the cups so that the water is deep enough to cover an M&M.
  2. Place the three cups on the white paper. Write *cold*, *room temp*, and *hot* near its cup.
  3. With the help of your partners, place a same-colored M&M in the center of each cup at the same time. Observe for about 1 minute.

1. **Does the temperature of the water affect the amount of coating that dissolves from an M&M?**

**How do you know?**

# EXPLAIN IT WITH ATOMS & MOLECULES

1. **What are the differences in the way water molecules move in cold, room temperature, and hot water?**
2. **On the molecular level, why do you think sugar dissolves better in hot water than in cold water?**
3. **Why do you think there is a greater difference in the amount of dissolving between the *hot and room temperature water* than between the *room temperature* and *cold* water?**

# A person pouring salt into measuring tubes Description automatically generatedDEMONSTRATION

1. **Your teacher showed you a demonstration comparing the amount of salt that can dissolve in hot and cold water and the amount of sugar that can dissolve in hot and cold water. Just like in your M&M experiment, much more sugar dissolved in hot water.**

**Does much more salt dissolve in hot water than in cold?**

**How do you know?**

1. **The following data table and graph compare how much sugar and salt can dissolve in water over the temperature range 0 °C to 100 °C. Use the table and graph to answer the following questions.**

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| **Solubility of sodium chloride and sucrose**  Measured in grams of solute dissolved in 100 mL of water | | | | | | |
| Temperature °C | 0 | 20 | 40 | 60 | 80 | 100 |
| Sodium chloride | 35.5 | 36 | 36.5 | 37.5 | 38 | 39 |
| Sucrose | 179 | 204 | 241 | 288 | 363 | 487 |

A graph of water and sucrose

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**The activity showed that temperature affects the dissolving of sugar more than it affects the dissolving of salt. Explain how the graph shows this.**

**How much sugar dissolves in 100 mL of water at 50 °C?**

**How much salt dissolves in 100 mL of water at 50 °C?**

# TAKE IT FURTHER

1. **Potassium chloride is a salt substitute sold in grocery stores for people who should limit their intake of table salt (sodium chloride). Use the data table to plot the solubility curve for potassium chloride on the graph below. Then use the graph to answer the following questions.**

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| **The solubility of potassium chloride**  Measured in grams of solute dissolved in 100 mL of water | | | | | | |
| Temperature °C | 0 | 20 | 40 | 60 | 80 | 100 |
| Potassium chloride | 28 | 33 | 38 | 44 | 50 | 55 |

1. **At what temperature would you say that the solubility of sodium chloride and potassium chloride are about the same?**

A graph of water and sucrose

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**At 0 °C, which substance is the least soluble?**

**At 0 °C, which substance is the most soluble?**

**Activity Sheet Name Lesson 6 – Part 2**

**Temperature and Dissolving Gases Date**

# ACTIVITY

## Question to Investigate

Does carbon dioxide stay dissolved better in water that is warmed or water that is cooled?

**Materials for Each Group**

* + Carbonated water in 2 clear plastic cups
  + Hot water (about 50 °C)
  + Cold water (about 5 °C)
  + 2 deli containers (that cups easily fit in)

## Procedure

1. A couple of glasses with water

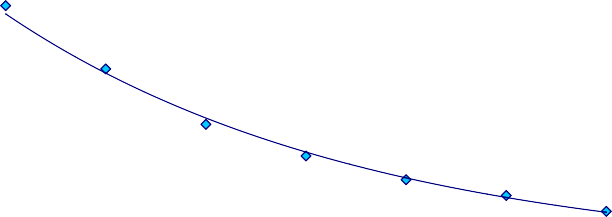
   Description automatically generatedGet the two cups of carbonated water that you moved aside earlier.
2. Fill one empty deli container about ⅓ of the way with ice cold water and another about ⅓ of the way with hot tap water.
3. Place each of the cups of carbonated water into the cold and hot water, as shown.
4. Watch the surface of the soda in each cup of carbonated water.
5. **Does carbon dioxide stay dissolved better in hot water or in cold water?**

**How do you know?**

1. **Based on what you observed in this experiment, why do you think people store soda pop in the refrigerator after the bottle has been opened?**

# EXPLAIN IT WITH ATOMS & MOLECULES

1. **Why does warming carbonated water make it easier for carbon dioxide to come out of solution?**
2. **Look at the graph showing the solubility of carbon dioxide in water to answer the following questions.**



**Carbon dioxide solubility in water**

0.35

0.3

0.25

0.2

0.15

0.1

0.05

0

0

10

20

30

40

50

60

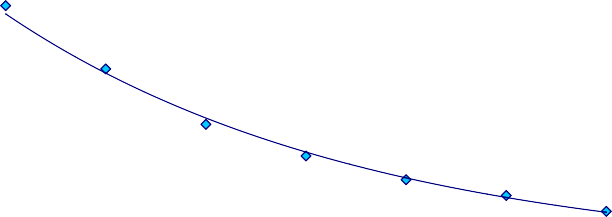
**Temperature (C)**

**a. As the temperature increases, is carbon dioxide *more* soluble in water or *less* soluble in water?**

**b. Does this graph match or not match your observations from the experiment? Explain.**

1. A graph of sugar and water

   Description automatically generated**What do the graphs below tell you about the solubility of carbon dioxide compared to sucrose, as temperature increases?**



**Carbon dioxide solubility in water**

0.35

0.3

0.25

0.2

0.15

0.1

0.05

0

0

10

20

30

40

50

60

**Temperature (C)**

# TAKE IT FURTHER

1. **During a long hot summer, you may notice fish gulping air at the surface of a pond. Why do you think the fish come to the surface like this, instead of breathing dissolved oxygen in the water the way that they normally do?**
2. **Coal-burning power plants heat water to turn turbines to make electricity. After using the water, it is cooled and then returned to the river or lake it came from. Why is it important to cool the water before returning it to the river?**
3. **Does warming ocean water mean that less carbon dioxide will be dissolved so ocean acidification should slow down?**