**Name: \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ Date: \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_**

**“Follow the Water” Lab**

**INTRODUCTION:**

A key NASA strategy to look for current or past life on Mars involves “following the water” – looking for places where water currently or once existed on the planet. In this activity, we will consider some of reasons why liquid water is important for life on Earth and may be important for life on Mars. In particular, we will consider the properties of ease of evaporation, solubility, and abundance.

**PART 1: Pre-Lab Questions**

**Read the following paragraphs and answer questions 1-6 in your lab journal.**

­­­­­­­­­Ease of Evaporation

 Even though a liquid may not boil at room temperature, it can still evaporate depending upon atmospheric conditions. If a liquid evaporates over the course of a few hours when set on a counter top, it is easy to evaporate. If a liquid can remain on a countertop for several days without evaporating, it is difficult to evaporate.

1) If you place a full cup of water out on a table in your classroom, will it start to boil? Why or why not?

2) If you leave a full cup of water out on the table overnight, would you expect the level of the water to increase, decrease, or stay the same by the next day? Explain your reasoning.

3) Now imagine that you leave three cups out on a table overnight. One is filled with water, the second with rubbing alcohol, and the third with vegetable oil. They are all filled with exactly the same amount of liquid. How would you expect the levels of each liquid to change by the next day? Which will evaporate the most? Explain your reasoning.

## Solubility

 The *solubility* of a liquid describes how easy it is for another substance to dissolve in the liquid. If you dissolve a solid in a liquid, the solid is called the *solute* and the liquid is called the *solvent*. Following this pre-lab, you will design and conduct an experiment to test the solubility of three solvents (water, vegetable oil, and rubbing alcohol) using three solutes (salt, sugar, and cornstarch).

4) Two students dissolve a spoonful of salt into a container of water. Which substance is the solvent and which is the solute?

5) Chocolate powder is soluble in milk. What does soluble mean?

6) Two students are preparing to do a solubility experiment. They carefully measure equal amounts of three solvents (water, oil, and rubbing alcohol) into different containers. They are now discussing ideas for testing the solubility of sugar in these liquids.

*Student 1:* I think we should put ten spoonfuls of sugar into each cup. If the sugar is soluble, the solvent should be able to dissolve all of it. After we stir up the liquid, we’ll see if the sugar has disappeared.

*Student 2:* What if the solvent can dissolve one spoonful but not ten? If we dump too much sugar in at once, we won’t know if the solvent could have dissolved a smaller amount. I think we should add a spoonful of the sugar at a time.

 Do you agree or disagree with either or both of these students? Explain your reasoning.

**PART 2: Class Observation of “Ease of Evaporation”**

Make observations about the ease of evaporation of the different solvents. **Record these in your lab journal**. You must get Ms. Campbell to review your observations and give you a stamp before you may continue.



*(Ms. Campbell’s stamp goes here)*

**PART 3: Solubility Lab**

Lab Objective: The purpose of this lab is to determine the relative solubility of the following solvents: water, rubbing alcohol, vegetable oil. You will have the following solutes to conduct this experiment: sugar, salt, and cornstarch.

Materials: Below is a list of materials for the lab. In the Procedure Section, describe how you will use these materials to complete the lab objective.

Solvents: water, rubbing alcohol, vegetable oil

Solutes: sugar, cornstarch, salt

Other materials: beakers for solvents, stirrers, etc.

Procedure: (How will you do your experiment? Be sure to include step-by-step instructions, including the amounts of each substance you are using.) **Write this in your lab journal.**

You must get Ms. Campbell’s approval and stamp before continuing.



*(Ms. Campbell’s stamp goes here)*

Observations/Data Collection: Carry out your experiment to test the relative solubility of the specified solvents and solutes. **Record all data and observations in your lab journal.**

You must get Ms. Campbell’s approval and stamp once data collection is finished.

*(Ms. Campbell’s stamp goes here)*



**PART 4: Relative Abundance of Solvents**

## Abundance at the Surface of the Earth and Other Properties

 A final characteristic we will consider is the abundance or amount of liquid present at or near the surface of the Earth. The table below lists the abundances of rubbing alcohol, crude oil, and water at or near the surface of the Earth in units of cubic miles. Crude oil and vegetable oil have similar solubility and stability properties, but there is much more crude oil present at or near the surface of the Earth than vegetable oil.

|  |  |
| --- | --- |
| **Solvent** | **Abundance (in cubic miles)** |
| Rubbing Alcohol | Trace amounts |
| Crude Oil | 42 |
| Water | 330,000,000 (330 million) |

What do you notice about the abundance of water near the surface of the Earth compared to other two liquids? **Write these observations in your lab journal.**

**PART 5: LAB REPORT**

**ANALYSIS SECTION:**

Recreate the following table in your results section and fill it in based upon the results of our three investigations. In each column, rank the solvents from high (1) to low (3) in terms of their solubility, stability to evaporation, and abundance at or near the surface of the Earth.

|  |  |  |  |
| --- | --- | --- | --- |
| **Solvent** | **Solubility** | **Stability to Evaporation** | **Abundance** |
| Water |  |  |  |
| Oil |  |  |  |
| Rubbing Alcohol |  |  |  |

**Conclusion questions:**

**Answer the questions below in paragraph format in your lab journal and make it into the lab conclusion.**

## With the three solutes tested in the solubility lab, which liquid was the **worst** solvent (water, rubbing alcohol, or vegetable oil)? **Explain your reasoning.**

1. Sugars, salts, and other solutes need to be able to move into, out of, and inside cells in order to carry out the basic functions of life. If a cell composed of mostly the liquid you listed in Question 1 above, would the cell still be able to transport solutes easily around the cell? Explain your reasoning.
2. Based upon the results of stability ALONE, which liquid would you expect to be the most useful for life? Explain your reasoning.
3. Based upon the results of the solubility experiment ALONE, which liquid would you expect to be the most useful for life? Explain your reasoning.
4. Based upon abundance ALONE, which liquid would you expect to be the most useful for life? Justify your answer.
5. Based upon all three properties considered TOGETHER, decide which liquid (water, oil, rubbing alcohol) is probably most important for life on Earth. Explain your reasoning.
6. In this activity, we have tested only three liquids (water, vegetable oil, and rubbing alcohol) for three properties (solubility, stability, and abundance). List some other liquids we could test if we had more time and resources. What are some additional properties that could be investigated?
7. NASA scientists looking for evidence of life on Mars think it is important to “follow the water.” Why do you think scientists link the presence of water on other planets to possible life there?
8. What further investigations could you do to explore the importance of water for life?
9. Write a summary paragraph to explain why water could be considered the most important chemical for life.