Grade Level	Content Area	Course Title *(9-12 Samples Only)*	Unit Title
8	**Science**	**N/A**	**Life on Mars: Why Follow the Water?**

Length of Unit	Time of Year Taught	Expected Prior Knowledge
3 days	**28th week**	How to connect experimental results/evidence to scientific explanations using logic; understanding how to conduct an experiment; taking precise measurements

Unit Description

Students read and discuss why NASA uses a "follow-the-water" strategy for looking for life on Mars; then students make observations, complete an experiment with both pre-lab and post-lab questions, and read more about water in order to learn that water is a good solvent that is abundant and relatively stable, which makes it conducive to sustaining life on Earth. At the end of the unit, students compose written responses that explain why water is important to life and why NASA "follows the water" in its search for life on Mars.

Standards: See instructions on page 15.	8th Grade Science Stand 1: Inquiry Process Concept 2: Scientific Testing (Investigating and Modeling) Performance Objective 4: Perform measurements using appropriate scientific tools (e.g., balances, microscopes, probes, micrometers).
Summative Assessment *In addition to the description, include a copy of the summative assessment in the application package.*	After the lab has been completed and Post-Lab questions have been answered and discussed, students will be asked to write for homework responses to the following questions: Why is water important to life on Earth? Why should NASA "follow the water" on Mars? This will gauge whether students have understood and synthesized the various readings, experiments, and discussions on the topic.
Scoring for Summative Assessment *In addition to the description, include a copy of the answer key and scoring rubric (if applicable) for the summative assessment in the application package.*	A rubric will be used (as shown on p. 6) that uses a 4-point scale for the various components of the grading; a score of 4 exceeds the standard; 3 meets the standard; 2 approaches the standard; 1 falls below the standard
Materials/Resources Needed *Include all items for the entire unit.*	Pens, butcher paper, student worksheets, clear plastic cups, graduated cylinders, coffee stirrers or popsicle sticks, permanent markers, small spoons, paper towels, water, rubbing alcohol, vegetable oil, sugar, kosher salt, cornstarch, NASA article: Mars: A Dry Planet Compared to Earth

	Lesson 1	Lesson 2	Lesson 3
Instruction and Timeline	The teacher divides the class into groups of three or four and gives each student a copy of the background article: NASA article: Mars: A Dry Planet Compared to Earth. The students read the article aloud. After students list their ideas about why water is important to life (below), the teacher asks students to brainstorm whether other liquids could be conducive to life. (15 minutes for preconception activity). The teacher passes out copies of the Pre-Lab questions and tells students they will examining the solubility, stability, and abundance of water, rubbing alcohol, and vegetable oil. Discuss the three common phases of matter and how to change from one phase to another. Using a graduated cylinder, the teacher puts equal measures of the three liquids in separate cups and tells students tomorrow they will note how much liquid evaporated. The teacher discusses the stability to evaporation of liquids (i.e. a more stable liquid is able to stay in a liquid state as opposed to evaporating). The teacher asks a	The teacher asks 3 student volunteers to measure the amount of liquid left overnight in the three cups of water, rubbing alcohol, and vegetable oil. Based on the measurements, the students are asked to deduce the relative stability to evaporation of each liquid and how closely it matched their pre-lab hypothesis; the teacher guides the discussion. (10 minutes) The teacher distributes to each lab group 3 cups with one containing sugar, another kosher salt, and another cornstarch, as well as 3 empty cups, 3 spoons, 3 coffee stirrers, a graduated cylinder, and a permanent marker for labeling the cups. The teacher approves students' experimental designs when students demonstrate a clear and logical sequence of procedures to follow. The teacher explains that a good solvent is one that dissolves a large amount of solute and that students should be analyzing how effective each solvent is. (The lab takes 30 minutes)	The teacher asks students to finish their Post-Lab Questions in their groups. After the teacher collects the Post-Lab questions, the teacher and students discuss the results of the experiment (i.e. the solvents from best to worst: water, alcohol, oil; water dissolved sugar and salt, while alcohol dissolved some sugar and some salt, and oil dissolved cornstarch or did it just suspend the particles?) The teacher also reviews the stability to evaporation results from yesterday (i.e. most stable to least stable: vegetable oil, water, rubbing alcohol). Teacher asks students to discuss what would happen if cells were made up of alcohol or oil? Would they be able to dissolve the sugars and salts that entered the cells? How does the solubility of water relate to life as we know it? What role does abundance play? Why would NASA scientists look for water in their search for life on Mars? The teacher discusses the answers with students. (15-minute discussion). After students read and answer questions about water (below), the teacher discusses and hands out tonight's homework, which is the

	series of questions about evaporation and tells students that water is fairly stable to evaporation and gets replenished through the water cycle. The teacher then discusses solubility and asks students what they already know about solubility. Terms and concepts related to solubility are discussed. The teacher tells students they will be conducting an experiment on solubility tomorrow and discusses the parameters of the experiment and challenges students to come up with a sensible procedure to follow for tomorrow's lab. The teacher helps the groups who are unsure how to set up the solubility lab by providing a sample set-up and procedures. (Pre-lab discussion and set-up: 35 minutes)		summative assessment. (5 minutes)

	Lesson 1	Lesson 2	Lesson 3
Student Activities and Timeline	After reading the background article, students in groups write on a piece of butcher paper: “Why is water important to life?” They write their ideas below the question and present their group’s ideas to the class. During the teacher demonstration of the stability to evaporation of the three liquids, students answer questions on their Pre-Lab worksheets. After the discussion of solubility, students write their procedures for the solubility lab with the teacher’s guidance. (As noted above, 15 minutes for preconception activity and 35 minutes for pre-lab)	While the teacher passes out materials, the students review their lab procedures from yesterday and finalize their experimental plans (i.e. how much solvent to use in each cup, etc.) Students use a worksheet to help them design their experiment with a clear purpose, materials, and procedures in mind. After getting teacher approval, students complete the solubility lab by measuring and testing all three solvents with all three of the solids. Students fill out a data table to track their results. (30 minutes for lab). Afterwards, students begin to answer Post-Lab Questions with their groups. (10 minutes)	Students finish their Post-Lab Questions in their groups. (15 minutes). Students discuss their findings with the teacher in a class discussion. (15 minutes). Students read a short expository text about water and answer the comprehension and critical thinking questions that follow: individual work. (15 minutes)

Life on Mars: Why Follow the Water?

Write your response to the following questions on a separate piece of paper. Reponses may be handwritten or typed. Use your observations and results from the stability **and** solvent labs, information from the NASA article, the water worksheet, class discussions, and your textbook in order to thoroughly answer each question with compelling evidence.

1. Why is water important to life on Earth?

2. Why should NASA “follow the water” on Mars?

Rubric: Life on Mars: Why Follow the Water?

In their responses, students should demonstrate their knowledge of the solvent nature of water and the abundance and stability of water on Earth. Students should be able to use the information they have learned about water to describe why water is important to life on Earth. They should also discuss why scientists plan to look for evidence of life where liquid water exists on other planets. Use the following rubric for grading.

	Exceeds Standards	**Meets Standards**	**Approaches Standards**	**Falls Far Below Standards**
Solvent Content	Solvent lab conclusions reported and extended to include predictions about other solvents, conclusions justified, many details and evidence used to relate results to the importance of water. (4)	Solvent lab conclusions reported, conclusions justified, results related to the importance of water using several details and evidence. (3)	Solvent lab conclusions reported, one of the following incomplete or missing: -conclusions justified -results related to the importance of water using several details and evidence. (2)	Two or more of the following missing or incomplete: -solubility lab conclusions reported -conclusions justified -results related to the importance of water using several details and evidence. (1)
Stability Content	Stability lab conclusions reported and extended to include predictions about other liquids, conclusions justified, many details and evidence used to relate results to the importance of water. (4)	Stability lab conclusions reported, conclusions justified, results related to the importance of water using several details and evidence. (3)	Stability lab conclusions reported, one of the following incomplete or missing: -conclusions justified -results related to the importance of water using several details and evidence. (2)	Two or more of the following missing or incomplete: -stability lab conclusions reported -conclusions justified -results related to the importance of water using several details and

				evidence. (1)
"Follow the water" Defense	Detailed description of NASA's "follow the water" goal, many reasons and details explaining why NASA should follow the water. (4)	Detailed description of NASA's "follow the water" goal, several reasons and details explaining why NASA should follow the water. (3)	Incomplete or missing one of the following: -description of NASA's "follow the water" goal -reasons and details explaining why NASA should follow the water. (2)	Incomplete or missing both: -description of NASA's "follow the water" goal -reasons and details explaining why NASA should follow the water. (1)
Writing		Paper is well organized, detailed, clear, and free of spelling/grammar mistakes. (3)	Missing one of the following traits: -well organized -detailed -clear -free of spelling/grammar mistakes (2)	Missing two or more of the following traits: -well organized -detailed -clear -free of spelling/grammar mistakes (1)