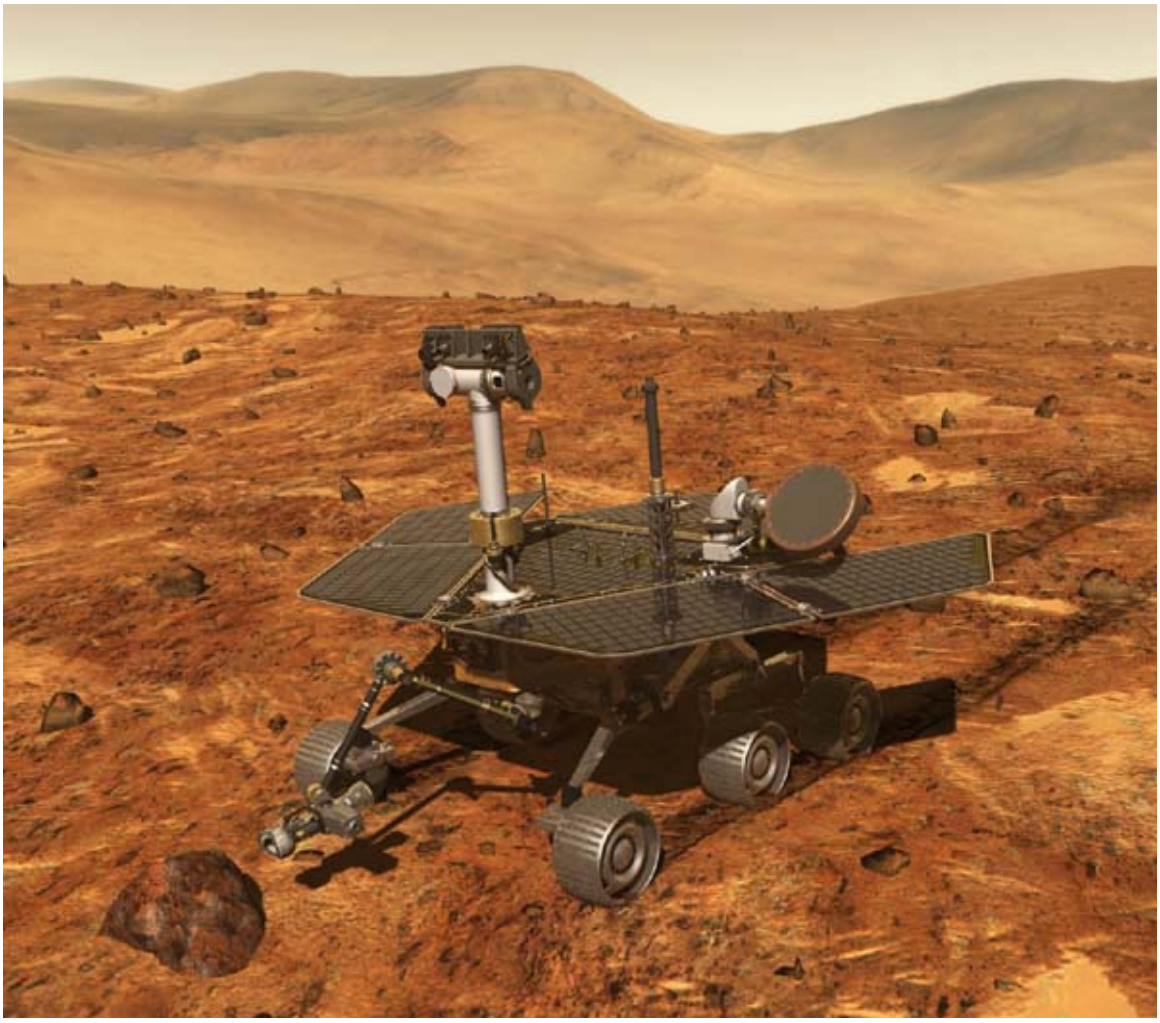
# Living on Mars: Searching for Life



**Student Level:**
Middle School (6-8)

**Objectives:**

- Students will demonstrate an understanding that life requires the right amount of energy and material inputs in order to prosper.

**Resources:**

- empty, clean, clear plastic bottles with caps (such as 1 or 2 liter soda bottles)
- water from various sources
- sugar
- fertilizer

**Outcomes:**

- Students will write reasonable hypotheses at the beginning of the experiment.
- Students will record accurate observations over the course of the experiment.
- Students will orally discuss and evaluate the results of the experiment.

**Assessment:**

- Were the students able to make reasonable decisions about how a search for life on Mars might be undertaken?
- Were the students able to develop rational hypotheses before the experiment?
- Were the students able to interpret the results of the experiment in relation to their understanding of life's needs for energy and materials?

**Time:**

About 45 minutes for the first day, about 5 minutes per day for observation over the course of the experiment, and about 25 minutes on the last day.

**Procedure:**

~5 minutes:
Define "exobiology" as the study of life beyond the Earth (or the possibility of such life). Explain that while life has never been confirmed to exist elsewhere, many scientists think that it is possible, and even likely, if given the right conditions; one of the most important of these conditions is liquid water. Therefore, apart from the obvious usefulness of liquid water to the explorers themselves, finding it on Mars may be an important first step toward answering the question about whether there is life native to the planet. Liquid water cannot exist on the Martian surface; it would either freeze into ice (due to the generally low temperature) or sublimate into water vapor (due to the very low pressure of the atmosphere). Therefore, looking for liquid water means looking underground.

~10 minutes:
Facilitate a discussion in the class on possible approaches for searching for liquid water underneath the Martian surface. Possible questions include:

- How might the explorers dig/drill under the surface (by hand, tractor, robot, etc.)?
- What landforms (cliffs, craters, volcanoes, etc.) might be targeted, and why?
- How deep should they look (5 meters, 50 meters, 500 meters)?
- What precautions should be taken, in case there is native life?

~30 minutes:
Explain that water would be tested to see if life is present and that the students will perform their own experiments on water from several sources. All life needs energy, and almost all life gets its energy (directly or indirectly) from the sun. Life (at least on Earth) is mostly composed of SPONCH (sulfur, phosphorus, oxygen, nitrogen, carbon, and hydrogen). Each type of water will be tested with various levels of energy input (direct sunlight, indirect light, and darkness) and various types and amounts of material input (sugar, fertilizer, both, nothing). Possible sources of water (which may be procured in advance, with or without the students) should include those likely to contain life, such as water from a pond or a creek, and those that perhaps aren't so likely, such as tapwater or bottled water. Label each bottle according to its water source, energy input, and material input (perhaps each student will have his/her own bottle). Have the students write hypotheses as to what they expect to see happen in the different bottles over the course of the experiment.

~5 minutes per day:
At regular intervals (perhaps daily or semi-weekly), have the students examine their bottles (without opening them) and record what they observe (written records can be added to their hypothesis papers).

~25 minutes:
On the last day, after making their final observations, have the students share and discuss what they observed, how their hypotheses fared, and what results they ended up with (did water source, energy input, and/or material input affect the observable growth in the bottles?). Additionally, what might make running such experiments to find life on Mars more difficult? How might explorers, searching for life, address those difficulties?

**Standards Addressed:**

**California:**
*Science, Grade 6*
5.e. Students know the number and types of organisms an ecosystem can support depends on the resources available and on abiotic factors, such as quantities of light and water, a range of temperatures, and soil composition.
*Science, Grade 7*
3.e. Students know that extinction of a species occurs when the environment changes and the adaptive characteristics of a species are insufficient for its survival.
*Science, Grade 8*
6.b. Students know that living organisms are made up of molecules consisting largely of carbon, hydrogen, nitrogen, oxygen, phosphorus, and sulfur.

**Florida:**
*Science, Grades 6-8, How Living Things Interact with Their Environment*
1.4 The student knows that the interactions of organisms with each other and with the nonliving parts of their environments result in the flow of energy and the cycling of matter throughout the system.

**New York:**
*Science, The Living Environment*
6. Plants and animals depend on each other and their physical environment.

**Texas:**
*Science, Grade 6*
12. The student knows that the responses of organisms are caused by internal or external stimuli; the student is expected to: C) identify components of an ecosystem to which organisms may respond.
13. The student knows components of our solar system; the student is expected to: A) identify characteristics of objects in our solar system.
*Science, Grade 7*
12. The student knows that there is a relationship between organisms and the environment; the student is expected to: C) describe how different environments support different varieties of organisms.