Life in the Universe

Ever since mankind has been contemplating the heavens, people have thought about what aliens might be out there. Even the Greeks had aliens of sorts in their writings. In the 16th century, Bruno suggested that every star had planets and life (the first to conceptualize the universe this way, he was eventually burned at the stake, though not solely for this view).

Later, when Percival Lowell used his telescope to look at Mars, he even imagined he saw canals signifying life (partly due to a mistranslation of Schiaparelli's c*anali*, which means channels, not canals). Of course, the human brain is very good at drawing connections where they don't really exist, and today we know that those “canals” were just the human eye connecting unrelated features.

Whether or not planets actually exist around other stars was an open question until we started detecting them. At first, we could only find planets that were very large – bigger than Jupiter – and very close to their parent stars. These huge, hot gaseous planets aren't especially good for life as we know it. However, as our technology improves, we find more planets – recently even planets and stellar systems similar to our own Solar System. We are beginning to have evidence that Bruno was more or less correct: while not all stars have planets around them, many probably do.

Today, what we know about other planets in our solar system, as well as life here on Earth, lets us imagine what life might be like on planets around other stars. In this lab, we will investigate what conditions life needs, and look at where else we might find it.

Part 1: What is "Life"?

The Kepler mission is searching for terrestrial planets in the "habitable zone" around the parent star. In choosing this mission goal, scientists are trying to find places where life as we know it could exist.

With your group, answer questions 1-3 based on what ***you*** think**. We will then discuss this as a class.**

For the remaining questions, you have several resources available:

- Textbooks
- The Internet
- Yellowstone Pamphlet
- Your brain!

Use each of these to think about questions 4-7 in this section.

Part 2: Life in Extreme Environments on Earth

Of course, life even now exists in some crazy places on Earth. We have found life at the bottom of 1 km deep mines, in superheated (above the normal boiling point) pools of water, in extremely salty situations, and even in clouds. Microbes that live in extreme environments are called extremophiles.

All of the websites below are linked from a central location:
http://ida.phys.stthomas.edu/ExtraSolar/

Some extremophiles are described at the following two websites:
http://hydrogen.montana.edu/ysmodule.html
http://serc.carleton.edu/microbelife/extreme/environments.html

1. Using the World Map of Extreme Environments from the Montana website, investigate the most extreme conditions life can be found. For more details on the Yellowstone extremophiles, you can click on the Yellowstone map. You may also use any other websites to find more information about other extremophiles.

2. Think about what properties of these areas make them "extreme" and **answer questions 1 and 2**.

The Kepler space telescope mission was designed to search for worlds that could potentially support life. We typically define the "habitable zone" around a star to be the range of distances that could potentially support life as we know it.

3. Using this *general* definition answer **question 3** in the packet.

Check out the Kepler mission at http://kepler.nasa.gov/ to see what its capabilities are. There are many parts of the website that are useful; in particular the menu Science → About Kepler has both a FAQ and science goals.

4. Use the Kepler website to answer **questions 4 and 5**.

Part 3: Finding Life – our own solar system and beyond

Now that you have some idea of the parameters life might require, let's take a look at some nearby (in our own solar system) places that might contain life.

1. Compare your criteria for "habitable" to locations within the solar system. What planets should you consider? What moons? Answer **questions 1 and 2** for planets and moons *within* our solar system.

2. Next, take a look at the table of extra-solar planets. Most of these have been found by the Kepler mission. Using this data and what you have learned so far, answer the remaining questions.