Bennett, Jeffrey et al. "Is There Life Elsewhere?" *Reading Across The Disciplines.* 3rd ed. Ed. McWhorter, Kathleen T. New York: Pearson, 2007. 557-560.

Is There Life Elsewhere?

1 We know of only one example of life existing in the universe—life here on Earth. No matter how reasonable and plausible the idea that life exists elsewhere might seem, we still don't know for sure that it does. Because of this uncertainty, all we can do today is discuss the issues that could determine whether extraterrestrial life is likely or unlikely to exist and how we might search for evidence of it.

2 Despite these limitations, we are at a unique point in the long history of the debate over the possibility of extraterrestrial life. We have the technological capability to explore Mars and much of the rest of our solar system, and we are rapidly developing technology that might allow us to find evidence about whether life exists on planets around other stars. After millennia of speculation about life beyond Earth, we have the potential to discover life on another planet within perhaps the next one or two decades. This remarkable prospect calls us to discuss the philosophical and cultural consequences of finding life elsewhere. But first let's summarize the key issues in our discussion about the prospects of finding life and the search for life in the universe.

Why Life Seems Likely

3 Why do we think life might exist elsewhere? Although we don't know for sure whether it does, current science offers reasons for optimism. We can examine the nature of life on Earth—its building blocks and how it originated—and understand the environmental conditions in which life can exist. We can look at the other planets and satellites in our solar system and determine whether the conditions conducive to life exist there. And we can look for planets around other stars, learn how abundant they are and how they form, and determine whether some of them might be Earth-like planets (that is, rocky planets in the inner regions of their solar systems that might have liquid water at the surface) that could be capable of supporting life.

4 When we do these things, we find three key pieces of evidence that point to the idea that life should be common in the universe. We'll list them and then discuss each briefly in turn:

1. The chemical elements that comprise life are common throughout the universe, and complex, carbon-bearing molecules important to life on Earth appear to form easily and naturally under conditions that should be common on many planets.
2. Life on Earth thrives under a wide range of environmental conditions that we once considered too extreme to be capable of supporting life, and many of these types of environments are likely to be found on other planets in our own solar system beyond.
3. It seems that life appeared on Earth quite quickly once the conditions became conducive to supporting life (that is, after the end of the heavy bombardment), implying that the origin of life took place rapidly and making it seem plausible that life would arise quickly elsewhere when the right conditions exist.

Prospects for Finding Life in Our Solar System

Europa
one of Jupiter's moons

Titan
one of Saturn's moons

Copernicus
father of modern astronomy, first scientist to believe that Earth revolves around the sun

Galileo
proved Copernicus's theory by using a telescope to observe the solar system

Kepler
used math to prove that the planets move around the sun

Newton
developed the law of gravitation, which explains how planets move

microbial
relating to microscopic organisms

5 At least two worlds in our solar system—Mars and **Europa**—seem to be good candidates for having life today or for having had it at some time in the past, and several other worlds seem to be possible candidates for life. As a result, NASA and other space agencies have embarked on a program to try to determine whether life might actually exist elsewhere in our solar system. Spacecraft are being developed for missions to Mars, with launches planned approximately every 2 years (at the times when Earth and Mars line up to make the trip relatively easy). Numerous other spacecraft are exploring or are being developed to explore other worlds, including the Cassini spacecraft currently en route to Saturn and **Titan**. Such missions will help us learn not only whether life can exist on various worlds, but also how interior, surface, and atmospheric processes play out on different planets and moons. This knowledge will help us understand why some worlds end up habitable and others don't. It will also provide guidance to us as we seek to answer the question of what planets in other solar systems might be like.

The Impact of Finding Life on Human Perspective

6 People have long speculated about life beyond Earth, and many people—including many scientists—have at times been convinced that life exists on the Moon, on Mars, or on other worlds. Why, then, would the discovery of extraterrestrial life have a major impact on human perspective? The answer lies in the difference between guessing and knowing. As long as there is uncertainty about the existence of life on other worlds, people are free to hold a wide range of opinions. People living before the time of **Copernicus** could continue to believe in an Earth-centered world, but it was very hard to continue to do so after **Galileo**, **Kepler**, and **Newton** offered convincing proof to the contrary. An actual discovery of life beyond Earth would force us, both as individuals and as a society, to reconsider the place of our planet and our species in the cosmos.

7 In contemplating the significance of finding life elsewhere, let's begin by considering what would happen if we found **microbial** life on Mars. The first question we would probably ask is whether the life was genetically related to terrestrial life (suggesting that it had migrated between planets on meteorites) or instead represented an independent origin of life on Mars. We could answer this question by determining the structure of the molecules that make up the martian life. Does it use DNA and RNA molecules similar to those used by terrestrial life? Does it use the same amino acids or the same proteins to carry out enzymatic reactions? Do the molecules that participate in life have the same "handedness" to them? It seems unlikely that there would be only one solution to the problems of containing and passing on the genetic information required for life to reproduce, of catalyzing the chemical reactions that comprise life, and of storing and using energy in metabolism. We would expect life that had an origin independent from life on Earth to have a different chemical structure.

8 While a discovery of life on Mars that was genetically related to terrestrial life would be exciting, it would not have as great an impact as a discovery of life that showed evidence of an independent origin. If and when such a discovery occurs, it

likely will seem to be the final step in recognizing that we on Earth are not so special. Life would be seen as just another example of the types of chemistry that can occur in a planetary environment, albeit an especially interesting one. A discovery of non-terrestrial-based life on Mars would be consistent with the views that have been put forward about the ease of formation of life would suggest that at least microbial life was common throughout the galaxy.

9 Would a discovery of alien microbial life have the same philosophical impact as a discovery of extraterrestrial intelligence? In informal polls, many people indicate that only the discovery of alien intelligence would have truly profound significance for them. Many scientists working in the nascent field of astrobiology disagree, however, feeling that the discovery of even the simplest single-celled organism on another planet would have profound significance for us. If this life had an origin independent from terrestrial life, it would tell us that the origin of life was not a unique event. With proof that life has originated twice, we would have every reason to think it has originated many times and thus that life is widespread in the universe. A discovery of alien microbial life would also help us better understand life in general. We would learn more about the conditions under which life can arise and persist, as well as the conditions under which it can evolve into more complex forms. That knowledge, in turn, would have implications for whether intelligent life might be common.

Significance of the Search Itself

10 A discovery of extraterrestrial life would undoubtedly bring important practical benefits. For example, studying it will help us understand what characteristics of terrestrial life are unique to Earth and what characteristics apply generally to life anywhere. If we find intelligent life elsewhere, we would learn much more about the nature of intelligence and might be exposed to cultures and societies very different from those of humans. If we could communicate with more advanced beings, we could possibly learn the secrets of the nature of the universe, the nature of consciousness and the mind, and technological marvels that could dramatically change our life here on Earth.

11 However, for many people excited by the scientific search for life in the universe, the search itself is much more than a means to an end. For them the search is just one more critical component in our exploration of the world around us. Other components in astronomy and space science include exploring the planets and moons in our solar system as a way to understand how planets work and exploring stars and galaxies as a way to determine the nature of our universe. Other components in biology include exploring the origin and evolution of life on Earth so that we can understand how we ourselves came to exist.

12 In all these cases, our exploration does not seem to be driven solely by the desire to find specific answers to the scientific questions we are asking, because in each case we end up asking more questions. Instead, we seem to be driven by our inherent curiosity, our desire to understand the world around us (Figure A, p. 554). Sometimes our curiosity leads to discoveries with practical applications, while at other times it simply helps us understand how or why the world is as it is. Understanding the world around us means learning about the broader-scale environment in which humans exist. Understanding the occurrence of planets orbiting other stars helps us understand

Figure A The Earth as viewed in space from the Apollo 17 spacecraft. Seen from this perspective, we recognize the strong connections between the terrestrial ecosystem and the planet itself, and we recognize that life, indeed, is a planetary phenomenon. As we explore the universe, we will learn whether the formations of planets around stars and the occurrence of life on planets are rare or commonplace. We may then finally answer the question of whether we are alone.

the significance of the occurrence of planets orbiting the Sun, including Earth. Understanding the occurrence of life elsewhere allows us to understand the significance of the occurrence of life on Earth. And understanding the potential for intelligent life beyond Earth brings with it an understanding of the meaning of the occurrence of intelligent life here on Earth. In essence, by learning about the world around us we are learning about ourselves and about what it means to be human.