There’s a deep and complex relationship between living creatures, inorganic material such as rock and minerals, and the climate conditions we experience, such as rain and wind. These relationships are not always easy to see. Sometimes, the relationship operates on a level that is microscopically small, such as the way plants transform sunlight into nutrients. Other times, the relationship can be observed only across a hugely long span of time—hundreds, thousands, or even millions of years. But the connection is there, and we’re in a unique and privileged position to see and appreciate it.

If you could overcome these two limitations of everyday seeing—if you could see things that were very small and subtle, and if you could see things that occurred over a very long stretch of time—what would you see?

It’s a matter of debate, but there’s certainly a good case to be made that photosynthesis may be the most exciting earth process we know of. We know that plants are capable of converting water, carbon dioxide, and sunlight into oxygen. They are able to achieve this
remarkable feat with a relatively small number of separate parts, and have done so, very reliably, for ages. Anyone who’s ever had a household plant, watered it, set it near light, watched it grow, and felt the air in her home to be cleaner has experienced this magic firsthand. But if you could see this process on a microscopically small scale, this abstract magic would be revealed as an extraordinary set of mechanisms.

What if you could see photosynthesis working over the span of billions of years? This is the other remarkable thing: This mechanism, which operates on the smallest scale imaginable, has consequences that are literally global in scope, and span ages. If you could watch the earth evolve, you could see how, over two-and-a-half billion years ago, before the emergence of plants that could release oxygen, there simply wasn’t much of it at all in the atmosphere. Not much oxygen in the atmosphere meant there were nowhere near the number and variety of creatures we’ve come to know today.

Over the course of hundreds of millions of years, you’d slowly begin seeing the emergence of tiny organisms capable of producing oxygen. However, you’d also notice that most of that oxygen was captured by minerals and other organic matter, never growing to very high levels in the atmosphere. Sooner or later, though, these organic and inorganic matter would reach their saturation point—the moment when they simply could not absorb any more oxygen. That’s when the oxygen created by organisms would become free oxygen. Free oxygen for everyone!

Then, as an observer across the ages, you’d begin seeing the atmosphere change, from one dominated by methane and other elements, to one plentiful with oxygen. As we know, this is what set the stage for a huge diversity of mineral and organic life to emerge, including, many billions of years later, human beings. All of us, along with the foods we consume and the ground we walk on, are the direct descendants of a process that began billions of years ago, and that continues today, all across the planet, on a microscopically small level. What could be more exciting than that?

Of course, if photosynthesis is the most exciting earth process we enjoy, then its energy from the opposite direction—heat from the Earth’s core—that’s the most mysterious. That’s because it originates, at least in part, from events that occurred at the very formation of the planet.
Can you imagine such a thing as “pre-earth” space? It’s a pretty heavy concept. But imagine the part of the universe where the earth would soon be, but wasn’t yet. There, when the hot gases and particles were pulled together by gravity to create the early earth, immense heat was generated, and the resulting planetary core continues to cool to this day, radiating heat outward. The movement of more and less dense parts of the earth’s core produces heat. Most of all, there are massive amounts of radioactive material deep in the earth’s core, decaying slowly and releasing heat as they do.

While energy from the sun sets in motion extraordinary interactions between the atmosphere, organisms and minerals, energy from the earth’s core profoundly affects the shape of the ground we walk on—literally. Again, imagine having the power to see very small and very slow. Processes that result from earth’s energy operate at these levels. We’re all familiar with the most visible results: earthquakes and volcanoes, which can be mighty indeed! But energy from the earth’s core is also responsible for the shift of tectonic plates, that is, the very placement of one continent relative to another, and, as a result, the emergence of mountains, chasms, oceans, and myriad more aspects of the environment.

This is what it really means to contemplate the origins of the planet and the universe. It’s not simply a matter of the far-away cosmos and their relationship to us. It’s the question of how it came to be that events occurring unimaginably long ago, and taking place at a rate so slow it’s impossible to see, have come to shape the ground we walk on. The decay of radioactive material deep in the earth’s core is responsible for not only the Rocky Mountains, but the formation of cities and societies that have lived there for generations, such as Rocky Mountain National Park, which serves as a beacon to the natural wonders of America and Canada. It’s responsible for mountains that serve as barriers, bringing to life divisions in culture unique to each side, while also posing a challenge to be crossed and burrowed into, spurring on scientific innovation in the process.

So many aspects of what it means to be human, from the way cities are constructed, to the way nations are organized, are influenced by our natural environment, by the vast and complex set of processes that have shaped the earth since its inception, and will continue to do so long into the future.
1. Photosynthesis is an example of what?
   A. one of philosophy’s big ideas
   B. one of Earth’s key processes
   C. one of humankind’s best inventions
   D. one of science’s most well-known innovations

2. In this passage, the author provides a list of what?
   A. ways that the earth has been shaped by ancient natural processes
   B. ways that the earth has been shaped by scientific innovation
   C. ways that our lives have been shaped by philosopher’s theories
   D. ways that our lives have been shaped by cultural events

3. Photosynthesis is an important process that supports many kinds of life. What evidence from the text supports this conclusion?
   A. Photosynthesis may be the most exciting earth process we know of.
   B. Photosynthesis produces oxygen, which allowed diverse mineral and organic life to emerge.
   C. Photosynthesis operates on the smallest scale imaginable.
   D. Photosynthesis is a process by which plants convert water, carbon dioxide, and sunlight into oxygen.

4. What do processes on Earth have an impact on?
   A. living things only
   B. living things and the non-living environment
   C. the non-living environment only
   D. climate conditions only

5. What is this passage mainly about?
   A. the history of the planets and moons within our solar system
   B. how the development of the earth has been impacted by its natural processes
   C. the early organisms that helped to populate the earth with oxygen
   D. the consequences that arise from the earth’s tectonic plate shifts
6. The author describes processes that involve changes happening on a small scale, and over billions of years. How does the author help the reader to understand those processes?

A The author includes graphs, charts, and a timeline.
B The author includes detailed illustrations to show these processes.
C The author describes what one would see as an “observer across the ages.”
D The author describes instructions for conducting one’s own experiments.

7. Choose the answer that best completes the sentence below.

Energy from the sun sets in motion extraordinary interactions between the atmosphere, organisms and minerals. ________, energy from the earth’s core profoundly affects the shape of the ground we walk on.

A Consequently
B Meanwhile
C In conclusion
D For example

8. Human beings need oxygen to breathe. Why is photosynthesis essential to the survival of human beings?

______________________________________________________________
______________________________________________________________
______________________________________________________________
______________________________________________________________
9. Explain how the earth’s core has impacted human life. Use evidence from the text to support your answer.

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10. Could humans survive on Earth over two-and-a-half billion years ago, before the emergence of plants? Why or why not? Use evidence from the text to support your answer.

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Teacher Guide & Answers

Passage Reading Level: Lexile 1280

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   B  Meanwhile
   C  In conclusion
   D  For example

8. Human beings need oxygen to breathe. Why is photosynthesis essential to the survival of human beings?

   **Suggested answer:** Photosynthesis produces oxygen, which humans need to breathe in order to survive.

9. Explain how the earth’s core has impacted human life. Use evidence from the text to support your answer.

   **Suggested answer:** Students should explain that the earth’s core affects the shape of the ground we walk on. Advanced answers may explain that this has implications on where people settle and how they form communities and societies.

   Students may also note that the decay of radioactive material deep in the earth’s core is responsible for not only the Rocky Mountains, but the formation of cities and societies that have lived there for generations, such as Rocky Mountain National Park. It’s responsible for mountains that serve as barriers, bringing to life divisions in culture unique to each side, while also posing a challenge to be crossed and burrowed into, spurring on scientific innovation in the process.

10. Could humans survive on Earth over two-and-a-half billion years ago, before the emergence of plants? Why or why not? Use evidence from the text to support your answer.

   **Suggested answer:** No. Students should note that humans need oxygen to breathe, that photosynthesis creates oxygen, and that our atmosphere did not become full of oxygen until after plants evolved.