Chapter 1

Exercises

1. There are many in the chapter. One example of a scientific model is the work by Eratosthenes to calculate the size of Earth.
2. The model could be tested today by using the information we have from seismic waves. We know fairly accurately the radius of Earth’s interior and the densities. Calculations using those values can provide a test.
3. Earth is not a perfect sphere because it bulges in the middle at the equator since it is rotating daily. Additionally, there are mountains and hills that are topographically higher. There are valleys, lakes, and oceans that are topographically lower.
4. 0.01 cm
5. No, there have been repeated meteorite impacts to Earth in the geologic past, and these impacts will continue to occur in the future.
6. The crust is composed mostly of silicate rocks. The elements found in the crust are mainly silicon, oxygen, and low amounts of iron. The mantle has lower percentages of silicon and oxygen with an increasing percentage of magnesium. The core is predominately composed of iron.
7. The heat and density increase with depth inside Earth. The deeper core has a higher temperature and density.
8. Both weather and climate describe the state of the atmosphere but the time scales differ. Weather describes the short-term state of the atmosphere whereas climate describes the long-term state of the atmosphere. One example would be a warm day in January. The weather in January would be warm but typically the climate in January would indicate cold weather (in the Northern Hemisphere). Climate also includes the interaction of the atmosphere with the hydrosphere, the cryosphere, biosphere, and lithosphere.
9. Convection is the movement of heat. Heat can move through solids like the mantle.

Thought Questions

1. Science seeks answers to explain the natural world by observing and testing natural phenomena. In order for an idea to be tested it must be observable and repeatable. Religion explains the natural world with ideas that are not necessarily testable or repeatable.
2. Starting our tour at the crust we encounter rocks that are high in silica, lighter in both density and color. You will notice that the rocks here are multicolored with both light and dark colored rocks. As we walk deeper inside Earth, we notice that the color begins to change with a larger percentage of darker minerals as the amount of oxygen and silicon decrease and magnesium and iron increases. The density also increases as we go deeper. When we reach the core, the density is very high and the rocks are composed mainly of iron.
3. If we look at only one of the systems, we will have an incomplete view of Earth. Since the systems are interconnected, a change in one system can result in a change in another system. An example is the plate tectonic system and the climate system. The plate tectonic system “manufactures” igneous rocks that make up Earth’s crust. Once these igneous rocks are exposed to water and ice from the climate system, the rocks begin to break down and weather.
4. All geosystems are large, interact with other geosystems, and change Earth’s environment. The geosystems differ in that the climate geosystem is driven by solar energy whereas the other geosystems are powered by Earth’s internal heat. Each of the systems involves different processes and affects different parts of Earth.
5. The geodynamo system is generated by convection currents in the core composed primarily of iron. If a planet does not have a liquid core rotating, then there would be no geodynamo system. If a planet has a core composed of silicate minerals, there would be no geodynamo system.
6. The climate system began to act 3.5 billion years ago evidenced by the evolution of life. The plate tectonics geosystem is responsible for mountains, volcanoes, and other landforms. Therefore its age can be tied to the earliest formation of these landforms. These landforms were eroded and provided nutrients for the evolution of life. The geodynamo system provided a protective layer in Earth’s atmosphere to shield the Sun’s radiation and allow for evolution of life on Earth.
7. Although no theory can be completely proven, a vast body of evidence including both fossils and modern-day organisms supports Darwin’s theory of evolution.