

Opening to Earth Systems
Discovering How Earth Works
Teacher Background for the Unit

It is a very great distance through the earth; and if it were possible to bore a hole through the planet, much of its insides would be observed as highly compressed or molten rock. The hole through the earth would be nearly 13,000 kilometers (8,000 miles) from one surface of earth to the other. That distance is nearly three times across the United States! The heaviest metals, like iron and nickel, would be near the middle and the lightest materials, like the carbon and calcium that life is built from would be found near the surface. This stands to reason. If earth were once molten, like geologists say it was, the lighter stuff would float to the surface. Life is only on the outer margin of the planet, about 19.35 kilometers (twelve miles) from top to bottom! Scientists call this zone the biosphere. It is like a very thin film at the surface of the earth and the conditions in this film must remain very constant for life to continue to exist.

How old is the earth and how long has it been cooling to the condition that we find it today? Our best estimates are that the earth is four and a half billion years old. This is 4,500 million years. The number is unimaginably large, even for adults to really understand. But comprehending the age of earth and events in its past, relative to events in our recent history is important for us to understand as we maintain the health of the planet. For example, how long did it take oil and gas to form? With all of the uses we have for fossil fuels, how long will they last? What is the rate of species extinction and how long did it take for species to evolve? How long will it take to repair a hole in the ozone layer or cool the atmosphere if global warming continues?

Suppose the earth's history had all been recorded as a one-year movie that was shown from January 1 through December 31. When in the film did the dinosaurs come into existence? Not until December 12! When were the Egyptian pyramids built? Twenty-two seconds before the film is over! How far back in the film was it when Thomas Jefferson signed the Declaration of Independence? Six tenths of a second before midnight in the last minute of the yearlong film! It is important to understand relative earth time when we study about how earth's systems function and how we affect them. In a few short decades, because of our modern society, we have put some of the systems at risk. Biologists have identified about three million species of living organisms. But our search has really only begun. Each year thousands of new species are identified, and there are environments where we have hardly begun the search. Current estimates of the total number of species on Earth range from 5 to 30 million, of which, approximately 2 million have been formally described (according to the 2005 Millennium Ecosystem Assessment). Over half of all described species are insects. The current rate of extinction surpasses the rate of new species evolving by many thousands of times. The numbers of new forms to discover, classify, and understand their place in the web of life are rapidly being depleted as this effort goes on. We know some are gone before we even know about them. Extinction rates have been studied for the species-rich tropical rain forests. At the current rate of forest destruction, half of the remaining rainforest will be gone by 2022. According to Dr. Edward O. Wilson, world authority on biodiversity and extinction, "If the rainforests are as rich in diversity as most biologists believe they are, their destruction alone will eliminate 5 to 10 percent or more of all species in thirty years." This statement was made in 1992. The current mass extinction is entirely human caused. This is being accomplished through a variety of means including habitat destruction, hunting and poaching, the introduction of non-native species, pollution and climate change.

Often the damage we cause to organisms that results in extinction or endangerment is in ignorance or unintentional. We all love the richness of animal and plant life that surrounds us. Often we damage the opportunity for other organisms to coexist with us because we do not understanding the particular needs of organisms.

This unit of activities is about how earth's systems work. Every species, and the earth itself, are tied into systems that must function within rather close limits if life as we know it is to persist on the planet. This chapter about earth's systems is primary to understanding the "big picture" about humans in relationship to the environment. Discover and have fun with your students.