

References and Further Reading

Chapter 8: Geologic Time

There is a lively ongoing debate over just how we got here. Most earth science books tend to ignore the debate, even though it is one of the most discussed science question in the media and in society at large. Whether the debate is framed as Young Earth versus Old Earth, or Creationism versus Evolution, the vast majority of earth scientists agree on their interpretation; Earth is billions of years old and life evolved slowly over time from primitive to more sophisticated forms. We drew on essays by many scientists as well as numerous news reports and Gallup poll results to help frame this debate but especially appreciated the work of Donald Wise (*American Scientist*, 1998, v. 86, p. 160-173; *Journal of Geoscience Education*, 2001, v. 49, p. 30-35).

We went to several sources to learn about the history of ideas that developed into the concept of geologic time. Once again we recommend Anthony Hallam's book, *Great Geological Controversies* (Oxford University Press). Books by Jack Repcheck (*The man who found time: James Hutton and the discovery of the Earth's antiquity*, 2001) and Simon Winchester (*The map that changed the world: William Smith and the birth of modern geology*, 2001) gave us some perspective on key players. Biographies of many of these folks (Steno, Cuvier, Smith, Lyell) are also available at the University of California, Berkeley, Museum of Paleontology. We recommend the museum's geological time machine (www.ucmp.berkeley.edu/help/timeform.html). You can learn more about fossils and the ages and character of rocks in your state by visiting the Paleontology

Portal (www.paleoportal.org). The Tiktaalik fossil discovery is nicely described at the University of Chicago (<http://tiktaalik.uchicago.edu/>).

The early exploration of the Colorado River is described by PBS and you can read excerpts from John Wesley Powell's journal (www.pbs.org/wgbh/amex/canyon/). You can take your own virtual 3-D tour of the Grand Canyon produced by the USGS (<http://3dparks.wr.usgs.gov/grandcanyon/>).

The USGS has two relatively short online publications, Geologic Time, by William Newman (<http://pubs.usgs.gov/gip/geotime/>) and Fossils, Rocks, and Time by Lucy Edwards and John Pojeta, Jr., (<http://pubs.usgs.gov/gip/fossils/>). Each contains a discussion of how radioactive decay is used to determine the ages of rocks.

Hal Stephens and Eugene Shoemaker, followed Powell's journey down the Colorado River and compared modern photographs with the originals (In the footsteps of John Wesley Powell, 1987). Andrew Goudie (Changing Earth: Rates of Geomorphological Processes, Blackwell Press) describes a wide array of geological processes and the rates at which they work.