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**ABSTRACT**

Here's a relatively concrete activity to teach the large numbers representing evolutionary deep time.

**Key Words:** Evolutionary time; deep time; teaching large numbers; geological time.

There are many ways to help students get a sense of geological time, but with every one I've seen, it's still a stretch to link familiar time (years) to deep time (millions of years). Recognizing this challenge, and preferring some kind of linear analogy, I developed the following approach.

1. To show how time is commonly expressed in a linear scale, display a calendar with equal horizontal dimensions for each day (e.g., 1 inch). Students can see that 1 week is 7 inches long, 1 month is about 30 inches long, and a year is 365 inches long (about 10 yards). If we carry this to geological times, it quickly becomes unwieldy and unfamiliar. So we switch gears, and change the scale.
2. Shrink 10 years of your life to equal 1 mm. If you do this, 1 million years is about 1 football field (fbf), 6 million years is 6 fbf, 65 million years is 65 fbf (about 4 miles, or 6.4 km), and 500 million years is about 30 miles (48 km). (I prefer miles here because this unit is more familiar to most students.)
3. I like to limit this scaling to 500 million years, because that's about how far back our more familiar fossil record goes. I keep reminding my students that, in this scale, TEN YEARS of their lives is only ONE MILLIMETER (while holding up a paper clip wire – about 1 mm thick) and ONE MILLION YEARS is ONE FOOTBALL FIELD LONG. Also, they can see the 1 mm (10 years), and they have probably traveled about 30 miles to some concert, relative, or friend (500

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million years), so they have firsthand experiences with those extreme dimensions and points in between.

4. To reinforce these experiences, I have students plot some key geological time markers on a map of their area and relate those distances (millions of years) to familiar points of interest in their area. For details, see my lesson "Patterns in Time" at <http://www.indiana.edu/~ensiweb/lessons/pat.in.time.html>.
5. Finally, I show them that, according to the fossil record, the earliest fishes emerged about 500 mya, the earliest amphibians emerged about 365 mya, earliest pre-mammals about 320 mya, earliest true mammals about 220 mya, etc. They calculate and plot the miles for each time marker and can readily see (in miles or kilometers) the many tens of millions of years that actually separate the emergence of those major groups of vertebrates – and that they clearly did *not* come into existence all at once (as they may have inferred from hearing about the "Cambrian explosion" idea).
6. As an interesting application, it just so happens that ten \$1 bills stack to 1 mm thickness, so one million \$1 bills would make a football-field-high stack (sound familiar?) It's also impressive to wave a bundle of a hundred \$1 bills in the air (1 cm thick – close to a maximum human lifetime). Then visualize 500 million dollars stacking 30 miles high (or farther). From there, it's not too hard to extrapolate to the billions and trillions of dollars of our economy in linear dimensions – which do become hard to imagine, but impressive!

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