Teacher Guide to BLOSSOMS Lesson:
Geologic Time: The Ticking of Our Planet's 4.6 Billion Year Clock

The Earth is 4.6 billion years old. That's a hard number for anyone to conceptualize. What does 4.6 billion look like, and what happened during all those hundreds of millions of years between the formation of our planet and now? This BLOSSOMS lesson will help students conceptualize the enormity of geologic time and learn about important events in Earth's history. An understanding of geologic time is essential to help students comprehend processes that occur over long time scales, such as evolution, mountain building, plate tectonics, and changes in the Earth's climate. Thus, in this lesson, students will also learn how geologic time can help explain seemingly incomprehensible processes, like the formation of the Himalayan Mountains from a flat plain to their current height, and the evolution of a tiny group of reptiles into the enormous dinosaurs.

Activity 1 – When Did the Dinosaurs Go Extinct?: After seeing Francis stand at three positions along the scale-model of the geologic timeline, students must pick which position represents the time when dinosaurs went extinct. This happened 65 million years ago, which seems like a really long time until you realize that the Earth is 4.6 billion years old. So the correct answer is the closest position to the end of the timeline.

Activity 2 – Building your own Geologic Timeline: During this break, students will make their own to-scale geologic timeline in the classroom or a nearby hallway. You will need a measuring tape or a meter stick. Measure out 4.6 meters in a straight line. Place a piece of tape every half meter from the beginning. Each meter represents 1 billion years of earth's history. Mark the first piece of tape as the present, the next piece as 500 million years ago, the next as 1 billion years ago, and continue on – the last piece of tape will read 4.5 billion years ago, add one extra piece of tape at the end to represent 4.6 billion years ago and the formation of the planet. See the included PDF "Geologic Timeline Activity – Teacher Guide" for an example of how the timeline should look.

Activity 3 – Placing Events on The Timeline: During this break, students will break up into small groups (3 or 4 students is ideal). Each group will get a subset of the 14 event cards (see included PDF "Timeline Cards" – these should be cut up along the black lines). They will work together to place their event cards in the appropriate place along their timeline. The students do not need any prior knowledge to put their events on the timeline – the idea is for them to work together to figure out their events, and then in the next segment they will re-arrange their events into the correct position.

Activity 4 – Rearranging Your Events: After watching the segment on the correct order and placement of the events, the class (in groups, or all together) will re-arrange their events on their in-class timeline in the correct order and placement. If time permits, discuss any events that the students were surprised by. See the included PDF "Geologic Timeline Activity – Teacher Guide" for an example of how the timeline should look and where each event belongs.

Activity 5 – Using a 24 hour day as a timeline: In this activity, the students will calculate how long ago the dinosaurs went extinct and when our species evolved, using a 24 hour day as an analog to the 4.6 billion years in Earth history. This is a great exercise in decimals and order of magnitude! Imagine that noon on a Monday is the formation of the planet, and noon on Tuesday is the present. Below are the calculations that need to be done in order to figure out how long ago our species, homo sapiens, evolved, and how long ago the dinosaurs went extinct.

With 24 hours in a day, and 4.6 billion years of time, we calculate 24/4.6 = 5.2 hours / billion years. That means 5.2 / 1000 = 0.0052 hours per million years. The dinosaurs went extinct 65 million years ago, so we calculate 65 million years x 0.0052 hours/million years = 0.338 hours since the dinosaurs went extinct. That's about 20 minutes! So if the present is noon on Tuesday, the dinosaurs went extinct at about 11:40 AM on Tuesday. For the evolution of our species, which happened 200,000 years ago, we calculate from 0.0052 hours per million years that our clock is 0.00052 hours per hundred thousand years (we add one extra zero to our decimal), so 200,000 years ago would be 0.00104 hours ago, x 60 minutes in an hour x 60 seconds in a minute gives us 3.7 seconds!! That means that our species evolved at about 11:59:46 on Tuesday morning. There are certainly other ways to do this calculation, so feel free to adapt this to whatever you feel would be most comfortable for you and your students.

Activity 6 – Estimate the Length of a Lizard's Leg: Students will calculate how long the average leg length in a population of lizards would be after 1,000 years and 1,000,000 years of evolutionary change. They will use a rate of change for a population of lizards from the Caribbean that were monitored for 14 years. They will use two different rates, one 'slow' and one 'fast', because not all changes are equal across the lizard populations. For 'slow' rate: 0.03 mm / 14 yrs = 0.002 mm/yr is the rate of change; the 'fast' rate is 0.05 mm / 14 yrs = 0.003 mm/ yr. So for slow lizards, after 1,000 years, their legs would be 2 mm longer, or 4.24 mm long. After 1,000,000 years, they would be 2,000 mm longer, or 2 meters longer!! The 'fast' rate lizards would be 3 mm longer after 1,000 years and 3 meters longer after 1,000,000 years.

Activity 7 – Estimating the Height of the Himalayan Mountains: The calculated Himalaya rate of uplift is 10 mm/yr (the rate actually varies, but that's the fastest rate, we might as well use it!). So after 10,000 years, the mountains will be 100,000 mm higher, or 100 meters higher. Not that much. But after 1,000,000 years, the mountains would be 10,000,000 mm higher, which is 10,000 meters, or 10 km. That's over twice as high as they are now!