SCIENTIST IN RESIDENCE PROGRAM™

Science Unit: Fossils

Lesson # 5 A Walk Through Geologic Time

School Year:	2015/2016
Developed for:	George T. Cunningham, Vancouver School District
Developed by:	Kate Gregory (scientist); Jodi Carson and Craig McNeil (teachers)
Grade level:	Presented to grade 5-7; appropriate for grades 4-7 with age appropriate modifications
Duration of lesson:	45 min
Notes:	Note this lesson deals with evolution, which is part of the BC grade 7 science curriculum

Objectives

1. Learn that fossils can be used to help reconstruct the Earth's history and the history of life
2. Gain an appreciation of the huge expanse of geologic time by walking a proportional timeline of Earth history
3. Learn about some of the important events in the history of life.

Background Information

One of the big ideas in Earth Science is "Deep Time," the vast, 4.5-billion-year expanse of earth's history. In this lesson, students put the fossils that they examined in the previous lesson into the context of Deep Time by walking a 68.5 m, proportional timeline, and reading about important events along the way. Students are especially struck when they see the tiny, 1.25mm piece of tape at the end of the timeline that represents the whole of human history and prehistory.

Often the concept of Deep Time is taught by giving students the list of important events, and then having them convert their ages to distances (or relative dates if earth's history is being represented as a calendar year). However, often the activity ends up being more about math than geology. We suggest, therefore, doing the calculations beforehand and setting up the timeline for students, and then letting them spend their time experiencing the proportional distances.

Vocabulary

Geologic Time:	The long period of time covered by earth's history
Proportional:	Having a constant ratio to another quantity
Scale:	The proportion that a representation of an object has to the object itself

Printables Included:

- List of events in earth history and corresponding distance, for setup (see below)
- Event sheets with pictures (see link to separate PDF on lesson plan page)
- Student worksheet (see below)

Materials

- Ruler, and 22m long rope or soft tape measure to serve as physical timeline (optional)
- Tape measure, to measure distance
- Tape or paper clips, to secure event sheets to timeline

In the Classroom

Introductory Discussion

1. Geologic Time and fossils. Show students "Our Story in One Minute": http://apod.nasa.gov/apod/ap121114.html Warn students that the movie moves quickly, and they may not know what all the events are, but that they will take the rest of the class to explore the history of life.
2. Proportion and Scale. Show students a map and discuss the concept of proportionality and scale.

Setup:

- Decide where to set up your timelline (in class, another space in the school, or outside).
- Before class, print out the event sheets and put them along the timeline.
- You may also want to take some of the fossils the students examined last week and place them along the timeline.
- You can use a physical timeline, such as a rope or soft tape measure, or you can just place the event sheets at the specified distances. We used a rope, which we marked with distances, as this makes setup easier in future years.
- Use a 30 cm ruler to show the last two events: Use a piece of coloured tape that is 1.25 mm wide to mark the appearance of prehistoric humans draw the thinnest of lines at the very edge of the ruler to mark written history - this visual always surprises students!

The geologic timeline in this activity has a scale of 1 Million years = 5 mm. At this scale, 23 m represents the distance from the time of the formation of the earth (4600 miliion years, or 4.6 billiion years) to the present, which usually is a good match for the circumference of a classroom in an older Vancouver school. If you would like to modify the scale to fit your space, you can use the spreadsheet here: https://drive.google.com/open?id=1UqNHTwdJHQNRHNdWhu9dl_YOdnMYYWusd3YOHLGZih8

Activity:

The goal for the activity is for the students to be able to identify the events in the "Our Story in 1 Minute" video. Tell students to walk the timeline, and to take notes at each station on their worksheet (Appendix B). You may want to also give them some questions to answer to further focus their observations.

Closure Discussion

1. Rerun "Our Story in 1 minute" at a slower speed (option under the settings wheel). Pause at critical points, and have students identify the event
2. Note some interesting observations about Earth history, for example:
   - Life arose relatively quickly (in terms of geologic time) after the surface of the earth cooled
   - The early atmosphere would have been poisonous for us; bacteria created at atmopshere that allowed for the rise of oxygen breathing animals - which then ate the bacteria!
   - Snowball earth - the earth was almost a ball of ice, and it was probably CO2 from volcanic eruptions that warmed the surface again
   - Mass extinctions - at the end of the Paleozoic, and at the end of the Mesozoic (this is the one that killed most of the dinosaurs)

References

1. Clary, Renee, and Wandersee, James. 2010. How Old? Tested and trouble-free ways to convey geolgic time. in Liftig, Inez Fugate. Tried and True: Time-Tested Activities for Middle School. NSTA Press. pp. 105-110.
2. Goldsmith, Mike. 2011. Earth: The Life of Our Planet. Kingfisher (also published in French)
3. O'Brian, Thomas. 2011. 5 E(Z) steps back into "deep" time. in Even More Brain-Powered Science. NSTA Press. pp. 193-229.
4. Winston, Robert. 2012. Life as we Know it. DK.
5. <http://www.bbc.co.uk/nature/history_of_the_earth> History of Life on Earth. BBC Nature. [online exibit].
6. <http://apod.nasa.gov/apod/ap121114.html> Our Story in 1 Minute. Astronomy Picture of the Day. NASA. [video of Earth's History]
7. <http://www.ucmp.berkeley.edu/geotime/> Understanding Geologic Time. University of California Museum of Paleontology. [online interactive lesson on geologic time, with teacher guide]

Extension of Lesson Plan

1. Math - students transfer the events in the timeline to the scale of a calendar year.
2. Students choose an event on the timeline and research it, or add events to the timeline.

Timeline of Major Events: Big Bang to Present

Time, in Million years	Event	Distance (in m)	in cm	in mm	Time in "Our story"
13700	Big Bang	68.5	6850	68500	0.08
4600	Solar system, Earth forms	23	2300	23000	0.15
4500	Collision creates moon	22.5	2250	22500	0.23
4000	Surface cools, rocks, oceans form	20	2000	20000	
3800	First life	19	1900	19000	0.34
3000	Photosynthesis begins	15	1500	15000	
2300	Oxygen in atmosphere	11.5	1150	11500	
2100	Snowball earth	10.5	1050	10500	
1800	Complex cells	9	900	9000	0.37
1500	Multicellular life	7.5	750	7500	0.41
700	Snowball earth	3.5	350	3500	
680	Visible animals	3.4	340	3400	
540	Cambrian explosion	2.7	270	2700	0.42
525	First vertebrates	2.625	262.5	2625	
450	First land plants	2.25	225	2250	0.49
380	First land animals - amphibians	1.9	190	1900	
362	Forests and winged insects	1.81	181	1810	
300	First reptiles	1.5	150	1500	
252	Largest extinction	1.26	126	1260	
225	First dinosaurs	1.125	112.5	1125	
155	First bird	0.775	77.5	775	
100	First flowering plants	0.5	50	500	
65	K/T extinction	0.325	32.5	325	
50	Rise of the mammals	0.25	25	250	
0.25	Prehistoric humans	0.00125	0.125	1.25	1.05
0.005	Written history	0.000025	0.0025	0.025	

Time, in Million years	Event	Notes
13700	The Big Bang	
4600	The Earth forms	
4500	Collision between two protoplanets	
4000	Earth's surface forms	
3800	Living in a bacterial world	
3000	Food from sunlight	
2300	Oxygen accumulates	
2100	Extreme cold 1	
1800	Complex cells	
1500	Cooperation and communication	
700	Extreme cold 2	
680	Animals become visible	
540	Cambrian "explosion"	
525	First vertebrates	
450	First land plants	
380	Animals move on to land	
362	Great forests and winged insects	
300	First reptiles	
252	Permian mass extinction	
225	Age of the dinosaurs	
155	First bird	
100	Flowering plants	
65	K/T mass extinction	
50	Rise of the mammals	
0.25	Modern man	