Session 1

How Old Is Old?

Acknowledgments

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Session 1

How Old Is Old?

Objectives

1. Through a review of geologic history and plate tectonics, participants will determine whether forecasted events are plausible.
2. Participants will view geologic time from a mathematics perspective to develop a sense of scale and a proportional perspective of the time period in which modern humans, or *Homo sapiens*, have existed.
3. Participants will increase their understanding of how to use technology in a way that facilitates learning without making technology the focus of the lesson.

Facilities

- A room with broadband Internet access, a data projector, tables, and space for participants to work comfortably in small groups
- Electricity for participants' computers

Equipment/Materials

- Computer with Internet access for facilitator
- Laptop computers with Internet access (1–2 per group)
- Measuring tape per group
- Adding machine tape per group
- Masking tape or duct tape (to mark locations on a model of a number line) per group
- Cord or string to serve as a physical model of a number line (at least 50–100 ft.)

Software

- Google Earth (http://www.google.com/earth/index.html)
- Real-Time Earthquakes plug-in for Google Earth (http://earthquake.usgs.gov/learn/kml.php)

Participants
Up to 25 teachers

Time Required
3 hours

Handouts

❑ 1: BSCS 5Es Instructional Model

Facilitator Preparation

- Read the session guide and familiarize yourself with the activities and Handout 1.
- Make copies of the handout.
- Ensure adequate numbers of materials for all participants and groups.
- Locate and bookmark a clip from the movie *2012* that shows worldwide destruction and chaos, such as from YouTube (http://www.youtube.com/watch?v=nAY16UM9Oac&feature=related).
- Bookmark and preview this short YouTube video of how the Earth has changed over the last 550 million years (http://www.youtube.com/watch?v=jx--C7NVkWU).
- Identify recent earthquakes, tidal waves, and volcanic eruptions from news sources such as CNN, the *New York Times*, or the *Los Angeles Times*.
- Locate a digital image of a fossil commonly found in Central Texas, such as the *Exogyra tigrina* (pictured on p. 1.7).
- Install Google Earth on the facilitator's computer (http://www.google.com/earth/index.html).
- Install the U.S. Geological Survey's (USGS) Real-Time Earthquakes plug-in on the facilitator's computer (http://earthquake.usgs.gov/learn/kml.php).
- Bookmark the "Earthquake Facts and Statistics" from the USGS, which lists historic data of U.S. earthquake activity (http://earthquake.usgs.gov/earthquakes/eqarchives/year/eqstats.php#table_us).
- Ensure that space is available for participants to create physical representations (e.g., "number lines") of geologic time and the era of modern humans.
- Review the related Texas Essential Knowledge and Skills (TEKS) Mathematics, Science, and Technology Applications standards listed at the end of this session.

Prerequisite Skills of Participants and Facilitator

- Basic computer skills
- Basic understanding of Web navigation
- Basic understanding of geologic time

Grouping Strategy

Use a heterogeneous grouping strategy. Ensure that each group of three to four members includes both math and science teachers as well as elementary school teachers who teach in self-contained classrooms.

Session Sequence

In this activity, participants will engage in a project that simulates a classroom setting. After an introductory discussion about whether natural disasters are increasing, participants will examine how the Earth has changed over the past 550 million years. They will then hypothesize how certain fossils could have become located in certain areas around the state of Texas.

Working in heterogeneous groups, participants will discuss how best to convey the idea of geologic time to students. Each group will create a graphic representation of geologic time to which students can relate. Participants can then use this context to help students make comparisons and establish a foundation for proportional reasoning and the idea of scale. For example, a group might make a physical model of a number line showing geologic time going back approximately 550 million years. The challenge for participants, and later for students, will be to choose the appropriate scale and units to effectively show the relationship and relative size of the era of modern humans compared to a time span of 550 million years. Participants will also be challenged to determine whether it is reasonable to expect catastrophic events in their region.

Engage

Equipment/Materials

- ❑ Computer and data projector for facilitator
- ❑ Digital film clip of *2012*
- ❑ News headlines and videos of recent earthquakes, tidal waves, and volcanic eruptions

Whole Group

1. Play the clip from the movie *2012*. The clip shows worldwide destruction and chaos in a world-ending scenario.
2. Ask participants, *"Can this happen here?"* Facilitate discussion about *2012* and the possibility of worldwide catastrophic change and destruction.
3. Show news headlines and videos about earthquakes, tidal waves, and volcanic eruptions that have occurred recently. Say to participants, *"It sure looks like we're having more and more earthquakes, tidal waves, and volcanic eruptions. Is this true? Is something happening to our planet? Should we be worried? What would your students say?"*

Explore

Equipment/Materials

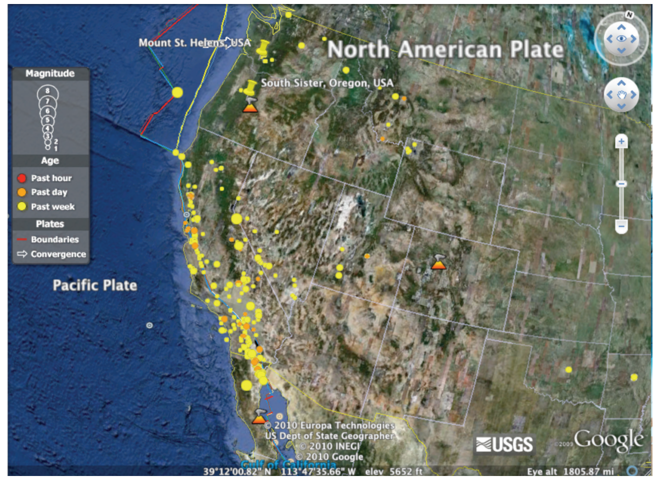
- ❑ Computer and data projector for facilitator
- ❑ Google Earth (http://www.google.com/earth/index.html)
- ❑ Real-Time Earthquakes plug-in for Google Earth (http://earthquake.usgs.gov/learn/kml.php)

Whole Group

4. Say to participants, *"To get a better idea of what is truly happening with our world, we can take advantage of some technological applications that are available to us free of charge. We are going to use a tool called Google Earth along with a real-time earthquake plug-in."*
5. Start the Google Earth application and launch the Real-Time Earthquakes plug-in by the USGS. This plug-in shows earthquake activity for the past 7 days.
6. Focus on the California coast. Say, *"A lot of activity seems to be occurring along the California coast. Let's take a closer look."* Point out recent earthquakes, many of which may have been quite small.

7. Zoom out to a view of the entire United States and direct participants to look for any recent earthquake activity. Ask participants, *"So have there been more earthquakes than usual? Well, let's look at the data."* Go to the following USGS Web site, which gives data of U.S. earthquake activity for the past 10 years: http://earthquake.usgs.gov/earthquakes/eqarchives/year/eqstats.php#table_us. Have the whole group examine the data.

8. Pose the question again, *"Are there more earthquakes now? Should we be worried?"* Facilitate a discussion about the role of the media and the availability of 24-hour news in the perception of increased earthquake activity.



© Google Earth. U.S. Geological Society (USGS) image is in public domain. Retrieved January 12, 2012, from USGS M1=Real-Time Earthquakes plug-in.

9. Bridge this activity to the next one through the use of both science and technology. Ask the participants to explain why so many earthquakes occur in California. Teachers should respond that earthquakes occur as a result of the shifting of the tectonic plates. In addition, this shifting contributes to other interesting events, such as the perplexing case of the *Exogyra tigrina*.

Explain

Whole Group

10. Show participants a fossil commonly found in the region of Central Texas, such as the *Exogyra tigrina* pictured on the following page.

11. Ask, *"Does anyone know what this is?"* Encourage participants to make guesses. Explain, *"This is an* Exogyra tigrina *fossil that was found in a park near Austin, in Central Texas. Where would this organism have lived?"* In this case, the fossil was found on land, but the organism lived in saltwater, such as the Atlantic Ocean.

Equipment/Materials

- ❑ Computer and data projector for facilitator
- ❑ Laptops with Internet access (1–2 per group)
- ❑ Digital image of a fossil commonly found in Central Texas, such as the *Exogyra tigrina* pictured on p.1.7
- ❑ Video clip of changes in the Earth over the past 550 million years (http://www.youtube.com/watch?v=jx--C7NVkWU)

12. Ask participants, *"So how did this fossil end up in Central Texas, so far from the coast? Fortunately, we have the technology to re-create what has happened to this area in the past. If* Exogyra *lived in saltwater, we can use the power of the Internet to locate resources that show changes that occurred millions of years in the past to see when the* Exogyra tigrina *could have lived and thrived in Central Texas."*

Table Groups

13. Do the following activity with participants working in heterogeneous groups. Plan for a 3-minute transition from whole group to table groups.

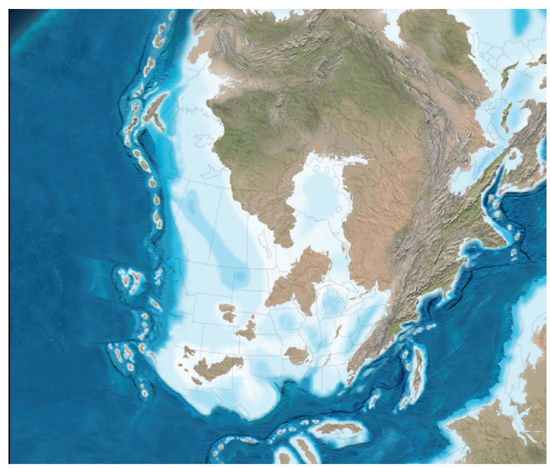
14. Present the geographic video clip showing changes in the Earth over the last 550 million years. This video cycles through 40 maps created at Northern Arizona University.

Exogyra tigrina fossil
© SEDL.

15. Tell the groups, *"There has been a lot of plate movement over the past 550 million years. What did you notice in the video? I am going to play the video again. This time, document specific changes in the landmass that represents Texas. Look specifically for the times when this landmass was (a) underwater, (b) not underwater, (c) frozen, or (d) thawed. Take a minute with your team to discuss a strategy for documenting the data."*

    This may be a good time to suggest that the groups develop a common understanding of their definitions of the terms *underwater, not underwater, frozen,* and *thawed* as well as what percentage of Texas must have been affected to meet a particular condition (e.g., more than 50% of the area must have been iced over to be counted as frozen). The groups may also want to assign each team member to document one of the four conditions.

16. Show the video two more times. Each time, the groups should document the changes they see. After the two viewings, ask the groups to share with the whole group the number of times the landmass of Texas was underwater, not underwater, frozen, or thawed. Facilitate discussion regarding any variations in the data collected by different groups. Note, you may want to have the groups share their definitions and criteria as well.



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17. Ask the groups what this activity has to do with the appearance of *Exogyra tigrina* in Central Texas. If the participants do not bring it up, explain that the shifting of the plates in turn affects the relative elevation of the Earth's surface, so different areas on the planet may be above sea level during some time periods and below sea level during others. These changing conditions will obviously have a direct impact on the type of organisms and plant and animal life that live in a location during different geologic time frames. Such geologic changes have led to fossils, such as the *Exogyra tigrina*, being found in perplexing environments.

18. Turn to the consideration of how long ago the *Exogyra tigrina* lived in the region of Central Texas. Students often have a hard time conceptualizing geologic time. To help students, teachers can introduce the next section by asking students how old they are. Model this strategy for participants. Then ask them how their lifetimes compare to a geologic time frame spanning 550 million years. Ask participants, *"I wonder what the era of modern humans looks like compared to 550 million years?"* Use this question and the resulting discussion to segue to the next task, looking at geologic time from a mathematical perspective.

Elaborate

Table Groups

19. Ensure that each table group has the necessary materials, as listed at right. Ask each group to use the next 45 minutes and the supplies to create a graphic representation of geologic time from 550 million years ago to the present. The groups should indicate the period when the *Exogyra tigrina* lived and the period that modern humans, or *Homo sapiens*, have existed. Laptop computers with Internet access will be useful for helping the groups to identify eras and periods as well as when *Exogyra tigrina*, modern humans, and other interesting organisms lived.

    The challenge for each group will be to create a representation that teachers can present to students. Encourage participants to be creative and use their knowledge of their students, such as their students' prior knowledge. Figures 1 and 2 show examples of possible representations.

20. One approach is for groups to construct a number line using a measuring tape, cord or string, and masking tape—both to mark the intervals and hold the cord in place. The intervals would represent elapsed time where 1 foot represents a certain number of million years. Consider the use of numbers as *mya* (million years ago) or *ya* (years ago) in lieu of negative integers. Also, consider the idea of using zero as both the starting point and the basis for the time comparisons. In Figure 2, adding machine tape serves as a geologic timeline with eras noted. The group that made this timeline then made a second one (not shown) that used a different scale to represent the era of modern humans.

Equipment/Materials

- ❑ Laptops with Internet access (1–2 per group)
- ❑ Measuring tape per group
- ❑ Adding machine tape per group
- ❑ Masking tape or duct tape per group (to mark locations on a model of a number line)
- ❑ Cord or string per group to serve as a physical model of a number line (at least 50–100 ft.)

Figure 1: Time represented on a clock
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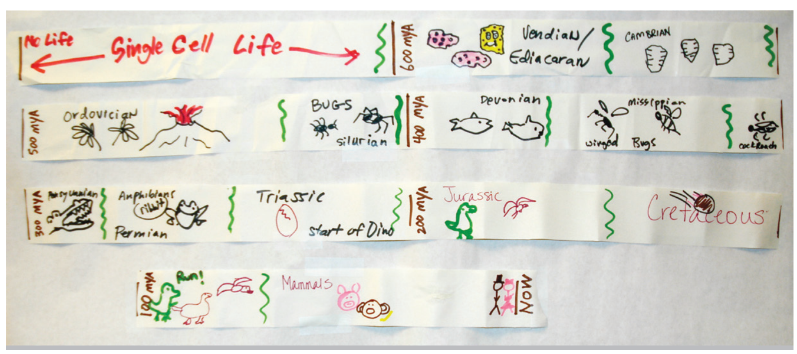

Figure 2: A timeline with eras noted
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Evaluate

Equipment/Materials

- ❑ Handout 1: BSCS 5Es Instructional Model (1 per participant)

Table Groups/Whole Group

21. Ask the table groups to share their graphic representations with the whole group. Facilitate discussion to encourage the other groups to provide peer feedback on the strengths and weaknesses of each representation.

22. Discuss what happened over time. Ask the groups what existed 550 million years ago. Then note that 65 million years ago, *Exogyra* existed; 10,000 years ago, saber-toothed cats and mammoths existed; and so on. Present a timeline task that effectively compares geologic time to the era of modern humans and discuss why it is difficult to make comparisons effectively using the same-sized intervals marked on the entire timeline.

23. Remind participants that the activity when used in the classroom should be adjusted based on the students' number sense and understanding of the concept of numbers. Teachers need to be especially vigilant regarding the key decisions students make about the scale used on the graphic representation. This task involves the careful consideration of interval size and the consistent use of equal intervals. Because the existence of modern humans makes up such a small portion of geologic time, students will be tempted to change the size of the intervals. Stress the importance of consistency. For example, if a group decides each mark on a number line represents 10 million years, the group cannot then change the marks in the latter part of the number line (e.g., for the era of modern humans) to represent 1,000 years each. Through the activity, students should develop a proportional perspective of the extremely small amount of time spanned by the era of modern humans. If possible, teachers should encourage students to create a second number line with a different scale to zoom in on the small period represented by modern humans.

24. **Reflection.** Lead a discussion about what participants learned during this activity and ways in which they could utilize it in their specific classrooms, given their individual students and circumstances.
    - Review the BSCS 5Es Instructional Model, which was used in this session. Ask, *"Who has used this model before?"* Then ask if anyone would like to share their experiences and understanding of this lesson cycle or of one of the Es of the BSCS 5Es. If any of the following concepts is not mentioned, add the information to the discussion.
        - **Engage:** This stage is intended to pique the students' interest in the topic.
        - **Explore:** This stage provides all students with common experiences to draw upon in the following discussions.
        - **Explain:** This stage provides an opportunity for the teacher to informally assess the students' understanding of the concepts. The students do most of the explaining.
        - **Elaborate:** This stage is where students develop a deeper understanding of the concepts. The teacher continues to informally assess students to ensure they are building the targeted conceptual understanding.
        - **Evaluate:** This stage provides an opportunity for the students to demonstrate their understanding of the unit's concepts.

- Give each participant a copy of Handout 1: BSCS 5Es Instructional Model. Ask the participants to review the handout and to highlight any portions they would like to remember in the future. Also, tell participants they will use the handout during the rest of the session and to keep it handy.
- Emphasize that teachers may be tempted to use just some of the activities in the BSCS 5Es Instructional Model instead of the entire unit. Ask the group why this pick-and-choose approach may not obtain the outcome they are seeking.
- Moving on from the BSCS 5Es Instructional Model, ask participants, *"Which TEKS does this activity address?"* (See the next section for a list of TEKS the activity addresses.)
- Ask participants to reflect on the types of questions they were asked during the activity: Did the questions differ from those they usually ask students, and if so, how? What differences, if any, might there be in student responses to these questions than to those participants typically ask their students? How do the types of questions used in this activity promote student learning?

25. Discuss strategies for making modifications for English language learners or students with disabilities. This discussion should include how technology was used and how it could help engage all students and facilitate learning.

26. Lead a discussion about some ways participants may adapt the unit to meet the needs of their students. Include the following questions:
    - What are some advantages to adapting the unit?
    - What are some things you should watch for when adapting this unit?

Table Groups

27. Ask the participants to identify how math, science, and technology were integrated into the unit.
    - For the next 10 minutes, have participants discuss in their table groups some ways they could integrate some of their lessons.
    - Ask each group to report at least one idea to the whole group.
    - Explain that they will be asked to share their successes and challenges with integrating math, science, and technology the next time they meet.
    - Also, let participants know you will be contacting them between the sessions to see if you can help them in any way. Assistance may be provided by phone or as a personal visit to the campus. This decision will be determined individually between you and each participant.

Technical Assistance Follow-Up

The technical assistance provider will individually contact the participants after they return to their classes.

- Ask how they are integrating math, science, and technology.
- Ask when this integration will occur if it has not already.
- Ask if it would be possible to visit to capture some of the good things going on in the classroom to share with the whole group the next time you meet.

Texas Essential Knowledge and Skills (TEKS)

Please note, not all of grades 4–8 have standards that directly relate to this session. Avoid "stretching" the session to make it apply to TEKS other than those listed below. This effort would not be an appropriate use of the students' learning time.

§111.16. Mathematics, Grade 4

(b) Knowledge and skills.

(10) G*eometry and spatial reasoning.* The student recognizes the connection between numbers and their properties and points on a line. The student is expected to locate and name points on a number line using whole numbers, fractions such as halves and fourths, and decimals such as tenths.

§111.24. Mathematics, Grade 8.

(b) Knowledge and skills.

(1) *Number, operation, and quantitative reasoning.* The student understands that different forms of numbers are appropriate for different situations. The student is expected to:

(A) compare and order rational numbers in various forms including integers, percents, and positive and negative fractions and decimals.

§112.15. Science, Grade 4, Beginning with School Year 2010–2011.

(b) Knowledge and skills.

(7) *Earth and space.* The students know that Earth consists of useful resources and its surface is constantly changing. The student is expected to:

(B) observe and identify slow changes to Earth's surface caused by weathering, erosion, and deposition from water, wind, and ice.

§112.16. Science, Grade 5, Beginning with School Year 2010–2011.

(b) Knowledge and skills.

(7) *Earth and space.* The student knows that Earth's surface is constantly changing and consists of useful resources. The student is expected to:

(A) explore the processes that led to the formation of sedimentary rocks and fossil fuels;

(B) recognize how landforms such as deltas, canyons, and sand dunes are the result of changes to Earth's surface by wind, water, and ice.

§112.18. Science, Grade 6, Beginning with School Year 2010–2011.

(b) Knowledge and skills.

(10) *Earth and space.* The student understands the structure of Earth, the rock cycle, and plate tectonics. The student is expected to:

(D) describe how plate tectonics causes major geological events such as ocean basins, earthquakes, volcanic eruptions, and mountain building.

§112.19. Science, Grade 7, Beginning with School Year 2010–2011.

(b) Knowledge and skills.

(8) *Earth and space.* The student knows that natural events and human activity can impact Earth systems. The student is expected to:

(A) predict and describe how different types of catastrophic events impact ecosystems such as floods, hurricanes, or tornadoes.

§112.20. Science, Grade 8, Beginning with School Year 2010–2011.

(b) Knowledge and skills.

(9) *Earth and space.* The student knows that natural events can impact Earth systems. The student is expected to:

(A) describe the historical development of evidence that supports plate tectonic theory.

§126.3. Technology Applications, Grades 3–5.

(b) Knowledge and skills.

(1) *Foundations.* The student demonstrates knowledge and appropriate use of hardware components, software programs, and their connections. The student is expected to:

(A) use technology terminology appropriate to the task.

(3) *Foundations.* The student complies with the laws and examines the issues regarding the use of technology in society. The student is expected to:

(A) follow acceptable use policies when using computers; and

(B) model respect of intellectual property by not illegally copying software or another individual's electronic work.

(4) *Information acquisition.* The student uses a variety of strategies to acquire information from electronic resources, with appropriate supervision. The student is expected to:

(A) apply appropriate electronic search strategies in the acquisition of information including keyword and Boolean search strategies; and

(B) select appropriate strategies to navigate and access information on local area networks (LANs) and wide area networks (WANs), including the Internet and intranet, for research and resource sharing.

(7) *Solving problems.* The student uses appropriate computer-based productivity tools to create and modify solutions to problems. The student is expected to:

(A) use software programs with audio, video, and graphics to enhance learning experiences;

(B) use appropriate software to express ideas and solve problems including the use of word processing, graphics, databases, spreadsheets, simulations, and multimedia; and

(C) use a variety of data types including text, graphics, digital audio, video.

(11) *Communication.* The student delivers the product electronically in a variety of media, with appropriate supervision. The student is expected to:

(A) publish information in a variety of media including, but not limited to, printed copy, monitor display, Internet documents, and video; and

(B) use presentation software to communicate with specific audiences.

(12) *Communication.* The student uses technology applications to facilitate evaluation of communication, both process and product. The student is expected to:

(A) select representative products to be collected and stored in an electronic evaluation tool;

(B) evaluate the product for relevance to the assignment or task; and

(C) create technology assessment tools to monitor progress of project such as checklists, timelines, or rubrics.

References

Bybee, R. W., Taylor, J. A., Gardner, A., Van Scotter, P., Carlson Powell, J., Westbrook, A., & Landes, N. (2006). *The BSCS 5E Instructional Model: Origins, effectiveness and applications.* Retrieved from http://www.bscs.org/bscs-5e-instructional-model

BSCS developed the BSCS 5E Instructional Model in the 1980s. Since that time, BSCS has used this model in its curriculum development programs as well as its professional development programs. The BSCS 5E Instructional Model has been widely disseminated and widely used as an effective instructional model that allows the students to construct their understanding across time. Adapted by SEDL with permission from BSCS. http://www.bscs.org.

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