Grade

7

Strategic Science Teaching

Title of Lesson:

How Long Ago Was That?

Essential Question:

How does evidence found on Earth help us understand the evolution of life?

Conceptual Statement:

Researchers use evidence from rocks to build the geologic time scale that tells us about the history of life on Earth.

Conceptual Learning Sequence:

This lesson is part of a conceptual unit focused on understanding the evidence for the evolution of life on Earth. This lesson introduces the scale of geologic time and how to position significant developments and extinctions in evolutionary history on the geologic time scale.

Student Outcomes:

- Students understand the relationships between major geologic events and the evolution of life on Earth.
- Students construct a geologic time scale using their own calculations to determine positions of events in Earth's history
- Students use an "Analogy Graphic Organizer" to enhance their understanding of the concepts of time and scale.

Lesson Overview:

Students use proportion and data collected to respond to the question: "How can we use the geologic time scale to help us understand Earth's age, and the significant developments and extinctions of plant and animal life on Earth?"

Students develop the familiar concept of their own life timeline, citing evidence of major events in their lives. Students next create a geologic time scale, determining positions of given time periods in Earth's history. Using an "Analogy Graphic Organizer" students then compare and contrast their life timeline to Earth's time scale. They further investigate sources of information on significant developments and extinctions of plant and animal life on Earth and add these events to their geologic time scale.

English Language Learning:

English Language Development standards are referenced in the lesson where appropriate. The hand icon appears throughout the lesson when learning strategies and lesson components are identified as pathways for academic success and reflect critical developmental differences for students who are English learners.

Literature in the Science Learning Cycle:

Sections of the book *Dr. Art's Guide to Planet Earth* are used in the EXPLORE stage. The book serves as a source of information as the students gather data to build their geologic time scale.

Learning Strategy:

Students use the "Analogy Graphic Organizer" and proportional thinking to help them determine the positions of the geologic events on their time scale. The "Analogy Graphic Organizer" strategy enhances their comprehension of Earth's history by providing a visual framework for students to identify similarities and differences between a new concept and something with which they are already familiar. (See Appendix pages 182-183.)

Literature Selection:

Title: *Dr. Art's Guide to Planet Earth*
Author: Sussman, Art
Publisher: Chelsea Green Publishing, 2000 ISBN: 189013273X
Annotation: This book focuses on big ideas and uses systems thinking to help the reader understand Earth's cycles of matter, flows of energy, and web of life. From evolution and extinction, to carbon and climate change, this book demonstrates the interdependence of the Earth as a system. The book is linked to http://www.planetguide.net which contains activities, animations, and discussions.
Genre: Nonfiction

California Science Content Standards:*

Science: Grade 7 - Earth and Life History (Earth Science)

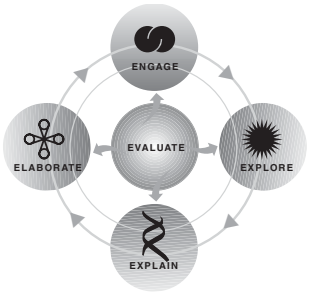
4. Evidence from rocks allows us to understand the evolution of life on Earth. As a basis for understanding this concept:
   d. Students know that evidence from geologic layers and radioactive dating indicates Earth is approximately 4.6 billion years old and that life on this planet has existed for more than 3 billion years.
   e. Students know fossils provide evidence of how life and environmental conditions have changed.
   g. Students know how to explain significant developments and extinctions of plant and animal life on the geologic time scale.

7. Investigation and Experimentation

Scientific progress is made by asking meaningful questions and conducting careful investigations. As a basis for understanding this concept and addressing the content in the other three strands, students should develop their own questions and perform investigations. Students will:

b. Use a variety of print and electronic resources (including the World Wide Web) to collect information and evidence as part of a research project.
d. Construct scale models, maps, and appropriately labeled diagrams to communicate scientific knowledge.

*Selected standards addressed within this lesson.

Lesson at  a Glance

Science Learning Cycle	Objective Science Thinking Process	Suggested Time
ENGAGE	The students respond to prompts to make connections to past learning experiences and to focus their thinking on the fossil and rock records. Communicating, Ordering	20-30 minutes
EXPLORE	The students use analogy and scale to create a personal timeline, and then construct a geologic time scale. Using the selections from *Dr. Art's Guide to Planet Earth*, students research major geologic events. Students complete an "Analogy Graphic Organizer" to compare and contrast their lifetime with Earth's time scale. Communicating, Comparing, Ordering	80-100 minutes
EXPLAIN	The students explain the geologic time scales that they constructed and critique each other's explanations. Communicating, Organizing, Categorizing	40-50 minutes
ELABORATE	The students use on-line and print resources to further research additional information and compare with the time scale they constructed. Communicating, Comparing, Ordering, Categorizing	60-90 minutes
EVALUATE	While evaluation occurs throughout the lesson, the teachers now assesses student understanding of analogies and Earth history as the students share their "Analogy Graphic Organizers" and their research on Earth's significant developments. Communicating, Comparing, Ordering, Categorizing, Inferring, Applying	40-50 minutes

How Long Ago Was That?

Teacher Background:

Scientists use a variety of terms to identify and label stretches of time in Earth's history. While our planet is 4.5 billion years old, most of the events for which we have reasonably accurate dates have occurred in the past 570 million years. From that time, the first organisms possessing hard body parts (external shells and internal skeletons) have left their remains as fossils that we find today.

Although scientists originally thought that life began about 570 million years, we now know that the earliest cells appeared on Earth about 4 billion years ago. Unfortunately, the single-celled organisms that were Earth's only life forms for billions of years have left few remains. In contrast, we have many fossils and other forms of evidence regarding events of the past 570 million years.

This stretch of time has been categorized into three major divisions, the eras known as Cenozoic, Mesozoic, and Paleozoic. The "zoic" part of the word comes from the root "zoo" meaning animal. "Cen" means recent, "Meso" means middle, and "Paleo" means ancient. These divisions reflect major changes in the composition of ancient faunas, each era being recognized by its apparent domination by a particular group of animals. The Cenozoic has sometimes been called the "Age of Mammals," the Mesozoic the "Age of Dinosaurs," and the Paleozoic the "Age of Fishes." This is an overly simplified view, which has some value for the beginning learner but is also misleading. For instance, other groups of animals lived during the Mesozoic. In addition to the dinosaurs, animals such as mammals, turtles, crocodiles, frogs, and countless species of insects also lived on land. Additionally, these animal-focused phrases neglect the plants, which are the basis for virtually all ecosystems. Ancient flora went through great changes, and not always at the same time that the animal groups changed.

Geologists and paleontologists use principles, techniques and tools based in many scientific disciplines to reconstruct Earth's history. The study of layered rock is called stratigraphy. Sedimentary rocks deposited layer by layer stacked on top of one another. In any sequence of undisturbed layered rocks, a given layer is older than any layer on top of it. This Principle of Superposition is fundamental to determining the relative age of rocks and the fossils found in them. The use of radioactive dating enables scientists to more accurately determine absolute ages of fossils and rocks.

Related California Content Standards

Math: Grade 7

Measurement and Geometry

1.2 Construct and read drawings and models made to scale.

Mathematical Reasoning

2.5 Use a variety of methods, such as words, numbers, symbols, charts, graphs, tables, diagrams, and models, to explain mathematical reasoning.

Language Arts: Grade 7

Reading

1.1 Identify idioms, analogies, metaphors, and similes in prose and poetry.

English Language Development: 6-8

Listening and Speaking

Early Advanced-Prepare and deliver presentations that use a variety of sources.

Reading Word Analysis

Early Advanced/Advanced-Apply knowledge of word relationships, such as roots and affixes, to derive meaning from literature and texts in content areas.

Reading Fluency and Systematic Vocabulary Development

Early Advanced/Advanced-Use idioms, analogies, and metaphors in content areas.

Writing Strategies and Applications

Beginning-Organize and record expository information on pictures, lists, charts, and tables for literature and content areas.

Writing Strategies and Applications

Intermediate-Narrate a sequence of events and communicate their significance to the audience.

Grouping: Groups of 2-3 students

For hands-on activities, mix the EL with the native speakers. For debriefing, include at least two EL with native speakers to form discussion groups.

Materials:

Per Group:

Meter stick
30 cm Ruler
1 5-meter Strip of adding machine tape
2 Pieces of masking Tape
Pencils (colored pencils optional)

Per Student:

Student Pages:

1.0 Analogies and Scale
2.0 Directions for Constructing a Geologic Time Scale
2.1 Part B Directions
3.0 Analogy Graphic Organizer

Book, *Dr. Art's Guide to Planet Earth*

Advanced Preparation:

1. Assemble all materials and duplicate Student Pages
2. Prepare transparencies of the Student Pages
3. Create an example of the geologic time scale on adding machine tape
4. Review Teacher Pages 1.0 (Student's Personal Timeline Activity), 2.0 (Sample Analogy Graphic Organizer), and Teacher Tips
5. Select a book for ENGAGE (see related student resources)

Teacher Resources:

California Journal of Science Education, Controversy in the Classroom II: Evolution, Volume 1, Issue 2, Spring 2001

Evolution, PBS video series in eight parts, 60 minutes, available on video and DVD from www.pbs.org

Marzano, Robert J., Pickering, Debra J., Pollock, Jane E. *Classroom Instruction that Works, Research-based Strategies for Increasing Student Achievement*, ASCD, Alexandria, VA, 2001

Pojeta, John Jr. and Dale A. Springer. *Evolution and the Fossil Record*, American Geologic Institute, 2001

Science Framework for California Public Schools Kindergarten through Grade Twelve, California Department of Education, Sacramento, 1990

Teaching About Evolution and the Nature of Science, National Academy of Sciences, 1998

Understanding Geologic Time http://www.ucmp.berkeley.edu/exhibit/geology/html

United States Geologic Survey, http://www.usgs.gov

VOCABULARY

word roots:

cen – recent

geo – earth

meso – middle

paleo – ancient

zoo – animal

analogy – using words or symbols to compare things that resemble each other

evolution – the historical development and changes of living organisms, the universe or other subjects

fossils – the remains, impressions, or traces of organisms from past geologic ages preserved in Earth's crust

geology – the scientific study of the history of Earth as recorded in rocks and other parts of Earth

proportion – a part, portion or share

time scale – an arrangement of events in history or time

Teacher Tips:

- Before beginning this lesson, review student's familiarity with similes, analogies and ratios/proportions. Make links to their understanding of these topics in other content areas (e.g., math, language arts).
- If necessary, review metric measurement with students.
- Help students with the difference between a timeline and a time scale: timeline is used for short periods of time as in a human's life; time scale is used to indicate much longer periods of time as in the age of Earth.
- Consider assigning the student's personal timeline as homework since the "evidence" is at home (e.g., pictures, teeth, report cards).
- Suggest that students use time intervals of one year or 24-months to create their personal timeline.
- Suggest that students use a color-coding system to help discriminate the confirming from the discrepant information in Step 13.
- For more examples of analogies, use test prep books for the Miller Analogies Test.
- As an alternative activity, use "What Came First?" from this web site: http://www.ucmp.berkeley.edu/fosrec/ScotchmoorFirst.html

Misconceptions:

Students might think that:

Earth is not as old as it is.
Dinosaurs and humans existed at the same time.
Plants and animals appeared on Earth at the same time.

Related Student Resources:

Aliki. *Digging Up Dinosaurs*, HarperCollins, 1988.
Aliki. *Dinosaur Bones*, Thomas Y. Crowell, 1988.
Aliki. *Fossils Tell of Long Ago*, Harper Trophy, 1990.
Baylor, Byrd and Parnall, Peter. *If You Are a Hunter of Fossils*, AladdinBooks, MacMillan Publishing Co., 1980.
Brighton, Catherine. *The Fossil Girl*, Millbrook Press, 1999.
Dixon, Dougal. *Dougal Dixon's Dinosaurs Updated*, Second Edition, BoydsMills Press, 1998.
Duke, Kate. *Archaeologists Dig for Clues*, Harper Collins, 1997.
Facklam, Margery. *Tracking Dinosaurs of the Gobi*, Twenty-First Century Books, 1997.
Gurney, James. *The World of Dinosaurs*, Greenwich Workshop Press, 1998.
Oliver, Ray. *Rocas y fosiles*, Debate, 1993.
Ryder, Joanne. *Tyrannosaurus Time*, Morrow Junior Books, 1999.
Tanaka, Shelley. *Graveyards of the Dinosaurs*, Hyperion, 1998.
Taylor, Paul D. *Los fosiles*, Altea/Santillana, 1990.

American Geological Institute AGIWEB http://www.agiweb.org
Dr. Art's Guide to Planet Earth http://www.planetguide.net
National Academy Press http://www.nap.edu/readingroom/books/evolution98
Understanding Geologic Time (UC Berkeley and National Science Foundation)
http://www.ucmp.berkeley.edu/geotime
http:// www.ucmp.berkeley.edu/exhibit/geology.html

Lesson Credits:

This lesson is adapted from Geology, A Storyline Unit, developed by Project Storyline, a collaboration between the California Science Implementation Network (CSIN) and the University of California, Irvine, 1992.

ENGAGE
EVALUATE
ELABORATE
EXPLORE
EXPLAIN

The Science Learning Cycle:

How Long Ago Was That?

ENGAGE:

1. To initiate the learning, create interest and curiosity by reading aloud a short selection in a book such as *Fossils Tell of Long Ago* by Aliki. (See Student Resources).

2. Ask students to respond in journals to the following prompts:
   - What do I already know about fossils and the history of life on Earth?
   - What do I want to know more about?

3. Chart (or record on a transparency) responses to the two prompts from the class. Date the chart and keep for future reference and assessment.

EXPLORE:

4. Review scale and proportion with students, using the questions on Student Page 1.0.

5. Introduce the Personal Timeline Activity (Teacher Page 1.0). As a group, brainstorm possible milestones, evidence of major events, and what scale they would use to draw their life timeline. Students each create a personal timeline, choosing their own major events and sources of evidence. (You may want to have students create their timelines at home, and then share their personal timelines in their small group.)

6. Introduce the geologic time scale using the teacher-prepared example and directions from Student Page 2.0 "Directions for Constructing a Geologic Time Scale." Read directions aloud and clarify if necessary. Then ask students to do Part A - completing the "Position on Time Scale" column and then complete Part B of Student Page 2.1.

7. Have students research major geologic events, such as mass extinctions, that influenced the diversity of life on Earth, using the literature selections. (See *Dr. Art's Guide to Planet Earth*, pages 80-85, 20-23, 87-88, and 92-95.) Ask students to add any information they choose to their time scale. Remind students that all additions must include the source of the information on the Student Page 2.1, Part B.

8. Have students complete the “Analogy Graphic Organizer” (Student Page 3.0, Teacher Page 2.0), identifying similarities and differences using the relationship categories listed on the page. Ask students to add relationship categories if appropriate.

EXPLAIN:

9. Have students demonstrate their conceptual understanding by explaining to the class the geologic time scale they constructed. Note: This is a place in the instructional model where the teacher evaluates student understanding of the second student outcome.

10. Ask students to listen to and critique each other's explanations.

11. Return to the originally charted ENGAGE questions and to the student-generated questions which were charted. Ask students to review their initial answers in their journal and revise those answers based on their learning. Ask for additional student-generated questions and add them to the class chart.

ELABORATE:

12. Have students use the web (see student resources: understanding geologic time) to gather additional evidence to answer new questions and compare their findings to the time scale they constructed.

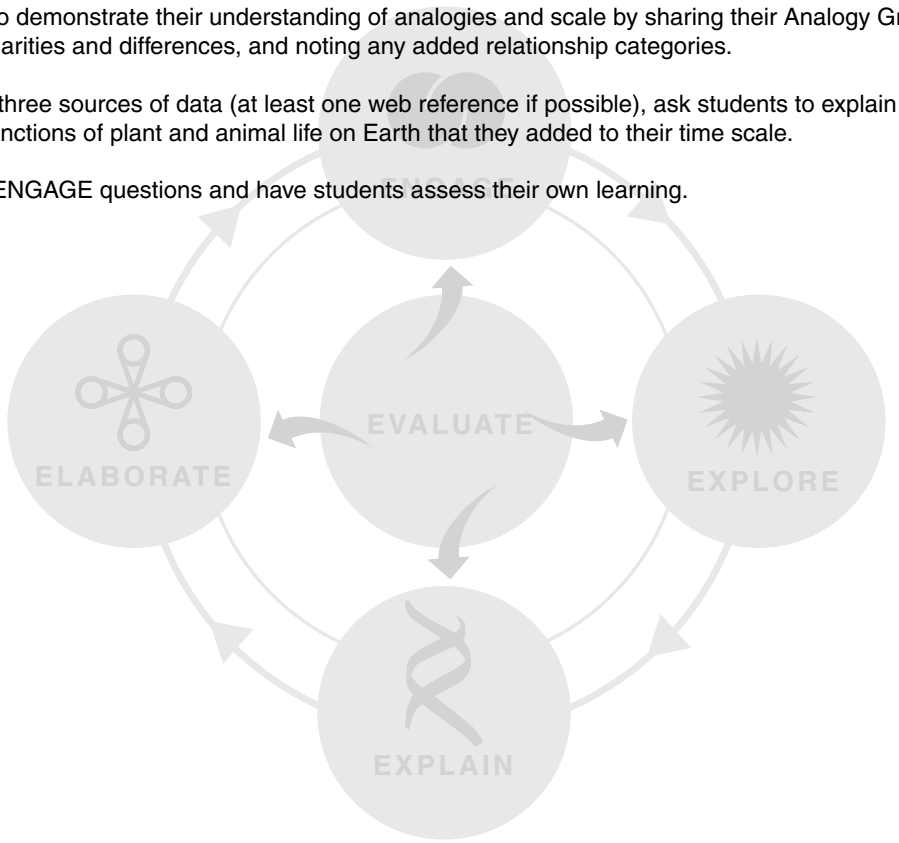
13. Ask students to record new information in their journals and include discrepant as well as confirming information on their time scales. Ask students to record new questions as they arise.

EVALUATE:

14. Ask students to demonstrate their understanding of analogies and scale by sharing their Analogy Graphic Organizers, listing the similarities and differences, and noting any added relationship categories.

15. Using at least three sources of data (at least one web reference if possible), ask students to explain significant developments and extinctions of plant and animal life on Earth that they added to their time scale.

16. Return to the ENGAGE questions and have students assess their own learning.



Teacher Reflection:

1. How does the student work provide evidence that the student understands about the relationship between geologic time and major events in Earth's history?

2. What instructional strategies used in this lesson promote student understanding? How do you know?

3. How does the literature selection support student understanding of the science concept?

4. How would you modify instruction to ensure understanding of student outcomes by all students?

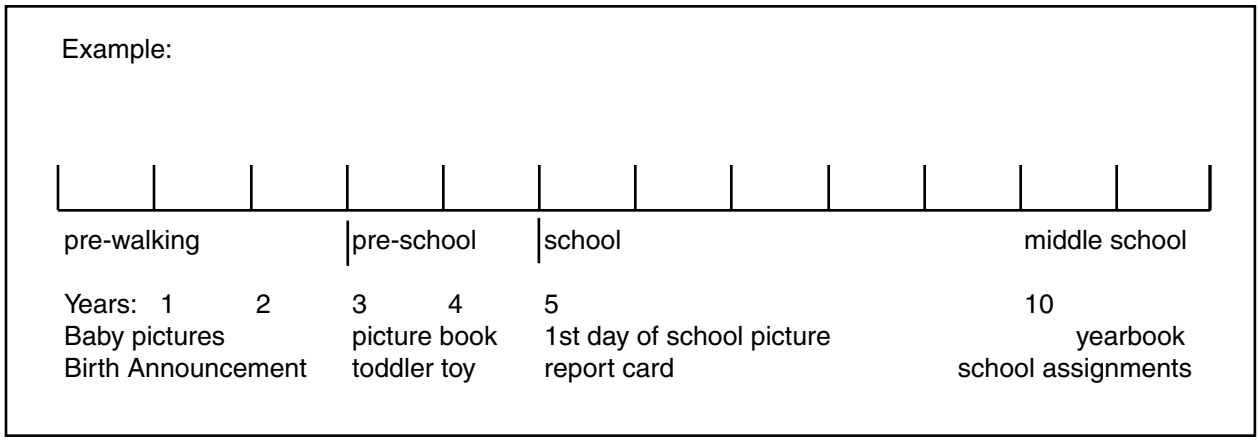
Students' Personal Timeline Activity

1. Ask students to name major milestones or "major events" in their lives (e.g., learning to walk, learning to talk, learning to feed themselves, learning to read, going to school). List these on the board or on a chart.

2. Ask students, "What evidence do you have that could demonstrate different time periods in your life?" If necessary, prompt the discussion with "evidence" such as: baby book, videos, school yearbooks, baby teeth, report cards, sports team photos, letters or birthday cards.

3. Discuss how the evidence could be arranged in sequence to create a timeline of the students' lives. What dividers might they use on a timeline to show these major milestones? (e.g., pre-walking, pre-school, pre-reading, reading.)

4. Have students make a timeline for their lives, using dividers and noting evidence of each period in sequential order. Use a common scale., (e.g., each year = 3 cm).



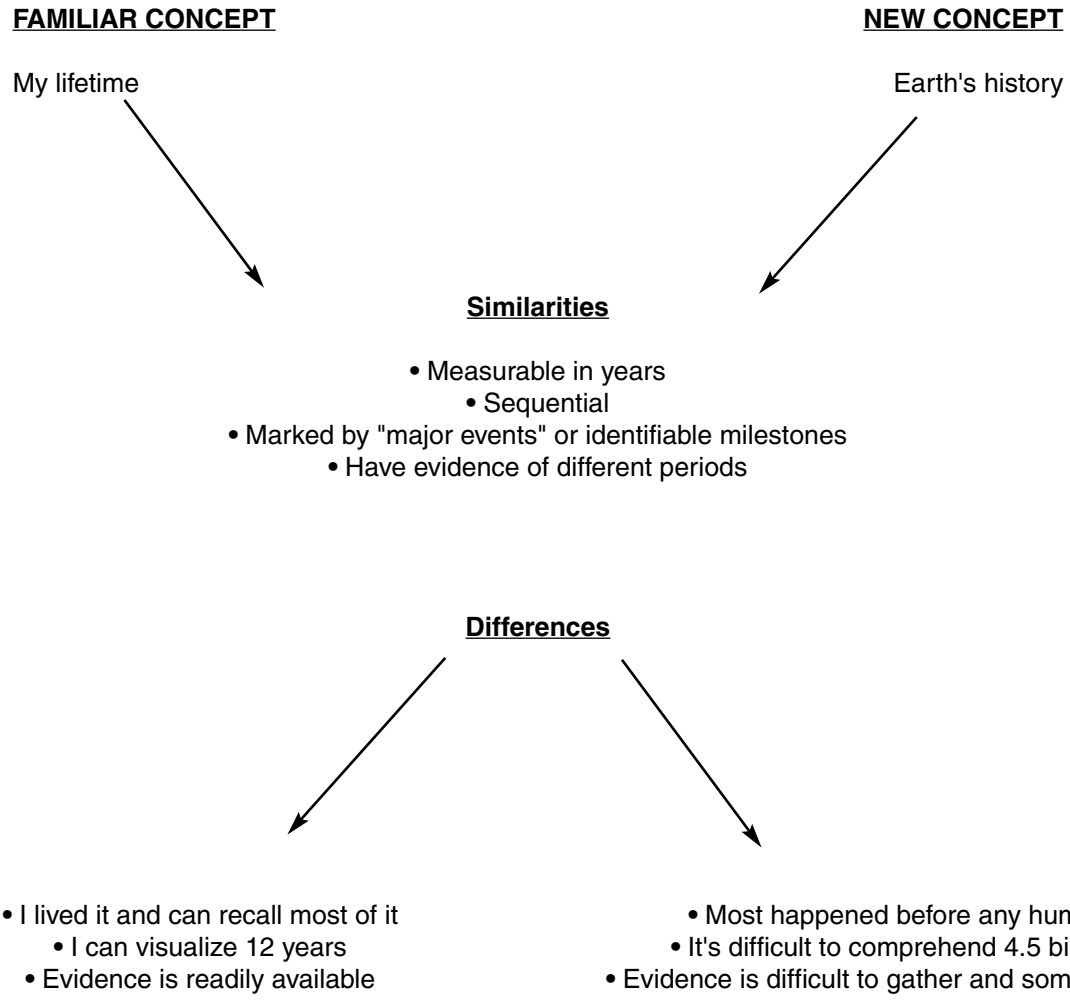
5. Ask students to share their timelines in small groups. Then ask groups to share with the whole class. Chart some of the major periods in their lives and evidence cited.

6. Ask "What kinds of evidence do we have from different periods in the Earth's history?"

7. Compare the scale for a 12 or 13 year timeline vs. a 100 year timeline, vs. a 1,000 year timeline. Tell them that in the next activity, they will be making a 4.5 billion (4,500,000,000) year time scale.

Sample Analogy Graphic Organizer

The analogy graphic organizer provides a visual framework for students to analyze important relationships among concepts and to identify the similarities and differences between a new concept and something with which they are already familiar.



Relationship Categories
Time scale
Milestones
Evidence

Analogies and Scale

Analogies help us see how seemingly different things are similar. For example, thinking about the nucleus of a cell as being like your brain helps you understand that the nucleus is the part of the cell that controls what it does and how it operates. Similarly, scale can be used to represent something large (e.g., the state of California) in a small space (on a map) by equating a large distance (1 mile) with a small distance (1 cm). Scale may also be used to divide large periods of time into manageable "chunks."

Complete the questions below, and note the relationship demonstrated.

1. A 48-year old person is telling the story of her life. She has chosen to use a clock's face to represent the events and time periods in her life. At 6:00 on her "clock" she is 24 years old.

   How "old" would she be at 3:00? _____

   How "old" would she be at 9:00? _____

   How "old" would she be at 11:00? _____

   What is the relationship?_____

2. On a map, the distance between New York and Los Angeles (3000 miles) is represented by 30 cm.

   200 miles would be _____

   2,500 miles would be _____

   10,000 miles would be _____

   What is the relationship?_____

3. On a geologic time scale, the dinosaur extinction was 65 million years ago. It is represented by 65 mm.

   17.5 million years would be _____mm

   150 million years would be _____mm

   500 million years would be _____mm

   1 billion years would be _____mm

   What is the relationship?_____

Directions for Constructing a Geologic Time Scale

Part A - Complete the chart

From your knowledge of analogies and proportions, you know that you can represent a given number of years with a given distance. Complete this chart using 1 mm (0.1cm) to represent 1 million years. All measurements should be in metric units. Check your work with at least two other groups before you proceed to part B.

The History of Earth

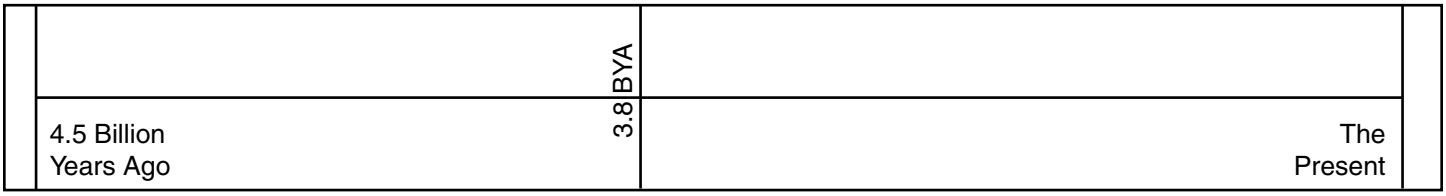
Era	Event	Years Ago (approximate)	Position on Time Scale
Cenozoic	First humans	3 million	
	Grass first appears	20 million	
	Apes appear	35 million	
Mesozoic	Major extinction including dinosaurs	65 million	
	First flowering plants	120 million	
	Early dinosaurs	225 million	
Paleozoic	Trilobites die out	275 million	
	Early reptiles	310 million	
	Amphibians and ferns found on land	350 million	
	Primitive land plants	420 million	
	Jawless fish	480 million	
	Marine invertebrates and trilobites	543 million	
(Pre-Cambrian)	Green algae	1.0 billion	
	Single-celled life abundant	3.0 billion	
	Oldest fossil	3.8 billion	
	Formation of the Earth	4.5 billion	

Part B - Directions for constructing a geologic time scale.

With an accurate chart from Part A, use a 5-meter long paper strip and other materials (meter stick, masking tape, pencil) to create a geologic time scale.

1. Lay the adding machine tape on the floor in a location where it will not disturb another group. Secure the ends of the strip of paper to the floor using making tape.
2. Begin measurement for the time scale with “The Present.” Draw a line across the width of the strip near one end and label it “The Present.”
3. Measure accurately the distance you’ve determined to represent the oldest fossil at 3.8 million years ago. Draw a line across the width of the strip and label it “3,800,000 years ago.”
4. Continue measuring and labeling all 16 points as in step #3.
5. Label every position represented with the corresponding event that occurred. Be prepared to share your time scale with the class.

Sample Timeline:



Scale: 1mm (0.1 cm) = 1 million years

Additional Information and sources:

Analogy Graphic Organizer

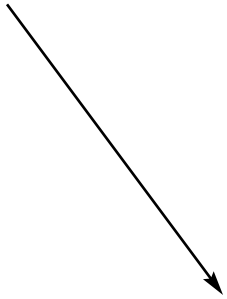
Complete the “Analogy Graphic Organizer” as you complete your life timeline and the Earth's geologic time scale. Use the relationship categories listed below in thinking of similarities and differences. You may add additional relationship categories if you wish.

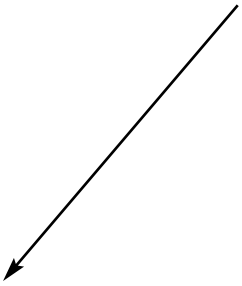
FAMILIAR CONCEPT

My lifetime

NEW CONCEPT

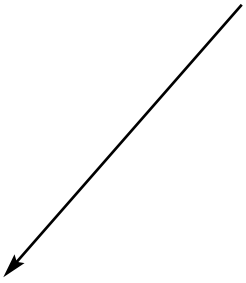
Earth's history

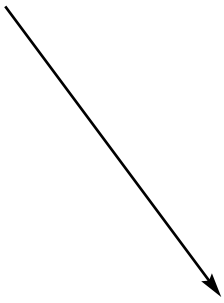




Similarities

Differences





Relationship Categories

Time scale
Milestones
Evidence

Energy Flows Matter Cycles Life Webs Dr. Artâ€™s Guide to the Planet Earth, Art Sussman, Ph.D. Published byWinifred Hood Modified over 4 years ago. Embed.Â Download ppt "Energy in the Earth System. In the Earth systemâ€¦ Energy Flows Matter Cycles Life Webs Dr. Artâ€™s Guide to the Planet Earth, Art Sussman, Ph.D." Similar presentations. Dr. Art's Guide To Science takes us on an awesome journey through atoms, energy, forces, and the universe. We land safely on planet Earth, explore our home, uncover the no-longer secret code of life, and investigate life's history. We look into the future and discover the dvd.Â The DVD also features the complete "Dr. Art's Planet Earth Show," combining exciting science demonstrations with audience participation to teach how our planet works Chapter 7 - Home Sweet Home. Using Earth system science, we investigate Earth?s solid stuff, its liquid stuff, and its gas stuff. Plate tectonics, the water cycle, and the carbon cycle help us conclude that Earth is essentially a closed system for matter. Dr. Art Sussman's Guide to Planet Earth online text. Mrs. Leary classroom policies 2018-2019. Mrs. Leary Parent Letter 2019-2020.Â Unit 1: What does CO2 have to do with you? Unit 2: What will Earth look like in 6000 years? Unit 3: Where does Energy come from? Unit 4: How could a butterfly take down the human race?