



Ancient Waters: The Ocean and its Prehistoric Inhabitants

INTRODUCTION

This lesson will have students dive into the vast history of the Earth and the ocean. Students will learn about the age of the Earth, and specifically the ocean. Through class discussion and hands-on activities, they will gain an appreciation for the extensive history of the Earth and the extraordinary changes that have occurred over many years. Students will discover the exciting field of paleontology and learn about the fossils they examine. Students will act as paleontologists by studying former geologic periods, through an investigation of the exotic and fascinating organisms that lived in the prehistoric era. The lesson will be concluded by emphasizing the importance of ocean exploration with an anecdote of one of these prehistoric species that was found after being assumed extinct for millions of years.

LESSON OVERVIEW

Grade Level & Subject: Grades K-4: Social Studies, Science

Length: Two 45 minute Class Periods

Objectives:

After completing this lesson, students will be able to:

- Comprehend the approximate age of the Earth and the ocean
- Describe what life was like before humans existed
- Introduce the science of paleontology and the work of paleontologists
- Identify prehistoric aquatic species that are still alive today
- Understand how the Earth and the ocean with all of its inhabitants have changed over many years

National Standards Addressed:

This lesson addresses the following [National Geography Standards](#) from [The National Geographic Society](#):¹

- **Content Standard: [NSS-G.K-12.3 PHYSICAL SYSTEMS](#)**

As a result of activities in grades K-12, all students should:

- Understand the physical processes that shape the patterns of Earth's surface.
- Understand the characteristics and spatial distribution of ecosystems on Earth's surface.
- **Content Standard: [NSS-G.K-12.5 ENVIRONMENT AND SOCIETY](#)**

¹ <http://www.education-world.com/standards/>.

As a result of activities in grades K-12, all students should:

- Understand the changes that occur in the meaning, use, distribution, and importance of resources.

- **Content Standard:** [NSS-G.K-12.6 THE USES OF GEOGRAPHY](#)

As a result of activities in grades K-12, all students should:

- Understand how to apply geography to interpret the past.

This lesson addresses the following [National Science Education Standards](#) from [The National Academies of Science](#):

- **Content Standard:** [NS.K-4.3 LIFE SCIENCE](#)

As a result of activities in grades K-4, all students should develop understanding of:

- The characteristics of organisms
- Organisms and environments

- **Content Standard:** [NS.K-4.5 SCIENCE AND TECHNOLOGY](#)

As a result of activities in grades K-4, all students should develop:

- Understanding about science and technology
- Abilities to distinguish between natural objects and objects made by humans

- **Content Standard:** [NS.K-4.6 PERSONAL AND SOCIAL PERSPECTIVES](#)

As a result of activities in grades K-4, all students should develop understanding of:

- Types of resources
- Changes in environments

- **Content Standard:** [NS.K-4.7 HISTORY OF NATURE AND SCIENCE](#)

As a result of activities in grades K-4, all students should develop understanding of:

- Science as a human endeavor

Materials Needed:

- 2 cups flour
- 1 cup salt
- 1 tablespoon vegetable oil
- 1 teaspoon alum
- ½ - 1 cup water
- 4" X 4" square of wax paper for each student
- Shells, acorns, plastic bugs, or other materials to make imprints
- Paint and paint brush (if painting fossils)
- Pencils
- Markers, Crayons, or Colored Pencils
- **Red** crayons or markers
- **Blue** crayons or markers
- **Green** crayons or markers
- **Orange** crayons or markers
- **Reproducible #1 – “Prehistoric Pictures”** (spare cardboard and glue if you plan on mounting the pictures)
- **Reproducible #2 – “The Earth in One Calendar Year”** (1 poster sized copy or overhead transparency and enough printed copies for each table of students)

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- **Reproducible #3 – “Coloring your own Calendar”**
- **Reproducible #4 – “How to Make Fossils”**
- **Reproducible #5 – “Fossil Creators!”**
- **Reproducible #6 – “Prehistoric Animals Alive Today”**

Assessment:

Students will be assessed through the following activities:

- Participation in class discussions
- Adherence to calendar activity instructions and thorough understanding of concepts
- Creation of model fossil and completion of worksheet

LESSON BACKGROUND

Relevant Vocabulary:

- **Bacteria:** Simple single-celled microorganisms prevalent throughout the biosphere.²
- **Dinosaur:** Any chiefly terrestrial, herbivorous or carnivorous reptile of the extinct orders Saurischia and Ornithischia, from the Mesozoic Era, certain species of which are the largest known land animals.³
- **Fossil:** A remnant, impression, or trace of an organism of past geologic ages that has been preserved in the earth’s crust.⁴
- **Geology:** The scientific study of the origin, history, and structure of the earth.⁵
- **Organism:** Any living individual; any plant or animal.⁶
- **Paleontology:** The study of fossils and ancient life forms.⁷
- **Pangaea:** A hypothetical land area believed to have once connected nearly all of the earth’s landmasses together.⁸
- **Prehistoric:** Of, pertaining to, or belonging to the era before recorded history.⁹
- **Sediment:** Material that is deposited by water, wind or glaciers and settles to the bottom of a liquid.¹⁰

² “Bacterium Entry.” [Merriam-Webster Online Dictionary](http://www.merriam-webster.com/dictionary/bacterium). Retrieved February 24 2011 from <http://www.merriam-webster.com/dictionary/bacterium>.

³ “Dinosaur Entry.” Dictionary.com, LLC. Retrieved February 18 2011 from <http://dictionary.reference.com/browse/dinosaur>.

⁴ “Fossil Entry.” [Merriam-Webster Online Dictionary](http://www.merriam-webster.com/dictionary/fossil). Retrieved February 18 2011 from <http://www.merriam-webster.com/dictionary/fossil>.

⁵ “Geology Entry.” Morris, William. *The American Heritage Dictionary of the English Language*. Houghton Mifflin Company, 1981.

⁶ “Organism Entry.” Morris, William. *The American Heritage Dictionary of the English Language*. Houghton Mifflin Company, 1981.

⁷ “Paleontology Entry.” Morris, William. *The American Heritage Dictionary of the English Language*. Houghton Mifflin Company, 1981.

⁸ “Pangaea Entry.” [Merriam-Webster Online Dictionary](http://www.merriam-webster.com/dictionary/pangaea). Retrieved February 18 2011 from <http://www.merriam-webster.com/dictionary/pangaea>.

⁹ “Prehistoric Entry.” Morris, William. *The American Heritage Dictionary of the English Language*. Houghton Mifflin Company, 1981.

¹⁰ “Sediment Entry.” [Merriam-Webster Online Dictionary](http://www.merriam-webster.com/dictionary/sediment). Retrieved February 24 2011 from <http://www.merriam-webster.com/dictionary/sediment>.

- **Species:** A class of individuals having common attributes and designated by a common name.¹¹

Information:

According to geologists, our planet has been in existence for approximately 4.5 billion years.¹² At the very beginning, the ocean, as we know it, did not exist. However, geologic evidence suggests that the ocean was formed with water from the atmosphere as early as 3.8 billion years ago.¹³ Since then, the ocean has changed drastically, shifting and forming as the Earth's tectonic plates collided and separated. Originally, life flourished in the ocean, yet it has also changed considerably over the years. Some species have survived for hundreds of millions of years, persisting through major extinction events, whereas others have become extinct in a relatively short period of time.

Because of the Earth's extensive history, it is important to not only learn about the ocean through the lens of human civilization, which has only been around for approximately 12,000 years, but also about the nature of the ocean before humanity's arrival. We can learn a great deal about past life from the work of paleontologists, geologists and other explorers of the ocean. Their work reveals fossilized evidence of life in prehistoric times, which has considerable influence on today's world. Their work offers unique insight into the dynamic structures that constitute our planet. For example, paleontologists have already learned that land-based dinosaurs actually first appeared about 230 million years ago and went extinct about 65 million years ago.¹⁴ How did they survive so long? What happened to them? How did their societies function? These are all important questions to understanding life on Earth. However, the investigation of prehistoric life is a vast endeavor and is not limited to the ever popular dinosaurs. Other species existed before the dinosaurs that rival in grandness, such as the Dunkleosteus, a 33 foot tall prehistoric fish from 380 million years ago!¹⁵ These organisms are equally important to study as the dinosaurs to help broaden our understandings of life before human existence.

Amazingly, not all prehistoric species have gone extinct. Many of the most recognizable species today, such as sharks or turtles, have direct lineage that spans hundreds of millions of years.¹⁶ There are also some species that were assumed extinct, but actually still exist. The Coelacanth is a prime example; a species initially believed to have been wiped out 65 million years ago, it was found off the southeast coast of Africa in the 1930's.¹⁷ As this story suggests, scientists continue to unearth many new discoveries about the ocean, its life and the critical relationship between the two.

¹¹ "Species Entry." [Merriam-Webster Online Dictionary](http://www.merriam-webster.com/dictionary/species). Retrieved February 24 2011 from <http://www.merriam-webster.com/dictionary/species>.

¹² "Geologic Time: Age of the Earth." *USGS Publications Warehouse*. USGS, 9 July 2007. Web. 18 Feb. 2011. <http://pubs.usgs.gov/gip/geotime/age.html>.

¹³ Cavosie, Aaron. "When Did Oceans Form on Earth?" *SERC*. Science Education Resource Center, 01 Feb. 2011. Web. 18 Feb. 2011. http://serc.carleton.edu/NAGTWorkshops/earlyearth/questions/formation_oceans.html.

¹⁴ "National Museum of Natural History - Dinosaurs." *Paleobiology Home*. Smithsonian Institution. Web. 23 Feb. 2011. <http://paleobiology.si.edu/dinosaurs/info/everything/what.html>.

¹⁵ "Dunkleosteus." *American Museum of Natural History*. Web. 23 Feb. 2011.

http://www.amnh.org/exhibitions/expeditions/treasure_fossil/Fossils/Specimens/dunkleosteus.html.

¹⁶ "Fathoming Geologic Time." *ReefQuest Centre for Shark Research Home*. Web. 23 Feb. 2011. http://www.elasmo-research.org/education/evolution/geologic_time.htm.

¹⁷ "Coelacanth - Deep Sea Creatures on Sea and Sky." *Sea and Sky - Explore the Oceans Below and the Skies Above*. Web. 23 Feb. 2011. <http://www.seasky.org/deep-sea/coelacanth.html>.

Resources:

- A Public Broadcasting Service (PBS) webpage that lists several fish families/species that have existed for many millions of years. It includes pictures and a description of each type of fish.
<http://www.pbs.org/wgbh/nova/nature/other-fish-sea.html>
- A dedicated website for learning about paleontology, produced by the University of California Museum of Paleontology, the United States Geological Survey, and several other organizations. It includes an interactive map of the U.S. that can be clicked on to learn more information about a particular state's geologic history. Pages for each state include sections on where to collect fossils, links to parks and museums that teach prehistoric science and other resources. This website also has information on paleontology as a career.
<http://www.paleoportal.org/>

Websites for Kids:

- An education website that has a plethora of information on ocean exploration and the creatures that inhabit it. It also contains numerous pictures of fishes, reefs, and other aquatic life.
<http://www.seasky.org/sea.html>
- A website explaining geologic time and the different periods of prehistory. Information is written in an easy to understand style. Ideal for older elementary school students/middle school students. The web pages for each time period includes an artist's rendering how the world looked and a descriptive explanation of the period.
<http://www.cotf.edu/ete/modules/msese/earthsysflr/geotime.html>
- A complimentary website for "Activity Three." This web page has a flash based applet that can help students learn more about the coelacanth and what makes it so unique.
<http://www.pbs.org/wgbh/nova/nature/anatomy-coelacanth.html>

LESSON STEPS

Preparation Step:

1. Print out **Reproducible #1 – Prehistoric Pictures** and cut-out the individual pictures. You can glue them onto cardboard rectangles to provide structural support when showing them to the class.
2. Print out enough copies of the completed example **Reproducible #2 – The Earth in One Calendar Year** so that each table/cluster of students has at least one copy to reference. Use a color printer so the difference in hues is more distinguishable. Also create a transparency or poster of **Reproducible #2** to be shown to the class at the beginning of “Activity 1.” Print out enough copies of **Reproducible #3 – Coloring your own Calendar** so that each student has a copy.
3. Put out the crayons or markers so that the students can use them to make their calendars.
4. For “Activity Two,” students will be creating their own fossils. On the day the class will be making the fossils, you can place the materials at the front of the classroom at the start of Activity Two if it is more convenient, but make sure to tell the students that they may not consume any of the materials. You will also need to cut up the wax paper into 4” squares. If you plan on painting the fossils after they have dried, paint and paintbrushes will also need to be prepared. Also, print out the handouts required for Activity Two: **Reproducible #4 – How to Make Fossils** and **Reproducible #5 – Fossil Creators!**
5. If you would like to print larger resolutions of any of the pictures, footnotes have been included for all images.

Warm-up: *Rocks and Fossils*

The warm-up will offer an opportunity for students to begin to understand the history of the Earth and the ocean. The warm up and Activity 1 can be completed within the first 45-minute class period.

1. Ask students the following questions: What is an organism? *Any living individual; any plant or animal.* What is the oldest animal or organism that comes to your mind? *Answers will vary but will most likely include references to dinosaurs.*
2. Ask students what they know about dinosaurs. Hold up the picture of “Tyrannosaurus Rex” from **Reproducible #1** and ask students if they recognize the dinosaur. How big can dinosaurs be? *They range in size from as big as modern-day buildings to as small as birds.* Show the class the two pictures of “Big Dinosaurs” and “Small Dinosaurs” with the size comparison to humans. Ask students to imagine standing next to the biggest dinosaurs! Tell them that the Tyrannosaurus has teeth that were as big as a toothbrush. The Brachiosaurus was as long as two school buses parked front to back. The Compsognathus, on the other hand, was about the size of chickens we know today. Two known Theropoda dinosaurs, Anchiornis and Epidexipteryx were both the size of pigeons.
3. Ask the students what is a fossil? *A remnant, impression, or trace of an organism of past geologic ages that has been preserved in the earth’s crust.* Where are dinosaur fossils found? *In the ground in layers of sediment*

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or exposed rock. How long ago were dinosaurs around? *Paleontologists believe they existed 65 to 230 million years ago* Who studies them? *Paleontologists.* What is a paleontologist? *A paleontologist is someone who studies prehistoric life (life from a long time ago). Dinosaurs are not the only organisms that we learn about through fossils. We can discover a lot about the ocean through the work of paleontologists.*

4. Write the number “230,000,000” at the top of the blackboard. Next, have one student write “1” on the left end of the board. Then, have another student write “2” on the board next to the “1.” Then have another student write “3” and so on until a full row of numbers reaches the right side of the board. Tell the students to look at the last number written, which will be much less than 230 million, and ask how far they think the numbers would stretch if they wrote all of them out up to 230 million. *Assuming each digit is reasonably wide (about 2 inches) and the space between numbers is about 1 inch, it would take more than 65,000 miles! That is more than 2 and a half times the circumference of the Earth!* This will help students to visualize how large a number 230 million is. Leave these numbers on the board.
5. Begin talking about the age of the Earth. Ask the following rhetorical question: If the dinosaurs were around more than 230 million years ago, how old is the Earth itself? Is the Earth older than dinosaurs? *Yes!* How much older: a lot older, a little older, or about as old? *A lot older.* Ask your students to guess how old the Earth is. *Geologists theorize that the Earth is approximately 4.5 billion years old!* Write “4,500,000,000” on the board next to 230,000,000, and ask the students to guess how far the numbers would stretch if they wrote out all the numbers to 4.5 billion. *Approximately 1.5 million miles. That’s the distance to the moon and back, 3 times!* So 4.5 billion is a really big number! What do the students think the Earth was like in its early days? *Think of what a volcano is like: hot, boiling, and dangerous! Now imagine if there were scores of them all around! At the beginning of the Earth’s composition, there were volcanoes and lava everywhere. You would not be able to walk anywhere because the ground would burn you. The air was sticky, humid and full of gases that would suffocate you if breathed them in. Meteor impacts were common since there was no atmosphere. As a result, the ground would be littered with craters, and ocean was non-existent.* Display the picture of the “Hadean Era Earth” from **Reproducible #1.**
6. Transition into the next question by asking the following question: if there was no ocean at the beginning of the Earth, when did they start to form? Let the students guess. *Geologists think the ocean formed at least 3.8 billion years ago.* Write this number on the board too. If the ocean is so old, and the dinosaurs only began appearing 230 million years ago, then life must have been very different before they existed. Show the students a picture of the “Dunkleosteus” which lived 360-380 million years ago in the Devonian period. Tell your students that, initially, life only existed in the ocean. The first living organisms were bacteria which eventually evolved into more complex creatures. Explain to the students that bacteria are simple single-celled microorganisms, like germs! Tell your students that the following activities will focus on the ocean. Since the ocean has such an extensive history, we will first explore several activities that relate to the ocean before humans existed.

Activity One: A One Year History

This activity will help to enforce the concept of how old the Earth is through an interactive worksheet.

1. Display **Reproducible #2 – The Earth in One Calendar Year** to the whole class, using an overhead projector or a poster size printout. Tell your students to imagine what it would be like

if we sped up time, so that the entirety of Earth's history was condensed into one full year from January 1st to December 31st. Remind the students of the Earth's approximate age. *Approximately 4.5 billion years old.* Referring to the timeline, explain that January 1 signifies the very beginning of Earth.¹⁸ The dates marked in **red** on the calendar represent the earliest period of the world, when planet Earth was first formed.

Ask students if they remember how long ago the ocean formed. *At least 3.8 billion years ago.* The oldest physical evidence of ocean presence was from 3.8 billion years ago. Following the same one year timeline analogy, the oceans would have formed around February 26 – about two weeks after Valentine's Day. Tell your students that the dates marked in **blue**, from February 26 onward, symbolize the period after oceans formed. Be sure to explain to the students that the world's geology is continuously shifting, and though the ocean formed many years ago, it did not appear then as it does now. Show students the picture of "Pangaea and Laurasia/Gondwanaland" from **Reproducible #1**. Explain to students that the world looked like this when the dinosaurs were alive, completely different from how we know it today.

2. Ask students how long ago the dinosaurs existed. *They first appeared about 230 million years ago and disappeared 65 million years ago.* In comparison to the age of the Earth, this 165 million year period is relatively tiny (about 4%). The Age of the Dinosaurs is colored in **green**. On the timeline, this phase lasts from December 13 to December 26. Remind your students that although the dates are in a different color, the ocean still existed during this time period.
3. Finally, ask students how long they believe human civilization has been around. *Archaeologists and historians have found evidence of human sedentary civilization dating back to approximately 12,000 years ago.* In order to help your students make sense of how long 12,000 years is, tell them to assume that the average age difference in generations is about 30 years. A generation is the group of people who were born in a particular descent from their ancestors. For instance, parents and grandparents are two different generations. Thus, a period of 12,000 years has approximately 400 generations. This would be your grandmother's, grandmother's, grandmother's, grandmother's, grandmother's... 195 more times! On the timeline, human civilizations arises on December 31 at 11:59 PM. Point to the last day on the calendar marked in **orange** and say that on this one year timeline, human civilization does not appear until approximately one minute before midnight! Human civilization did not exist until right before the ball dropped on New Year's Eve. The time in which humans have existed is extremely miniscule in comparison to the age of the Earth despite being thousands of years long.
4. Tell students that they will be making their own "Earth in One Calendar Year" calendars. Pass out the example calendars, **Reproducible #2**, so that there is at least one on each table, and give each student their own blank calendar handout, **Reproducible #3**. Tell your students to read over the worksheet directions and follow them. They will need to color the calendar and draw pictures in the margins according to the instructions. The calendar print out is actually the 2011 calendar, so after students are done they can take the calendars home with them or post them on a classroom wall.

¹⁸ Earth: The Power of the Planet. Prod. Phil Dolling. Perf. Iain Stewart. British Broadcasting Company. Web. Retrieved March 4, 2011 from <<http://www.youtube.com/watch?v=-x8-KMR0nx8&feature=related>>.

Activity Two: *Finding Pre-historic Inhabitants*

This activity will allow students to make their own realistic fossils. This activity and the next activities, along with the “Wrap Up” can be completed within the second 45-minute class period.

1. Explain to the students that as the ocean changed and species become extinct, their fossils are buried in sediment and preserved in the ground. Tell the students that sediment is earthen material that has been deposited by water or wind. Paleontologists search for these fossils by digging through various layers of rock. They study these fossils to determine the different diet, lifestyles, climate, and other clues about pre-historic organisms that give us details about life in the time before humans existed. In order to figure out how old a fossil is, paleontologists use modern tools and machines, ranging from microscopes and magnifying glasses to sophisticated technologies like genetic analysis. Show the “Paleontology” picture from **Reproducible #1**.
2. Tell students that they will be making their own model fossils from regular dough! First hand out **Reproducible #4 –How to Make Fossils** to all of the students. Read aloud the instructions as a group and answer any questions. When each student receives their ball of dough, remind them that they may **NOT** eat it. After the students have their “dough” ball, allow them to continue the fossil making process.
3. After the students have finished making their fossils, ask them to clean-up as they wait for them to dry.
4. Hand out **Reproducible #5 – Fossil Creators!** and ask students to answer the questions.
5. Review students’ answers to **Reproducible #5 – Fossil Creators!** Ask a few students to volunteer to present their fossils. The fossils can be kept in the classroom overnight to harden, and the students can take them home the next day. If they would like to, the students can paint their fossils after they have dried.

Activity Three: *It’s Alive!*

1. Emphasize for students how large the ocean is and how there is still much to explore. Many species have not been discovered. In some cases, we have found species that we thought were extinct are still alive!
2. Inform students that you want to tell them about a few more prehistoric creatures. As you describe each creature, ask students to try to figure out if this creature is alive today or went extinct a long time ago.
3. This species can grow up to twenty feet long. A type of shark, they are a predator who makes good use of its teeth. Unlike people who lose teeth and have a new tooth grow in or other sharks which have rows of teeth so that when one falls out they have back-up, this species grows new teeth throughout its life. And it never loses them; instead they grow in a spiral fashion, like a circular saw on the lower jaw. Ask students if this species is extinct or alive today? *The Helicoprion went extinct during the Triassic period, about 225 million years ago.*

4. A striking feature of this next species is its fins that extend away from the body and begin to look like legs. The Coelacanth also has a mouth on a hinged joint so it can widen its mouth for large prey. These fish also can grow to be six and a half feet tall (two meters). Can you imagine that? A fish taller than most people. Another interesting feature of these fish is that they have thick scales that only extinct fish have. Ask students if this species is extinct or alive today? *The Coelacanth was found to be alive after believed to be dead for 65 million years. A South African museum curator was surprised to find one off the southeast coast of Africa in 1938. This “living fossil” can truly tell us a lot about history!*
5. This third creature acts a lot like a seal. It catches its food in the water but comes onshore to eat it. It grows to be approximately ten feet in length. Its feet are webbed (like ducks) to help it swim faster. Its neck is long and it has a flat head and it eats fish and squid. This species has leathery skin, a long tail, short legs, has needle-like teeth and resembles a crocodile. Ask students if this species is extinct or alive today? *The Nothosaurus went extinct during the Triassic period about 250 million years ago.*
6. The first fossil records of this creature date back 425 million years ago. This species lives on the shores of the ocean and uses its tail to help steer it across sand. The tail is also used to help flip this creature over if it is on its stomach. The entire body is protected by a hard shell and they have five pairs of legs for walking, swimming and moving food into the mouth. Ask students if this species is extinct or alive today? *The horseshoe crab is alive today and has changed little from its original form 425 million years ago.*
7. Show students **Reproducible #6 – It’s Alive!** to see pictures of some of the prehistoric creatures described above.
8. Hold up **Reproducible #7 – Prehistoric Animals Alive Today** so the students can see pictures of other animals that have existed since prehistoric times. Despite changing so much throughout history, the ocean provides a habitat that has allowed many species to survive for a very long of time. Ask students why they believe this to be the case. *Answers will vary but it is related to the ability of a species to sustainably adapt to a specific ecosystem, such as the ocean.*

Wrap Up: Make Your Own Creature

1. Ask the students if they can name any more aquatic animal species alive today that might have been found during prehistoric times. Tell students that a species is a group of organisms that have similarly identifiable traits such as humans, domestic dogs, or giant pandas. *Turtles, sharks, some species of fish (sturgeon, lamprey, bonfin, hagfish), and horseshoe crabs are examples of such prehistoric creatures still alive today.*
2. Ask the student why they think these species survived and other species did not. *They were able to evolve and adapt to their surroundings. After food sources decreased, maybe their population dropped but they became more resilient and did not have to eat as much. Perhaps, after their main source of food went extinct they began getting their energy from another source.*
3. Have students imagine their own pre-historic organisms. Ask them to spend a few minutes drawing a picture of what their organism would look like. Remind them of the pictures from

Reproducible #6. Where does it live? Is it big or small? What would it eat?

4. Discuss with students the importance of studying prehistoric life. How can studying past life on Earth help us now? *It gives us understanding of what the world was like millions of years ago. It can help us to understand how animals and plants adapt to certain conditions which will help to explain where humans came from. Studying the conditions in prehistoric times, like the various ice ages and extinctions, will help humans to cope with future major natural disasters.*

Extension Projects:

1. Take a class trip to a local paleontology site or natural history museum. Explore the site or museum with a guide to learn about the various prehistoric species that lived in the ocean. Check out [The Paleontology Portal](#)¹⁹ for more information on museums and parks that feature paleontological finds in your area. Students can take pictures or get souvenirs which they can use to create an oral presentation or write up a report. If students cannot visit a dig site, they can write letters to a paleontological society and ask about the paleontologists' job or ask how the students can volunteer.
2. After the students' fossils have hardened, place them in a large sandbox and let the students try to dig for their fossils using paleontological tools (brushes, trowels). You can try using different types of sands to make several layers of earth and pretend that the different layers signify different eras of the Earth's history. You may even let the students make up names for the fossils.
3. Ask students to write up a story about a fictional encounter with dinosaurs. One scenario students could write about is what would happen if they traveled in a time machine back to prehistoric times. They could write about their adventures, which dinosaurs they see and what the environment is like during that time period. Another story scenario students could write about is what would happen if dinosaurs were brought back to life. Students would explain in their story how scientists were able to revive the dinosaurs. They could also discuss which species they would bring back and what the dinosaurs would be used for.
4. Back to the future: explain to students that scientists have recently been experimenting with fossilized DNA to bring extinct species back to life. Have them research articles from reputable news sources, and debate the pros and cons of potentially bringing dinosaurs back to life. Useful questions to spur debate include: *How would these new creatures effect the environment? How would they live, as zoo exhibits or roaming free? Would they raise a lot of money? What could go wrong?*

¹⁹ The Paleontology Portal. http://www.paleoportal.org/index.php?globalnav=time_space.

CONCLUSION

After completing the activities in this lesson, students will have gained a better understanding of the history and geology of ocean. Knowledge of geology and the ever changing nature of the planet will give students an appreciation of the malleable nature of their environment. A deeper awareness of how much time has passed since the inception of the planet will also foster an appreciation for the species that have existed, and will help students to develop an understanding of their own place in Earth's history. Students will also become familiar with the field of paleontology and will be able to name important prehistoric species that are still around today.

LESSON PLAN CREDITS

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PREHISTORIC PICTURES

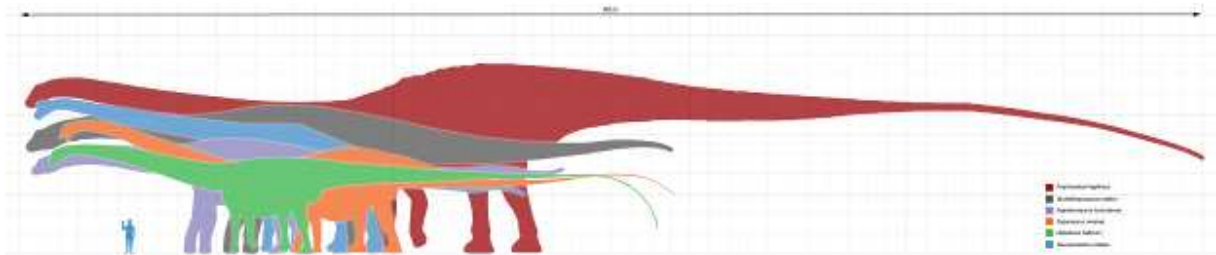
TYRANNOSAURUS REX²⁰



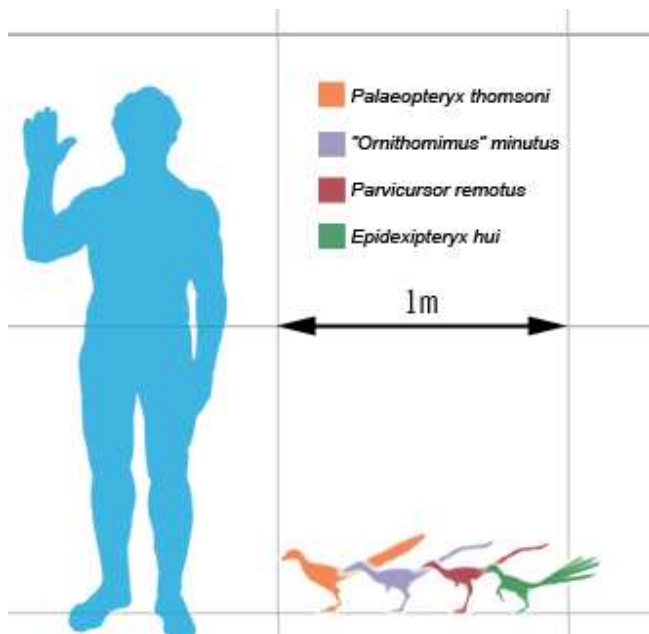
²⁰ *Stan the T. Rex*. The University of Manchester, The Manchester Museum. Retrieved February 12, 2011 from <http://www.museum.manchester.ac.uk/kids/galleries/stan/>.

BIG DINOSAURS²¹

#1 AMPHICOELIAS FRAGILLIMUS



SMALL DINOSAURS²²



²¹ Martyniuk, Matt. *Scale Diagram of Largest Known Dinosaurs*, November 2007. Retrieved February 11, 2011 from http://commons.wikimedia.org/wiki/File:Largestdinosaursbysuborder_scale.png.

²² Martyniuk, Matt. July 2010. Retrieved February 11, 2011 from http://upload.wikimedia.org/wikipedia/commons/8/8e/Smallest_theropods_scale_mmartyniuk.png.

HADEAN ERA EARTH²³

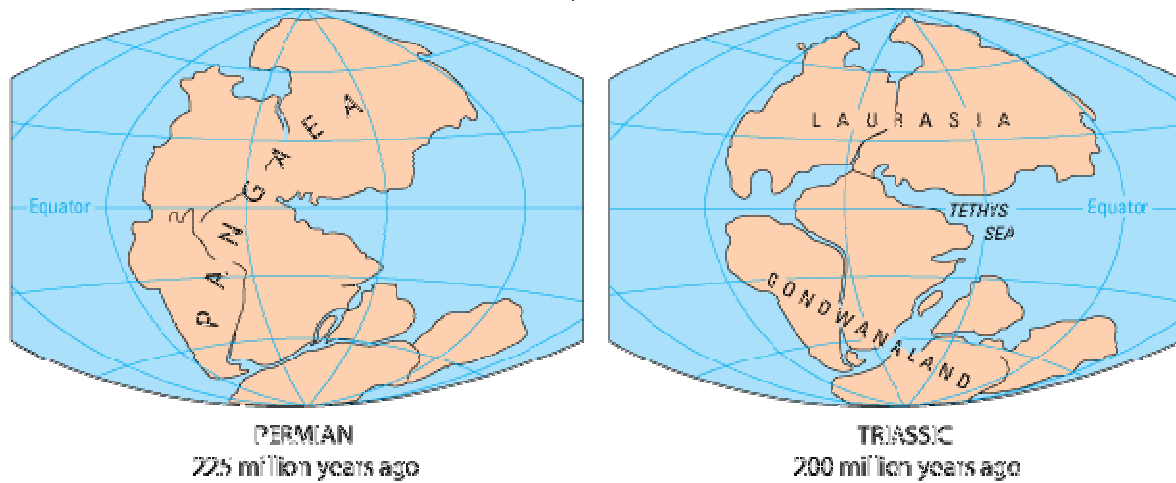


²³ "Origins." *Arizona Museum of Natural History*. Web. 02 Mar. 2011. <http://www.azmnh.org/exhibits/origins-uni.aspx>.

DUNKLEOSTEUS²⁴



PANGAEA AND GONDWANALAND/LAURASIA²⁵



²⁴ Tamura, Noba. *Dunkleosteus*. Retrieved January 28, 2011 from http://upload.wikimedia.org/wikipedia/commons/9/95/Dunkleosteus_BW.jpg.

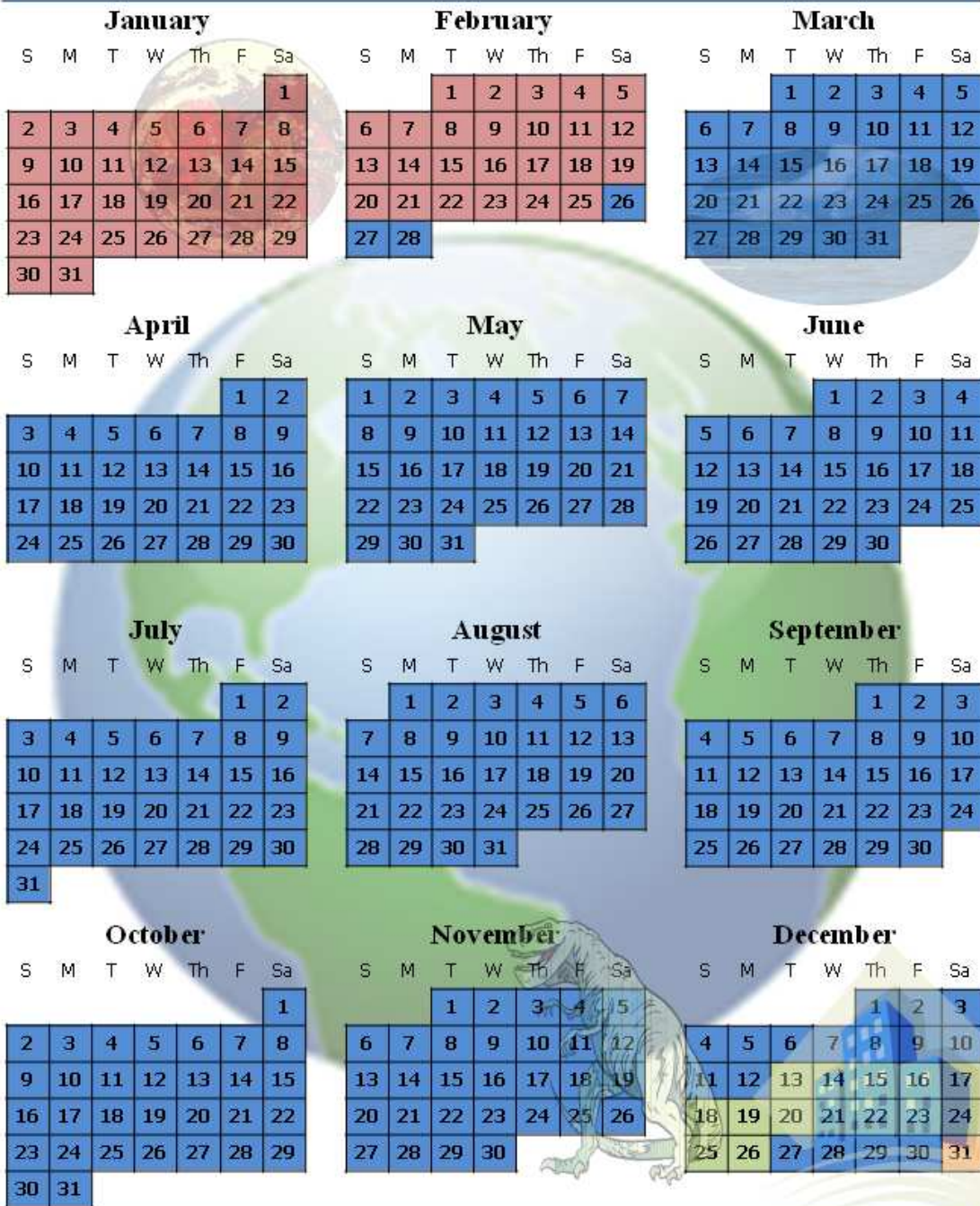
²⁵ *Pangaea and Laurasia/Gondwanaland*. United States Geological Survey Publication Warehouse. Retrieved February 4, 2011 from <http://pubs.usgs.gov/gip/dynamic/graphics/fig2-5globes.gif>.

PALEONTOLOGY²⁶



²⁶ Knötschke, Nils. Preparation of fossil bones of *Europasaurus holgeri*.. Retrieved January 5, 2011 from http://commons.wikimedia.org/wiki/File:Europasaurus_Praeparation.JPG.

The Earth in One Calendar Year



- January 1.** Beginning of the Earth: *approx. 4.5 billion years ago (red)*
- February 26.** First Oceans Appeared: *approx. 3.8 billion years ago (blue)*
- December 13.** Dinosaurs First Appear: *approx. 230 million years ago (green)*
- December 26.** Dinosaurs Face Extinction: *approx. 65 millions years ago (green)*
- December 31, 11:59PM.** Humans Civilization Arises: *about 12 thousand years ago (orange)*



Coloring your own Calendar



Materials:

- A pencil
- A **red** crayon (or marker)
- A **blue** crayon (or marker)
- A **green** crayon (or marker)
- An **orange** crayon (or marker)
- An uncolored worksheet

Directions:

For this activity you will be coloring in the calendar according to different time periods. At the bottom of the calendar is a list of dates with the time period they represent. Next to the time period is a color. Color in this date and any following days, up until the next listed date, with that color. If you need help, look at the example calendar.

After you are done coloring in all the days, you can begin drawing the pictures for each time period. Use the margins or your paper or the area in between the months to draw.

For the **red** area (beginning of the Earth) draw the earth as it might have looked at its very beginning.
Hint: during this time the Earth was full of volcanic activity!

For the **blue** area (Oceanic period) draw what you are reminded of when you think of the ocean. It can be a wave, a seashell, a beach or anything else that you think about.

For the **green** area (time of the dinosaurs) draw your favorite dinosaur!

For the **orange** area (era of human civilization) draw something related to human technology. Drawing a building, a car, or a computer are some options.

Again, be sure to look at the example calendar for tips and ideas.

The Earth in One Calendar Year

January

S	M	T	W	Th	F	Sa
						1
2	3	4	5	6	7	8
9	10	11	12	13	14	15
16	17	18	19	20	21	22
23	24	25	26	27	28	29
30	31					

February

S	M	T	W	Th	F	Sa
		1	2	3	4	5
6	7	8	9	10	11	12
13	14	15	16	17	18	19
20	21	22	23	24	25	26
27	28					

March

S	M	T	W	Th	F	Sa
		1	2	3	4	5
6	7	8	9	10	11	12
13	14	15	16	17	18	19
20	21	22	23	24	25	26
27	28	29	30	31		

April

S	M	T	W	Th	F	Sa
					1	2
3	4	5	6	7	8	9
10	11	12	13	14	15	16
17	18	19	20	21	22	23
24	25	26	27	28	29	30

May

S	M	T	W	Th	F	Sa
1	2	3	4	5	6	7
8	9	10	11	12	13	14
15	16	17	18	19	20	21
22	23	24	25	26	27	28
29	30	31				

June

S	M	T	W	Th	F	Sa
			1	2	3	4
5	6	7	8	9	10	11
12	13	14	15	16	17	18
19	20	21	22	23	24	25
26	27	28	29	30		

July

S	M	T	W	Th	F	Sa
					1	2
3	4	5	6	7	8	9
10	11	12	13	14	15	16
17	18	19	20	21	22	23
24	25	26	27	28	29	30
31						

August

S	M	T	W	Th	F	Sa
		1	2	3	4	5
6	7	8	9	10	11	12
13	14	15	16	17	18	19
20	21	22	23	24	25	26
27	28	29	30	31		

September

S	M	T	W	Th	F	Sa
					1	2
3	4	5	6	7	8	9
10	11	12	13	14	15	16
17	18	19	20	21	22	23
24	25	26	27	28	29	30

October

S	M	T	W	Th	F	Sa
						1
2	3	4	5	6	7	8
9	10	11	12	13	14	15
16	17	18	19	20	21	22
23	24	25	26	27	28	29
30	31					

November

S	M	T	W	Th	F	Sa
		1	2	3	4	5
6	7	8	9	10	11	12
13	14	15	16	17	18	19
20	21	22	23	24	25	26
27	28	29	30			

December

S	M	T	W	Th	F	Sa
					1	2
3	4	5	6	7	8	9
10	11	12	13	14	15	16
17	18	19	20	21	22	23
24	25	26	27	28	29	30
31						

January 1. Beginning of the Earth: *approx. 4.5 billion years ago* (red)

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Earth Day Network

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www.earthday.org/education • education@earthday.org

How to Make Fossils²⁷

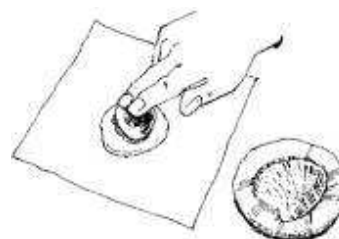
Warnings:

Be careful when mixing the materials.
Do **NOT** eat or drink any of the materials.
If you need any help, let an adult know.



Materials:

2 cups flour
1 cup salt
1 tablespoon vegetable oil
1 teaspoon alum
½ - 1 cup water
4" X 4" square of wax paper for each student
Shells, acorns, plastic bugs, or other materials to make imprints



Instructions:

Making the Dough (makes 25-30 one-inch balls)

1. The teacher will combine the flour, salt, vegetable oil, and alum, adding a small amount of water at a time until the mixture is the consistency of bread dough. Students may then take turns kneading the mixture until smooth.
2. The teacher will then split up the “dough” among the class. When you receive your piece of dough, shape it into a ball one-inch in diameter.

Making the Fossil

1. Place your square of wax paper on the table.
2. On the wax paper, press the dough ball into a disc. The disk should be about the size of a half-dollar.
3. Then select a piece of material (shell, acorn, bug, etc.) to make an imprint.
4. Press the selected material into the dough. Remove the material, leaving an imprint. Set aside to dry.

²⁷ Adopted from: “Create A Fossil.” *Mammoth Cave National Park*, Michigan State Government.
http://www.michigan.gov/documents/deq/p06create_304664_7.pdf.

Fossil Creators!

Draw a picture of your **fossil** in the area below.



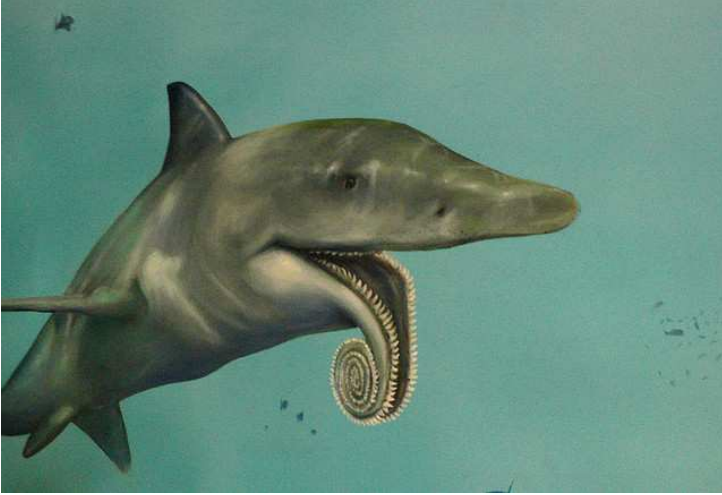
Describe what your fossil is created from (example: a plant, an ancient bug, a sea creature).

Draw a picture of what your creature or plant might have looked like if it was still alive.

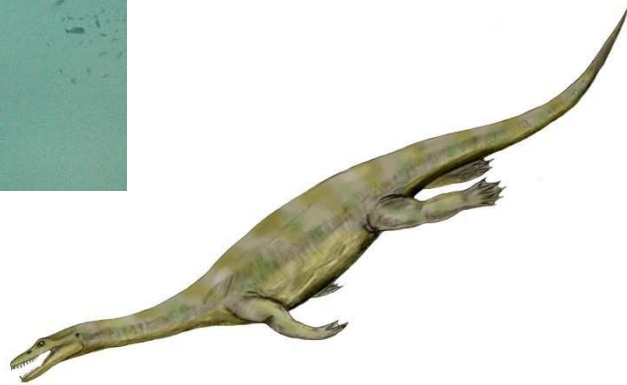


IT'S ALIVE!

HELICOPRION²⁸



NOTHOSAURUS²⁹



HORSESHOE CRAB³⁰



²⁸ Asher, S.C. "Helicoprion" *Las Vegas Natural History Museum*. <http://paleobiology.si.edu/helicoprion/index.html>.

²⁹ Nothosaurus, 2007. retrieved March 1, 2011 from http://en.wikipedia.org/wiki/File:Nothosaurus_BW.jpg.







³⁰ "Horseshoe Crab." Retrieved March 1, 2011 from http://commons.wikimedia.org/wiki/File:Horseshoe_Crab.jpg.

COELACANTH³¹



³¹ Lacz, Gerard. "Coelacanth." *Animals Animals—Earth Scenes* National Geographic. Retrieved March 1, 2011 from <http://animals.nationalgeographic.com/animals/fish/coelacanth>.

PREHISTORIC ANIMALS ALIVE TODAY

Turtles ³²	Sharks ³³	Sturgeon ³⁴
		
Lamprey ³⁵	Bowfin ³⁶	Hagfish ³⁷
		

³² Zander, Jonathan. *Florida Box Turtle*, 2008. Retrieved February 13, 2011 from http://upload.wikimedia.org/wikipedia/commons/f/f4/Florida_Box_Turtle_Digon3_re-edited.jpg.

³³ *Tiburón*, 2004. Retrieved February 13, 2011 from <http://upload.wikimedia.org/wikipedia/commons/b/bb/Tibur%C3%B3n.jpg>.

³⁴ Raver, Duane. "Acipenser oxyrhynchus." *National Conservation Training Center-Publications and Training Materials*. Fish and Wildlife Service. Retrieved February 14, 2011 from http://commons.wikimedia.org/wiki/File:Acipenser_oxyrhynchus.jpg.

³⁵ *Petromyzon marinus (Lamprey) mouth*, 2007. Retrieved February 12, 2011 from http://commons.wikimedia.org/wiki/File:Petromyzon_marinus.002_-_Aquarium_Finisterrae.JPG.

³⁶ Raver, Duane. Bowfin (*Amia calva*). *National Conservation Training Center-Publications and Training Materials*. Fish and Wildlife Service. Retrieved February 14, 2011 from http://commons.wikimedia.org/wiki/File:Amia_calva1.jpg.

³⁷ "Pacific Hagfish." US National Oceanic and Atmospheric Administration. Retrieved February 16, 2011 from http://upload.wikimedia.org/wikipedia/commons/1/12/Pacific_hagfish_Myxine.jpg.