

- fossils
- trilobites
- fish
- insects
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- reptiles
- dinosaurs
- birds
- mammals
- oceans and ocean life
- continents
- supercontinents (Pangaea, Laurasia, Gondwanaland)
- mountains
- oxygen and carbon dioxide

Resources

The BBC's Science and Nature website contains an appealing summary of prehistoric life that students and teachers can explore together:
http://www.bbc.co.uk/sn/prehistoric_life/



THE SECOND GREAT LESSON: LIFE COMES TO EARTH

When the earth first formed, along with other planets and stars in our solar system, it was a hot glowing ball of gases. Over millions of years, the ball of gases slowly cooled, and different layers of the earth formed. As gas cools, it can turn to liquid. Long ago, earth was covered in liquid, red-hot rock called molten rock. Meteorites were crashing into the earth. Volcanoes were spewing gases and red-hot lava. The earth's sky had so many gases in it that the sky may not have looked blue, as it does today, but reddish, like the color of a sunset.

In those days, the earth was still too hot for any plants or animals. But over even more millions of years, as the earth's surface slowly cooled, a solid crust began to form over the liquid material. As the crust continued to cool, it wrinkled and cracked. Water below the earth's crust escaped through the cracks. Water vapor formed above the earth and the first clouds

appeared. When the clouds first began to drop rain, the earth was still so hot that the raindrops quickly evaporated. But eventually the earth cooled enough that the rain stayed on the surface of the earth. At one time, long ago, the earth was covered by a giant ocean.

The water that remained on the surface of the earth mixed with rock particles from the earth's surface. Some scientists think that these particles made this first ocean a greenish color, like the color of green olives.

In those early days, this giant ocean covered much of the earth's land. The land that was not covered by ocean was all rock. Some scientists think that the rocky land may have been a reddish color, like bricks or rust. The earth's land at that time would have looked strange to people now because there were no trees, grasses, or flowers growing on it. Imagine the world with no plants!

Another reason the earth's land at that time would have looked strange is that there were no animals living on it. No frogs, dogs, spiders, snakes, elephants, or people. And because there were no people, there were no buildings or cars or any other inventions of people. Imagine the world with no people or animals of any kind! In fact, in the early days of the earth, there was no life on the land at all. Earth's land in those days was a very rocky, very red, very strange place indeed.

But deep in the earth's giant ocean, something different and marvelous was happening. Somehow — and even today's cleverest scientists don't know exactly how — one tiny bit of matter came to life. This

tiny bit of living matter was many, many, times smaller than a speck of dust or a grain of sand. This tiny bit of living matter was so tiny that it was invisible. In fact, to see this tiny bit of living matter, someone would need to look through a powerful microscope —but of course, there were no microscopes or people to look through them in these early days of the earth!

The tiny bit of living matter in the ocean was the earth's very first life. It was a very small and simple kind of life, because it had no legs or eyes or mouth. It had no leaves or stem or trunk. It was more like a little blob. But it was alive. Nowadays, there are millions and millions of these tiny life forms on earth, and they are called **bacteria**. The earth's first bacteria was special because it miraculously found a way to live and multiply in the ocean, even though that first ocean was filled with many minerals and gases that would poison the life forms of today.

Demonstration 1: Bacteria



Show a picture of bacteria. Emphasize that real bacteria are millions of times smaller than the picture.

For millions of years, there was only this one simple kind of life on earth — bacteria. After a very long time, one particular group of blue-green bacteria called **blue-green algae** began to live in the shallow parts of the ocean, where the light from the sun warmed the water quickly. In these warm, shallow waters, the blue-green algae found a way to make a simple type of food for itself. The blue-green algae made this simple kind of food by taking in three things that surrounded it. Those three things were: energy from sunlight, water from the ocean, and **carbon dioxide**, a kind of gas that was plentiful in the air. Nowadays, this process of making nourishment from sunlight, water, and carbon dioxide is called **photosynthesis**, and plants do it all the time.

As the blue-green algae produced food, it also began to create a new gas. Some of this new gas went right back into the ocean, but some of this new gas also went into the sky as it evaporated from the oceans. This gas became the start of what is now called the earth's **atmosphere**, the blanket of air surrounding the surface of the earth. This new gas was very special and important because it was the gas that all of earth's future animals would need to breathe. This gas is called **oxygen**.

Demonstration 2: Breathing oxygen



Show students how to place their hands on their own bellies and chests to feel breath (oxygen) coming into their bodies.

At this time, all of earth's life was in the ocean. After bacteria developed, many other kinds of sea plants and sea creatures gradually appeared, such as seaweeds, sponges, sea lilies, jellyfish, worms, and more. These plants and animals were the only life in the ocean for a very long time.

Demonstration 3: Early ocean life



Show students pictures, models, or specimens (if possible) of two kinds of ocean life, such as sponge, seaweed, worm, or jellyfish.

Then, one day, a new and fascinating creature appeared in the ocean. This creature was unlike any life that had come before. It had a head, a body, a tail, legs, and a hard shell on its back. It did not have bones. Instead, it had a hard outer shell, like a suit of armor. This type of shell is called an **exoskeleton**, meaning that the hardest part of the creature's body was on the outside instead of the inside.

This new and fascinating creature grew plentiful and soon there were thousands of different types. Some had eyes and swam around. Some had no eyes and simply crawled around on the ocean floor. Some were only as big as the head of a pin. Some were as big as a kitchen sink. If the creature was in danger, it rolled up into a little ball.



This new and fascinating creature was an animal called a **trilobite**, and it was different from anything else on earth. Because of that, the trilobite has become famous! So famous, that the time when they existed is nowadays called the **Age of Trilobites**.



Demonstration 4: Trilobite



Show students a picture or photograph of a trilobite.

Trilobites lived in earth's ocean for a very long time. Then, gradually, they all died, for reasons that nobody today really understands. Scientists say that when every single member of a certain type of animal dies, it is **extinct**. The trilobites became extinct.

But, if trilobites are extinct, how is it that people today know about them? Because trilobites left signs that they existed. When they died, trilobites' bodies became covered with layers of sand and rock. Over time, these layers of sand and rock became so heavy that the trilobites' body shapes were stamped or printed into the rock — the way your thumbprint might get stamped into a lump of modeling dough if you pressed very hard.

The shapes of plants or animals that are imprinted into very old rocks are called **fossils**. Over the years, people have enjoyed finding and studying fossils because fossils show what plants and animals from the past looked like. Also,

scientists can tell many things about the earth's past by studying fossils.

Demonstration 5: Fossil



Make a rock shape with the dough, creating a smooth surface on the top side by flattening it against a table top. Demonstrate the object chosen for the demonstration (e.g., fresh leaf, model of an insect). Invite a student to press the object firmly into the dough. Explain that pressing the object into the dough is like the layers of earth pressing on a trilobite. Carefully pull the object out of the dough. Invite the students to look at where the object was pressed into the dough and observe the impression the object left.

For a long time, in earth's ocean there were more trilobites than any other kind of life. But then a brand-new kind of ocean animal arrived. This animal had a long body, but no legs. Its skin was hard and scaly. It swam around the ocean easily because it had little flaps that helped it to steer and turn and stop. Now these flaps are called **fins**. This animal could breathe underwater through another set of flaps, called **gills**. This animal was the earth's first **fish**. Fish became very

plentiful — so plentiful that people call that time the **Age of Fishes**. Fish still exist in earth's oceans, lakes, and rivers, and some fish today still look similar to ancient fish.

Demonstration 6: Fish



Show students a picture, model, or specimen of a fish. Ask the students to identify the fish's body parts (fins, scales, eyes, gills).

Earth's first fish were special because they were the first animals to have their bones, their hardest parts, *inside* their bodies. The collection of bones inside an animal is called a **skeleton**. A skeleton is a sort of frame that an animal is built upon — the way a house is built upon a frame.

There is another reason that the earth's ancient fish were special. Fish were the first animals to have a long bone along their backs. Nowadays, this is called a backbone, and all animals with backbones are called **vertebrates**.

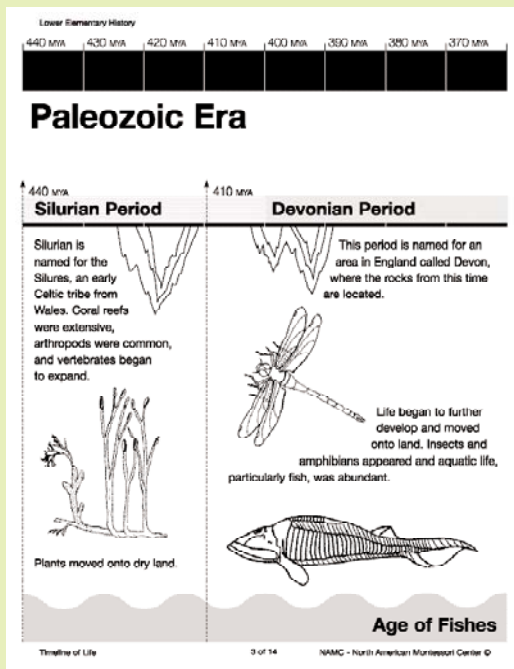
Demonstration 7: Vertebrates



Ask the students to pair up. One student will place his/her hands on another's back, locating and feeling the backbone. Then the students will change places.

While the earth's first ocean filled with more and more fish, something new and exciting was happening on the land of the earth. Some of the algae that lived in the shallow parts of the ocean begin to grow on the land. Perhaps the water level in one part of the ocean went down and left some algae in moist sand. These algae attached themselves to the moist sand, and in time, turned into plants that could live outside the water. On land, these plants gathered nourishment from sunlight and moisture from the sand. These plants were the very first life on the earth's land!

Demonstration 8: First life on land — plants



Show students the picture of the first life on land — plants.

Many kinds of plants with different shapes and sizes began to develop on earth. Today, there are still tiny plants that we can hardly see, and enormous plants, like trees. After plants started to develop on earth, a very busy and exciting time started. New life sprang up everywhere on earth. Another new type of life appeared on the land. This time, it wasn't a plant, but an animal. This animal was very small, and it laid eggs. It had an exoskeleton (like the trilobites had), a head, a middle part called a **thorax**, a rear part called an **abdomen**, and three pairs of legs. On its head, it had big bulgy eyes, and two small thread-like parts that stuck out. The animal used these two small thread-like parts to sense things. These small thread-like parts are called **antennae**.

This animal had no backbone, and all animals that have no backbone are now called **invertebrates**.

Many, many varieties of this animal appeared. Some crept and some crawled. Others had two pairs of wings, allowing them to fly in the air. These were the first animals on earth to fly! These amazing animals, which appeared on earth just after land plants, are called **insects**. Today there are more insects in the world than any other kind of animal.

Demonstration 9: Insect



Show students pictures, models, or specimens (if possible) of two insects. Invite the students to identify one insect's body parts (head, eyes, exoskeleton, thorax, abdomen, antennae, legs).

Around the time that insects appeared, another type of land animal developed — a very odd animal. In those days, there was a certain fish that had huge fins. Over a very long time, the huge fins turned into short legs. One day, some of the fish used their short legs to move from the ocean onto the land. On land, these fish with legs found delicious food to eat — insects! From

then on, these fish with legs had a double life. Sometimes they lived in the ocean, like fish, and sometimes they lived on land, like animals. Nowadays, this combination of land and water animal is called an **amphibian**.

Over a long time, many kinds and sizes of amphibians developed. Some were as big as someone six years old! Amphibians had smooth, moist skin, and through this skin they breathed and took in water. They could also breathe through gills when they were underwater. Amphibians were special because they were the first vertebrates, or animals with backbones, to live on the land. Today, there are many amphibians, such as frogs, toads, and salamanders.

Demonstration 10: Amphibian



Show students a picture or model of an amphibian (frog, toad, or salamander). Invite the students to identify the amphibian's body parts (head, body, legs, gills, skin, backbone).

At the time that insects and amphibians appeared on earth, other events were also happening. For example, now the land had broken into two giant pieces called **continents**. These continents slowly drifted

along in the giant ocean. Then, one day — crash! — the continents bumped into one another. They bumped with such a great force that they got stuck together and formed one supercontinent called **Pangaea**. Where the two continents stuck together, the land crumpled up and created a long row of mountains called a **mountain range**. This first mountain range still exists in today's world and is located in Russia.

Also in those days, many kinds of plants were growing on earth's land, especially a certain kind of green, leafy plant called a **fern**. Huge ferns grew in moist, shady areas nowadays called **swamps**. Each fern made special kinds of seeds called **spores**, and each spore could grow into another fern. Ferns became so plentiful that enormous fern forests sprang up all over the land. Today, ferns still grow in forests and gardens and in peoples' homes as houseplants.

Demonstration 11: Fern



Show students a potted fern and photo of a fern fossil.

Fern forests were very important to the earth. When a fern forest got old, it died, and then another fern forest grew up over

top of the old one. Over time, layers and layers of dead ferns created layers and layers of rich material for new plants to grow in. This rich material is called **soil**. Without soil made by the ferns and other dying plants, the earth's surface would just be bare rock.

Over a long, long time, as more and more layers of dead ferns piled up, the ferns in the bottom layers became so packed together that they turned into a type of black rock. This black rock, called **coal**, is something many people today burn for heat and energy.

Around the time that ferns started growing, another splendid new creature appeared on the earth's land. This animal was an amphibian that had gradually stopped living in the ocean. Maybe this creature liked being dry more than it liked being wet! Over time, the creature lost its gills and could no longer breathe underwater. This creature was a vertebrate and it laid eggs. It developed a dry, rough, thick skin, and it liked to lie around in the sun, getting warm. This creature is nowadays called a **reptile**.



Demonstration 12: Reptile



Show students pictures and models of two reptiles. Include a specimen (e.g., a tortoise) if possible. Ask the students to identify the reptile's body parts (skin, head, nostrils, eyes, neck, body, legs, tail).

Reptiles thrived on earth, and soon there were very many different kinds. There were so many reptiles that nowadays, that time is known as **The Age of Reptiles**. Then, a very strange thing happened. Some reptiles began to grow and grow and grow, until they became gigantic. Some grew as tall as a five-story building and as long as three buses put together! These gigantic reptiles were so heavy that the ground must have shook when they walked or ran. They had long, powerful tails, which helped them to balance. If attacked by other animals, these gigantic reptiles also used these tails as weapons. These gigantic reptiles had long necks, which helped them reach way, way up to eat the leaves at the tops of trees. These gigantic reptiles are called **dinosaurs**.

Some dinosaurs walked on four legs, some on two legs, and some even had wings and flew in the air. Some ate plants, and others ate amphibians and smaller reptiles. Hundreds of different types of dinosaurs developed. Dinosaur bones, skeletons, teeth, and fossils have been found buried in the earth's rocks all over the world and can be seen today in museums.

Demonstration 13: Dinosaur



Show students a picture or model of a dinosaur.

Dinosaurs ruled the land of the earth for millions of years. But then — they disappeared, never to be seen again. Scientists nowadays have different ideas about what made dinosaurs extinct. Many scientists believe that a giant meteorite, a rock from outer space, fell onto the earth. The enormous crash of the meteorite would have created a large amount of dust in the earth's atmosphere. The dust would have changed the earth's weather by blocking the light from the sun.

When sunlight couldn't reach the earth's plants, many of them died. Then many of the animals that depended on plants died, because there were no plants for them to eat. Then many of the animals that depended on eating those animals died,

because there were no animals to eat. Some scientists believe that only the animals that ate rotting plants survived this time when so many animals and plants became extinct.

Even though so many animals and plants died, life continued on the earth. Some animals and plants survived, and some new ones developed. One kind of new plant that started to grow was a tree that had needle-shaped leaves and produced seed-filled cones. Nowadays these kinds of trees are called **conifers**. Conifers still exist all over the world today. Some examples are pine, fir, cedar, and spruce trees. In some parts of the world today, people decorate conifers with lights for special celebrations.

Demonstration 14: Conifer



Show students a small, potted conifer as well as a few branches and cones (intact and dissected) from different conifers. Crush a conifer leaf and invite the students to smell it.

Another new and very beautiful kind of plant that began to appear on earth had colorful blossoms called **flowers**. These flowers attracted insects, especially glorious new winged insects called **butterflies**. The butterflies and other insects carried **pollen**, the powder produced by flowers, from one flower to another. Sometimes the wind blew the pollen from one flower to another.

Plants that received pollen from other plants could make a new plant. Soon, there were many, many kinds of flowering plants. Nowadays, flowering plants are the most plentiful plants on earth. Flowering plants make the world more beautiful, and many produce food, such as fruits and nuts.

Demonstration 15: Flowering plant



Show students a potted, flowering plant.

One new kind of animal that appeared after the dinosaurs died was a flying animal. There were already many flying insects on the earth. But this animal was much, much bigger than an insect. In fact, some varieties of this animal were as big as a schoolteacher! This new animal had wings,

feathers, and a funny mouth that was long, hard, and pointy. It was a vertebrate, and it laid eggs. These new animals were the earth's first **birds**, animals that are covered in feathers and have wings. Nowadays, many scientists believe that these first birds developed from large, flying reptiles.

Demonstration 16: Bird



Show students a picture or model of a primitive bird.

Another new kind of animal appeared after the dinosaurs died. This type of animal was a vertebrate, and it had a larger brain than other animals. It had a hairy coat that helped keep it warm. It could make milk in its own body, which it then fed to its babies. Many varieties of this type of animal developed. Some were as small as a finger, and others as large as a house. Most had four legs and lived on the land, but a few went to live in the ocean, and one even grew wings and flew like a bird! Some ate plants, and others ate animals. This type of animal is called a **mammal**.

Mice, rhinoceroses, elephants, horses, kangaroos, cats, bats, dogs, whales, camels, and monkeys are all mammals. Mammals thrived on earth and soon became very plentiful — so plentiful, that this time in earth’s story is known as **The Age of Mammals**.

Demonstration 17: Mammal

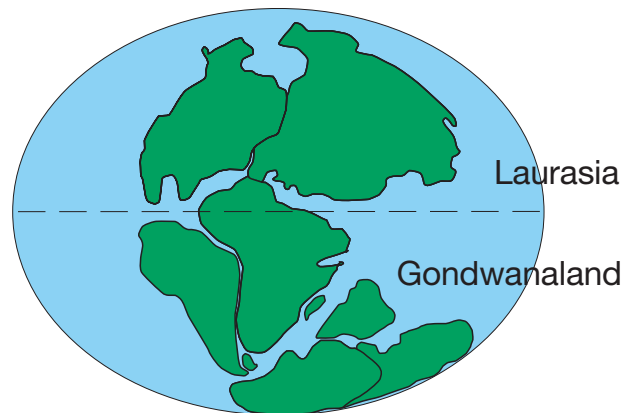


Show students pictures or models of a primitive and a modern mammal.

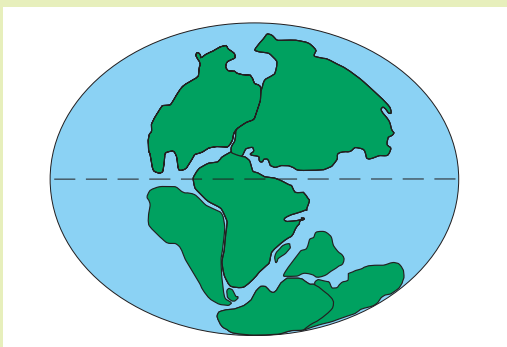
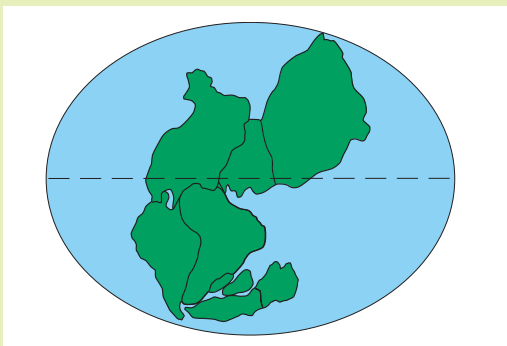
By this time, earth’s supercontinent, **Pangaea**, had broken apart. It had split into two huge pieces of land that floated away on the earth’s ocean. These two huge pieces of land, called landmasses, made two new, smaller supercontinents that are

now called **Laurasia** and **Gondwanaland**. Gradually, these two supercontinents also began to break apart and drift on the earth’s ocean. Slowly, over millions of years, these supercontinents formed seven new continents. These are the continents seen on the earth today.

The plants and animals that had lived on two supercontinents got separated when the supercontinents broke into seven smaller continents. Some scientists believe that this separating might be one of the reasons that nowadays, certain animals and plants are only found on certain continents.



Demonstration 18: Earth's changing continents



Show students three maps, the first showing Pangaea, the second showing Laurasia and Gondwanaland, and the third showing present-day continents (from NAMC History blacklines). Describe the shifting landmasses called continents, and explain how today's continents were formed from Pangaea. Point out how the continents' shapes seem to fit together like a jigsaw puzzle.

The earth was now rich with life. Plants of all shapes, colors, and sizes lived on land and in the water. Fishes, dolphins, and other sea creatures swam the earth's oceans. Amphibians such as frogs and salamanders lived partly in the water and partly on the land. Insects such as cockroaches crept on the land. Other insects such as butterflies flew in the air. Reptiles such as turtles and snakes crawled and slithered over the land. Birds such as seagulls and songbirds flew through the skies. Mammals such as apes and enormous creatures called **wooly mammoths**, which looked a bit like today's elephants, roamed the land.



Before life started on earth, earth was a red-hot rocky planet with an olive-green ocean. After life came to earth, the earth's ocean began to change color. Rains upon rains upon rains changed the color of the ocean from green to blue. As oxygen increased in the earth's atmosphere, the sky became blue too. The land of the earth also began to change. It cooled and was covered in rich soil, green plants, colorful flowers and fruits, and many, many kinds of animals.



The animals of the earth and the plants of the earth lived together in harmony, each in some way helping the other to thrive. Insects helped plants multiply by carrying pollen all over the land. Plants released oxygen into the earth's atmosphere, so that animals could live. Animals breathed carbon dioxide into the earth's atmosphere so that plants could live. Dead and rotting plants provided rich soil so that new plants could grow, which were then eaten by the animals on earth. Some animals became food for other animals.

There were many changes in the earth's weather over millions of years. Every time the weather changed, many animals and plants died because it was too hot, too cold, too wet, or too dry for them, and they could not change fast enough to thrive. But many plants and animals survived the earth's changes. And one more animal, a special mammal, had not yet appeared on



earth. This mammal would walk on two legs, and it would be very, very clever, and it would invent many, many things. This type of mammal is now called a human, and groups of humans are called people. How humans came to the earth is a whole other story.

