South Florida Science Museum
Jurassic Theater Program Curriculum

PROGRAM DESCRIPTION

SUNSHINE STATE STANDARDS

SC.K.L.14.3: Observe plants and animals, describe how they are alike and how they are different in the way they look and in the things they do.
SC.1.L.14.1: Make observations of living things and their environment using the five senses.
SC.1.L.14.3: Differentiate between living and nonliving things.
SC.1.L.17.1: Through observation, recognize that all plants and animals, including humans, need the basic necessities of air, water, food, and space.
SC.2.E.6.2: Describe how small pieces of rock and dead plant and animal parts can be the basis of soil and explain the process by which soil is formed.
SC.2.L.17.1: Compare and contrast the basic needs that all living things, including humans, have for survival.
SC.2.L.17.2: Recognize and explain that living things are found all over Earth, but each is only able to live in habitats that meet its basic needs
SC.3.L.15.1: Classify animals into major groups (mammals, birds, reptiles, amphibians, fish, arthropods, vertebrates and invertebrates, those having live births and those which lay eggs) according to their physical characteristics and behaviors.
SC.3.L.17.1: Describe how animals and plants respond to changing seasons.
SC.4.E.6.4: Describe the basic differences between physical weathering (breaking down of rock by wind, water, ice, temperature change, and plants) and erosion (movement of rock by gravity, wind, water, and ice).
SC.4.L.16.2: Explain that although characteristics of plants and animals are inherited, some characteristics can be affected by the environment.
SC.4.L.17.4: Recognize ways plants and animals, including humans, can impact the environment.
SC.5.L.15.1: Describe how, when the environment changes, differences between individuals allow some plants and animals to survive and reproduce while others die or move to new locations.
SC.5.L.17.1: Compare and contrast adaptations displayed by animals and plants that enable them to survive in different environments such as life cycles variations, animal behaviors and physical characteristics.
SC.6.E.6.1: Describe and give examples of ways in which Earth's surface is built up and torn down by physical and chemical weathering, erosion, and deposition.
SC.6.L.15.1: Analyze and describe how and why organisms are classified according to shared characteristics with emphasis on the Linnaean system combined with the concept of Domains.
SC.7.L.15.1: Recognize that fossil evidence is consistent with the scientific theory of evolution that living things evolved from earlier species.
SC.7.L.15.2: Explore the scientific theory of evolution by recognizing and explaining ways in which genetic variation and environmental factors contribute to evolution by natural selection and diversity of organisms.

SC.7.L.15.3: Explore the scientific theory of evolution by relating how the inability of a species to adapt within a changing environment may contribute to the extinction of that species.

MATERIALS
-Jurassic Theater PowerPoint
-Fossils and replicas for demo

VOCABULARY
Ammonite- squid with shells that lived in the oceans during the Mesozoic.
Excavate: to expose or uncover by or as if by digging.
Fossil: a remnant or trace of an organism of a past geologic age, such as a skeleton or leaf imprint, embedded and preserved in the earth's crust.
Fossilized- turned to stone or otherwise preserved.
Impact- to collide with, as in a "meteorite impact"
Petrified- turned into stone
Mass Extinction- When many species of plants and animals go extinct within a relatively short period of time.
Meteorite- A rock from outer space that has hit the Earth
Scavenger- a carnivore that usually eats animals that are already dead rather than hunting and killing its own prey.
Megalodon- a giant, whale-eating shark that is now extinct.
Mastodon- a hairy, Ice-Age elephant similar to woolly mammoths.
Mesozoic- means "middle life" and refers to the timeframe in which dinosaurs lived, approximately 240-65 million years ago.
Paleontologist: scientists who study the forms of life existing in prehistoric or geologic times, as represented by the fossils of plants, animals, and other organisms.
Paleontology: the branch of geology that deals with life forms from the past.
Strata- natural layers in the earth formed by erosion and deposition
Trilobite- a very early marine animal belonging to the arthropod phylum, along with insects, spiders, and crustaceans (shrimp, lobsters, crabs).

SCRIPT FOR SLIDE SHOW

Slide 1 - Introduction to Paleontology & Fossils

A fossil is "a remnant, impression, or trace of an animal or plant of a past geologic age that is left behind in Earth's crust."

- Ask students what they know about fossil to get a feel for what level they are at.
- Explain that, while dinosaur bones are the most famous types of fossils, scientists find fossils from a lot of different things that lived a long time ago, including all kinds of animals (like sharks and Ice-Age animals) and plants. While many fossils are bones, fossils can also be eggs, footprints, teeth, claws, etc.

- Fossils are any evidence left behind by something that lived a long time ago. Paleontologists are like detectives, who look for clues (fossils) to solve mysteries about life a long time ago.

Slide 2 - Paleontologist Dress-Up

- Call a volunteer student up on stage and explain that you are going to dress them up like a paleontologist.
- Tell the audience that you are going to show them one item or tool at a time, and if they know what it is or how paleontologists could use it, then raise their hands quietly.

  Items: Safety goggles, tool belt, shovel/trowel, rock hammer, chisel, paint brush, magnifying glass (remind them that a paleontologist is a detective!), tape measure, notebook (have students come up with what information should be recorded in the notebook. Emphasize the importance of recording information in science), pith helmet.

Explain that you have both real and replica fossils. Make sure the students understand what a replica is and why we use them. Assure them that we promise to tell them what ones are real and what ones are replicas. Pass around the fossils at the appropriate slides.

Slide 3 - Trilobites:

- Among the most abundant life forms in the Paleozoic Oceans

  Lived between 545 and 245 million years ago (way before the dinos!).
- Over 15,000 species of trilobites have been discovered, many varieties, the smallest were under 1mm long, the largest 2-3 ft long.
- Members of the Arthropod phylum, which also includes insects, spiders, and crustaceans (They were basically big "bugs" in the oceans. Point out that shrimp, lobsters, and crabs are basically ocean "bugs" too).
- Among the first animals with highly developed eyes
- Scavengers, feeding on seaweed, algae, and whatever food particles they could find in the mud
- Many species could curl up into a tight ball to protect their soft underside when threatened, like ancient "roly-polies."

- Were preyed upon by giant “Sea Scorpians” that could be 7-10 ft long
- Ask students if theis pictures is a photograph. Of course not! No cameras that long ago, and we can’t go back in time. These pictures are made by the scientists who study the fossils, and try to show us what the animals and their environments might have been like when they were alive. Explain that different scientists are going to come up with different looking pictures.

Slide 4 - Show Trilobite Fossils (replica)

- These are the “evidence” on which pictures like slides 1 and 2 are based on.

Slide 5 - Fossilized Plants

- **Show Fern Fossil (real):** This fossil is around 300 million years old, from the Carboniferous period
- The original fern material is long gone, what remains are imprints that the ferns made when they fell in the mud, and the mud dried up and hardened.
- **Show Petrified Wood (real):** This fossil clearly shows the students that a fossil can look like what it was (a bone or wood) but can have turned completely into stone while it was underground for millions of years. Knock on the wood so that they can hear that it doesn’t sound like “normal” wood.
- Since this fossil is so heavy, before letting them pass it around warn them to <u>never</u> lift it up above their heads to show off how strong they are. Since we emphasize that it is stone and therefore quite heavy, some students have a tendency to “show off” and lift it up high (“look at me, it’s not heavy to <u>me!</u>).

Slide 6 - Ammonites

- Cephalopods, relatives of squid & octopus, had tentacles: “squids with shells.”
- As common as fish in the seas of the “Dinosaur Age.”
- Lived 400 - 65 million years ago– went extinct with dinosaurs
- More than a thousand species have so far been discovered, and new species are being discovered every year.
- Ranged in size from less than half an inch to nine feet in diameter.

- Were fast, active predators that moved by jet propulsion: squirting water through a siphon to create thrust.
- Fed on plankton, sea lilies, and other small animals.
- **Show fossils (real).**

Slide 7 - Dinosaurs!

- Ask students if there are any dinosaurs alive today. The answer is NO! (Usually kids think alligators are dinos, but sometimes there's someone who says birds. If they do, tell them that that's the closest thing to dinos today and we'll talk about birds in a few minutes.
- People often think that a dinosaur is any big reptile, or anything big that is extinct, or even anything that lived a long time ago. Many children (and adults) think that alligators, woolly mammoths, sharks, and even roaches count as dinosaurs.
    - Students should understand that the word "dinosaur" is a scientific word, applicable only to a certain group of animals which meet the following criteria:

To be classified scientifically as a dinosaur, an animal must:

1. Be a reptile (therefore sharks and woolly mammoths are not dinosaurs).
2. Either walk on two legs all the time (like a raptor or T-Rex),

or, in the case of 4 legged dinosaurs, have relatively long, straight legs positioned directly underneath them.

- Ask students if they can think of any reptiles alive today that walk around on two legs all the time. There aren't any. (A few lizards, such as the basilisk, will run on two legs for short distances, but the rest of the time they walk like "normal" lizards.)
- In the case of the four-legged dinosaurs such as the "long-necks" (saurapods) have students compare the long, straight elephant-like legs of dinosaurs to the short, bent, out-to-the-side legs of an alligator, lizard, or turtle. Most reptiles alive today have legs like that. Their bellies touch the ground all the time. There are

no reptiles alive today with legs like a dinosaur. Thus, there are no dinosaurs alive today.

If there's time or if anyone asks:

When did the Dinosaurs live?

- During a time period called the **Mesozoic Era**, which lasted from about 250 mya until 65 mya.
- The Mesozoic consisted of three periods: First, the **Triassic Period**, from 248 to 213 mya, then the **Jurassic Period**, from 213 to 145 mya, and finally the **Cretaceous Period**, from 145 to 65 mya.

Slide 8 - Alligators are not dinosaurs!

- Point out their sprawled legs, bellies & chins on the ground.

Slide 9 - Lizards are not dinosaurs!

- Point out their sprawled legs, bellies & chins on the ground.

Slide 10 - There were Marine Reptiles in the Oceans, but no Dinosaurs

- Hundreds of species of Marine Reptiles populated the Mesozoic oceans. If it had flippers it wasn't a dinosaur!
- Point out that there were many animals in the oceans back then that are similar to those today: (sea turtles, corals, jelly fish, sharks, fish, diving birds).
- The large marine reptile in the foreground is a Mosasaur. They were fast moving predators distantly related to snakes, and reached up to 50 ft long.
- Point out the ammonites swimming away from the Mosasaur. Ask them if now they understand why the ammonites had protective shells!
- In the background there is an Elasmosaur, a type of Plesiosaur. NOT related to "long neck" dinosaurs (Plesiosaurs ate fish, squid). Kids will invariably associate the Elasmosaur with the "Lochness Monster."
- If there's time: Ask them if they think these reptiles could breath underwater. Did they have gills like fish? No, they had lungs like all reptiles, so they had to surface to breathe every few minutes, just like whales do today.

Slide 11 - Archaeopteryx

- 2 interpretations- we don't know what color their feathers were.
- Often considered the "first" birds, about the size of a crow or small chicken.

- Lived roughly 150 million years ago
- Hunted small lizards, tiny mammals, and large insects for food.
- Had a mixture of dinosaur and bird characteristics:

  Dinosaur characteristics: claws on forelimbs (wings), teeth, long bony tail, walked on 2 reptilian legs positioned under the body.

  Bird characteristics: Feathers, wishbone, hollow bones
- Point out that bird feet generally look like little dinosaur feet.
- Scientists are finding many species of dinosaurs and dinosaur-like animals that had feathers.

If there's time or if somebody asks:

It is thought that small theropod (bipedal carnivorous) dinosaurs developed feathers to retain body heat. Many dinosaurs, particularly raptors, are thought to have had some feathers. Only later did some species use the feathers for flying. Archaeopteryx probably could fly, but perhaps not very well. They may have climbed trees with claws and then glided from tree to tree, or down to the ground.

Slide 12 - Show Archaeoptryx Fossil (replica)

- This is a picture of the most famous archaeopteryx fossil, which was found in Germany, and is the basis for the illustrations in the previous slide.
- Hold up the replica and tell them it's the size of the real one, and the entire animal is embedded in the matrix.
- Use a lazar pointer to point out archaeptryx's tail, feet, spine, ribs, arms, fingers, skull. Point out the feather imprints extending from the arms and tail.
- Fossils such as these are excellent evidence that dinosaurs closest living relatives are birds.

Slide 13 - Which Dinosaur is This?

- Pictured are a fossil Allosaurus skull and assembled hind leg- with a man for scale. Explain again that these are the clues that help us to come up with the "pictures" of the animals. Let the students guess which dinosaur they think this one was.

Slide 14 - Allosaurus!

- Largest North American predator during late Jurassic, about 154-144 million years ago
- Had short arms (although not as short as T-rex's) with three-fingered hands. Each hand had a sharp, hooked claw up to 6 inches long.
- Up to 38 ft long, 16.5 ft tall, 3 ft long skull with 2 short brow-horns and bony ridges above eyes.
- Hunted stegosaurus, apatosaurus, and iguanodonts for food

Show Allosaurus sharp, hooked claw (replica)

Slide 15 - Which Dinosaur is This?

Slide 16 - Stegosaurus!

- Lived in North America during the Jurassic, 156-140 million years ago**.**
- 26-30 ft long, 9 ft tall, weighed up to 6800 pounds
- Had a walnut sized brain
- Had toothless beak with small cheek teeth
- 17 bony plates embedded in back– these plates are not placed right to have been used for protection. Rather, they were probably used to regulate body temperature, and also for display: thousands of blood vessels running through them, could have flushed red.
- Walked on 4 legs but may have reared up on hind legs to browse on leaves
- Tail spikes that could be up to 4 ft long. Used for defense against predators like allosaurus.
- **Show tail spike fossil (replica)**

Slide 17 - Dino Defenses

- Triceratops, anchylosaur, and pachycephalosaurus ("thick-headed")- examples of other herbivores that have defenses from carnivores.

Slide 18 - Which Dinosaur is this?

Slide 19 - Tyrannosaurus Rex

- Lived during late Cretaceous, 85-65 million years ago in North America and Asia.
- Very large carnivore. Was believed to be the largest carnivorous dinosaur until relative recent discoveries of spinosaurus, giganotosaurus and carcharodontosaurus, which were slightly larger than T-Rex.

- Up to 40 ft long, 20 ft tall, and weighed up to 14,000 pounds.
- Had 50-60 bone-crunching teeth that could be up to 9 inches long. If it broke or lost a tooth, a new one would grow in its place.
- **Show Tyrannosaurus Rex teeth fossil (real and replica)**

Slide 20 - Which Dinosaur is this?

Slide 21 - Utahraptor

- Large raptor that lived during the mid-Cretaceous, about 125 million years ago, in North and South America
- 16-23 ft long, 8-9 ft tall, weighed about 2,000 pounds
- Like other raptors, had a relatively large brain, may have hunted in packs and attacked much larger animals, was a **l**ightly built, fast runner with large, clawed grasping hands.
- Like all raptors, it kept its middle toe with the longest, sharpest claw– up to 12 inches long- lifted when running, so as to not damage it.
- **Show Utahraptor middle toe claw fossil (replica)**

Slide 22 - Megaraptor

- Largest raptor known. Lived during the late-Cretaceous, about 90-84 million years ago, in South America
- 25-30 ft long, up to 13 ft tall
- **Show Megaraptor middle toe claw fossil (replica) compare to Utahraptor.**

Slide 23 - Elephant Bird- Fossil & Interpretation

- Native to Madagascar, belonging to the ratites (ratites include ostrich, emus, cassowaries, kiwis, rheas, and extinct Moas.
- Went extinct only around 500 years ago.
- Largest bird known to science, could be over 10 ft tall and 1000 lbs.
- Largest eggs known to science: egg volume = 160 chicken eggs.

Show egg fossil (replica)

Slide 24 - Great White Shark

- Can get up to 20 ft long, about 2 inch long teeth.
- There are larger sharks alive today, such as the whale shark and basking shark

that feed on krill. White sharks are the largest predatory sharks alive today.

Slide 25 - Megalodon (Carcharodon megalodon)

- Largest shark that ever existed**,** could be 60-70 ft long
- Lived 16-1.6 million years ago
- Preyed on large whales
- The largest teeth ever found are over 7 inches long
- Could open mouth 6-9 feet wide
- Show Megalodon tooth side-by-side with Great White to compare size (real & replica)

Slide 26 - Mammoth

- Elephant relatives that lived throughout North America, Eurasia, and even North Africa during the Pleistocene, went extinct around 10,000 years ago.
- Similar in size to modern elephants.
- Vegetarian, primarily grazers (grass eaters).
- More closely related to today's Asian than African Elephants
- Many different species, some were "woolly" in colder regions.
- Reasons for extinction unclear, probably a combination of climate change, hunting by humans, and possibly disease.
- **Show Mammoth tooth fossil (real)**

Slide 27 – Smilodon

Smilodon or commonly called Saber-toothed cat lived 2.5 million – 500,000 years ago. Weighed between 120 and 880 lbs depending on species. Had short tails and muscular necks, built more like a bear.

Known for their very long canine teeth.

Not very fast.

Show Saber-toothed canines (replica)

Slide 28 – Extinction of the Dinosaurs

- What do you think caused the extinction of the dinosaurs?
- Scientists believe that our planet was struck by a giant asteroid that hit Earth with a force a billion times more powerful than an atomic bomb.

- This triggered large-scale fires, earthquakes, landslides, tsunamis…
- It also sent blasted material into the atmosphere covering our planet in darkness which caused a global winter and killed-off the many species that couldn't adapt.

Show meteorite to give an example of what an asteroid is (real)

- Meteorites are much, much tinier than asteroids