Overview:

Students will reconstruct a bird or fish skeleton and determine life history and physiological attributes modeling the manner in which paleontologists infer function from structure.

Objectives:

The student will:
- reconstruct a simulated fossil; and
- make predictions regarding the structure and function based on the reconstructed skeleton.

Targeted Alaska Grade Level Expectations:

Science

[4] SC1.2 The student demonstrates an understanding of how science explains changes in life forms over time, including genetics, heredity, the process of natural selection, and biological evolution by describing fossil evidence (e.g., casts, track ways, imprints, etc.) of extinct organisms.

[5] SC1.2 The student demonstrates an understanding of how science explains changes in life forms over time, including genetics, heredity, the process of natural selection, and biological evolution by making reasonable inferences about fossil organisms based on physical evidence.

Vocabulary:

body fossil- fossils of the actual animal or animal part

evolution – change over time; In biology this encompasses small-scale changes of gene frequency in populations from one generation to the next and large scale decent of different species from a common ancestor over many generations

extinction – event when the last member of a lineage or species dies

natural selection – the basic principle that only those living things that are best suited to living in a particular environment live long enough to produce offspring; The individual plants and animals that reproduce themselves pass their genes to their young, giving them a better chance of survival. Natural selection forms the basis of evolution

fossil – a trace or print or the remains of evidence of a living organism

trace fossil – evidence of an organism but were not part of the organism such as sediment disturbance from resting, moving, or feeding; Examples include burrows, root cavities, feces, and impressions of skin or feathers

trackway – set of fossilized footprints useful in determining walking and running speed of the organism that left them

paleontology – the study of life in the geologic past especially through fossils

Whole Picture:

Fossils are the physical remains or impressions of organisms that died thousands or millions of years ago. It is important to remember that most animals that die do not become fossilized and many parts of organisms do not fossil well. The soft tissues that decompose readily are rarely preserved. Instead, bones, teeth, and shells are more often found as fossils. A common form of fossilization is called mineralization in which minerals replace the organic material of the organism leaving behind stone in the shape of the organism. Some forms of fossilization preserve tissue well enough for DNA to be extracted. Some dinosaur fossils found in Alaska have a relatively high percentage of non-mineralized tissue, which allows scientists to further investigate living relatives of extinct organisms.

Fossils can be separated into two major categories; body and trace fossils.

FOSSILS

INSTRUCTIONS

Body fossils form when an organism dies and the body or parts of the body are preserved. Trace fossils are evidence of an organism activity but were not part of the organism. Examples include burrows of marine worms or the footprint impressions left behind when an animal walked across a muddy flood plain.

NOTE: It might be useful to explain that very well preserved fossils were likely the result of animals or plants being trapped in mud or tar pits rather than being exposed on the surface where the decay is much more rapid.

Chronological distribution of fossils can be explained by history of common decent (common ancestry). Within sedimentary rock strata, fossils found in layers provide information about the time of their origin called relative dating. Sedimentary strata are deposited on top of one another and can read as sequence with oldest rock and fossils at the bottom and progressively younger layers above. Fossils of similar animals are often found in layers above each other with small changes over time. Extinct relatives of living species can often be inferred by morphological (form and structure) evidence along with relative and/or absolute dating and sometimes directly compared by DNA analysis. For example, scientists have found strong and compelling evidence that birds are descended from dinosaurs based on morphological similarities.

Materials:

- Paint brushes or old toothbrushes various sizes (1 per student)
- Spoon or other digging implement (1 per student)
- Full or partial ptarmigan or other small animal skeleton, boiled to remove flesh (2)
- Full or partial fish or other small animal skeleton, boiled to remove flesh (2)
- Shallow cardboard box or plastic sweater box (4)
- Sand (enough to cover skeleton)
- Clear tape or masking tape (1 roll per group)
- Newspapers
- Bucket for waste sand
- Paper clips, shells or other material to add to the simulated fossil dig
- Photos of living animals used for simulated fossil dig
- Science journal
- Computer with Internet access
- TEACHER INFORMATION SHEET: "Alaskan Dinosaurs"
- VISUAL AID: "Dinosaur Fossil"
- STUDENT WORKSHEET: "Fossil Dig and Reconstruction"

Activity Preparation (day before):

1. Boil and remove the flesh from two ptarmigan and two fish (full or partial skeletons). You may want to ask parents of your students to supply the bird and fish skeletons. If local animals are not available use commercially available whole or partial chicken.
2. Air-dry the fleshed skeletons and partially disassemble each skeleton.

Activity Preparation (same day):

1. Place each partially disassembled skeleton into a shallow cardboard or plastic box and cover with sand. Add material to the sand such as paperclips or shells to simulate a fossil dig.
2. Number fossil boxes 1-4.
3. Lay out newspapers under fossil boxes to aid in cleanup.
4. Students who finish early may explore the American Museum of Natural History dinosaur fossils exhibits. Load the following site on to a computer: http://www.amnh.org/exhibitions/permanent/fossilhalls/virtualtours/

NOTE: Group should be made up of 4-6 students. If a class has less than 8 students only prepare and assemble two fossil boxes.

Activity Procedure

Critical Thinking Activity. ***Quick write.*** Ask students why scientists study fossils? For the first minute they should write down every idea they can think of in their science journals. In the last two minutes of the activity, have students take their brainstorm ideas and answer the question in two complete sentences. Have students share their ideas with their shoulder partner. Review student ideas as a class.

1. Show the students a fossil or the VISUAL AID: "Dinosaur Fossil" and ask the students what they know about fossils. Explain what a fossil is and how they are formed. Describe the two major types of fossils; body fossils and trace fossils. Give examples of both types. Use examples of real fossils or use photograph provided by the VISUAL AID: "Dinosaur Fossil."
2. Explain paleontologists are able to make connections between extinct species and living species based on certain physical similarities (homologous and analogous structures are likely too advanced for this age groups but could be addressed and investigated for an older class.) For example, paleontologists don't have living dinosaurs to help them reconstruct their fossil skeletons, but based on common decent they have a very good understanding of how certain fundamental anatomical and physiological functions operate. Additionally, paleontologists have living relatives of the extinct species to help them reconstruct their skeletons.
3. Describe the relationship between extinct dinosaurs and living birds.
4. Announce to the students they will be paleontologists and they will be conducting a dig to uncover and reconstruct a mystery animal.
5. Review the procedure for uncovering fossils; students will be working in groups to uncover a simulated fossil using tools such as spoons and, paintbrushes. Explain students need to work carefully so as not disturb the fossil placement as it may help them in reconstruction.
6. Break students in to groups of 4-6 and assign groups to one of the four fossil boxes.
7. After students have uncovered their skeletons have them make a brief sketch on their data sheet of bone placement. Allow enough time for students to assemble their skeleton.

NOTE: Student groups will likely assemble their skeletons differently. At the end of the lesson use these differences to illustrate the difficulty early paleontologists had in reconstructing animals they had never seen.

8. Student groups should share their results with the class. Groups that assembled the same organism should compare and contrast their results.
9. Display images of the animals to show living examples of the assembled skeletons.
10. Review the fossilization process and how scientists learn about living organisms by studying their extinct relatives.

Extension Ideas:

Create a grid system for the fossil boxes and investigate each section thoroughly and document findings. After all grid sections have been excavated commence with reconstruction.

The Alaska Museum of the North has dinosaur facts and activities.
http://www.alaskamuseum.org/education/dinosaurs/index.html

Bureau of Land Management has information regarding dinosaurs in Alaska.
http://www.blm.gov/ak/st/en/prog/culture/paleontology/dinosaurs.html

Have students send earth science questions to "Ask-A-Geologist" at the United States Geological Survey (USGS) website (http://walrus.wr.usgs.gov/ask-a-geologist/).

References:

"*A Lesson Plan on Fossilization; How Are Fossils Formed?*." Everything Fossils...Fossil Information for Education, Collecting and Fun!. N.p., n.d. Web. 25 May 2011. <http://www.fossils-facts-and-finds.com/fossilization.html>.

"*Alaskan Dinosaurs.*" Fossils in Alaska. Alaska Public Lands Information Centers. Retrieved on 24 May 2011. <http://www.alaskacenters.gov/alaskan-dinosaurs.cfm>.

Padian, K. 2009. *Review of Feathered Dinosaurs: The Origin of Birds*, by John Long and Peter Schouten. Wilson Journal of Ornithology 121:657-658.

Alaskan Dinosaurs

Excerpt from Alaskan Dinosaurs by Alaska Public Lands Information Centers.
Find the full text of the article at http://www.alaskacenters.gov/alaskan-dinosaurs.cfm

DINOSAUR MIGRATIONS FROM THE NORTH SLOPE

The first Alaskan North Slope dinosaur was discovered in the mid-1980s. The "duck-billed" Edmontosaurus is thought to have lived in groups or even herds. The question of how they survived so far north immediately raised two logical possibilities: either they stayed in the north and perhaps lived by slowing their metabolism (maybe even hibernating), or they migrated southward to warmer climates.

Discoveries at the Colville River dinosaur site in the later 1980's and early 1990's have thrown doubt on the migration theory. Several of the newer dinosaur types were not larger "herd"-type animals and probably could not have physically migrated a round-trip distance estimated to be more than 5,000 miles. Indeed, this distance would have been greater than today's "migration champion" caribou which migrate less than half this distance within a 250-mile-wide area. No land mammals migrate out of the Arctic today, so to think that dinosaurs did it is a real stretch of the imagination.

THE EXTINCTION OF THE DINOSAURS

Still another mystery about the dinosaurs concerns their extinction. If they died off due to a meteorite or comet smacking the earth and throwing up dust to block out the sun, then why did certain other reptiles, including crocodiles and snakes, survive? Indeed, why did most of the non-dinosaur types then living at 65 million years ago survive, including primitive mammal types from which humans later evolved? Further, since most paleontologists now think that birds are the living descendants of dinosaurs, why and how did they survive? Could the "Impact Theory" be wrong?

A few paleontologists have suggested that some type of disease may have played a factor; others point to new evidence of possible climatic changes not related to impacts from space debris; still others have noted that changing vegetation could have been unfavorable to some types of the dinosaurs.

In light of all of this, some of the latest thinking by paleontologists is to see the dinosaurs dying off from a combination of causes. Again, fascinating issue begging further research! And something to be the subject of many future scientific discussions and articles—and maybe even a movie or two!

DINOSAUR FOSSILS

While we commonly think of bones 65-70 million years old as having "fossilized" or turned to rock, this isn't always true for bones in northern Alaska. Some of the Colville River bones contain the actual bone tissue that was truly in the dinosaur. In fact, many of the bones are not 100% mineralized, and some have been found with 50% real bone tissue. These are the specimens, which will interest the DNA hunters the most.

Indeed, some of the Edmontosaurus bones on display in the federal building in Anchorage contain a large percentage of real dinosaur bone tissue. Thus, we may have our own makings for possible "Jurassic Park" and the exhibit sign "Jurassic Park—Alaska" may be truer than we think!

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"Alaskan Dinosaurs." Fossils in Alaska. Alaska Public Lands Information Centers. Web. 24 May 2011. <http://www.alaskacenters.gov/alaskan-dinosaurs.cfm>.

DINOSAUR FOSSIL

image courtesy of Matthias Kabel, wikimedia commons

NAME: _____

FOSSIL DIG AND RECONSTRUCTION

Introduction:

In this activity, your group will carefully dig up a skeleton of an unknown animal and reconstruct it to the best of your abilities.

Investigation:

Materials:

- Paintbrush or toothbrush
- Spoon or digging tool
- Masking tape or clear tape
- Pencil or pen

Procedure:

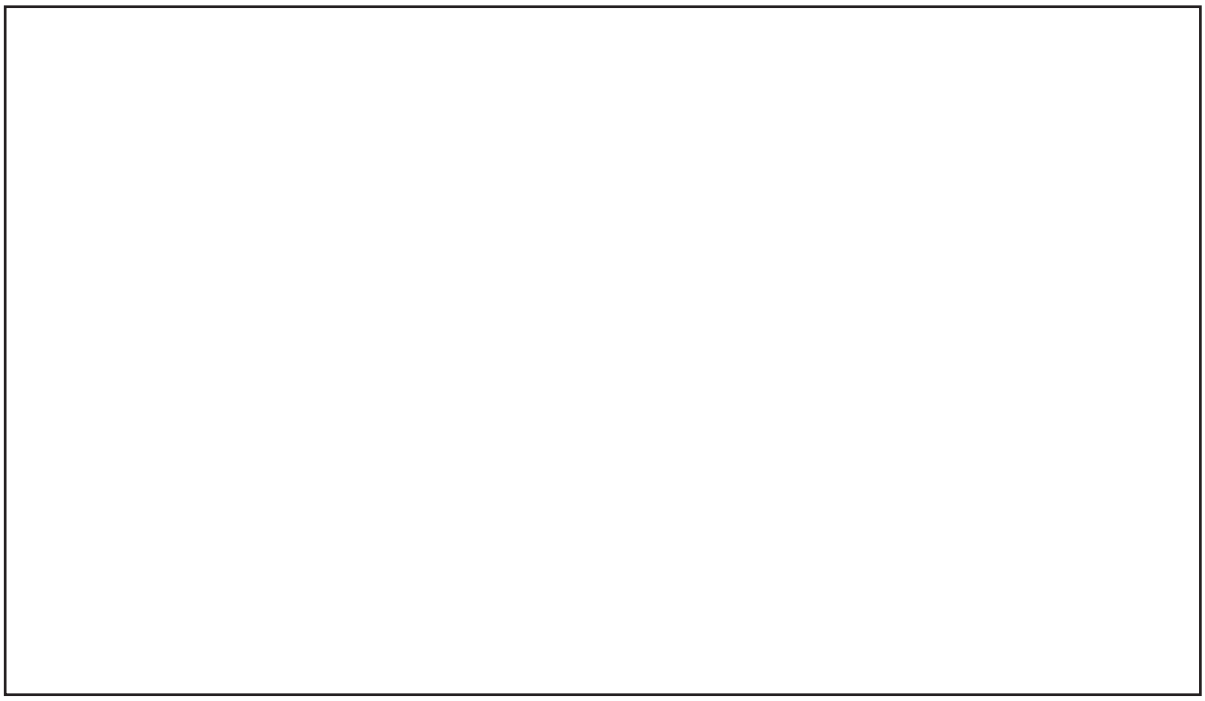
1. Write down the box number on you data sheet.
2. Carefully scoop out sand from your fossil box and investigate the sand for bones.
3. Make note of where you find the bones.
4. Use your paintbrush to carefully sweep sand off the bones.
5. Assemble the skeleton by using tape to connect the end of bone.
6. After completion, answer the questions at the end of the data sheet.

Data:

Box number_____

Names of "paleontologists" _____

Make a sketch of your fossil box and where you found the majority of bones.



Questions

1. When your animal was alive how to you think it moved?_____

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2. What parts of the skeleton helped you make that decision?

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3. What living animals does your skeleton resemble and why?

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