



FOSSIL SEARCH

GRADE LEVEL: 4 - 9

TIME REQUIRED: Two class periods

SETTING: Outdoors

GOAL: Use math skills to follow an orienteering course to locate a fossil and to analyze the object located.

OUTCOMES: At the end of this lesson the student will:

- demonstrate the correct use of a compass,
- demonstrate the ability to determine the length of his or her stride,
- use a compass to locate a specific location,
- apply observation skills to analyze an object, and
- make inferences about a specific object: what it might have been, where it might have lived, and the environment in which it survived.

KERA GOALS: Meets KERA goals 1.2, 1.3, 1.4, 1.6, 1.7, 1.8, 1.9, 1.11, 2.1, 2.9, 2.10, 3.4, 3.7, 4.1, 4.2, 4.4, 4.6, 5.1, 5.4, 6.1, 6.2, 6.3



BACKGROUND INFORMATION

As one proceeds on a fossil hunting expedition, one needs to know how to meet the challenge of traveling into unknown territories. The ability to follow little known trails, to read maps, to move cross-country and to return safely is critical to success. The use of a compass and the ability to calculate pacing are instrumental in transferring map information to a specific location within the landscape.

Pacing is a simple method of measuring linear distance by walking. A pace equals two normal steps, beginning and ending on the dominant foot. It is measured from the heel of the foot to the heel of the same foot in the next stride. Pacing can be used anywhere: indoors, outdoors, in the woods, or in open fields. The use of pacing as a measurement dates back to Roman times. The original Roman pace was 58.1 inches long. This has become known as the geometric pace, which measures about 5 feet. Today pacing is commonly used in forestry to pace off 66 feet from a tree in order to determine tree height.

A **compass** tells you the direction you are headed relative to magnetic north. In order to use a compass successfully you must first find magnetic north. The red needle on the compass (the one that moves) always points to magnetic north. Next, you need to know where you are in relation to where you want to be and set your bearings for where you want to go next. The circular part of the compass is measured in 360 degrees. By following these degree markings, you should be able to find your next location.

You can combine the use of a compass and pacing to find your way in an area where there may not be any paths or roads. Using a compass and pacing with a topographic map that shows mountains, streams and other landmarks is called **orienteering**.

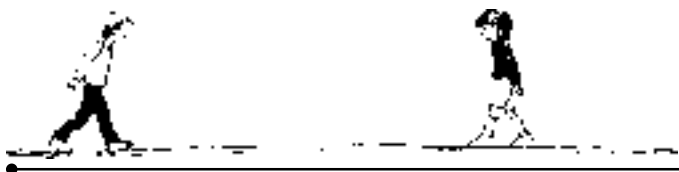
FOSSIL SEARCH

MATERIALS NEEDED

- One compass for each group of students
- 100 foot tape measure
- Pencils and paper
- One copy of "Fossil Search Clue List" for each team
- One set of "Fossil Search Clue Cards"
- Antique treasure or artifact to be analyzed, to be determined by the teacher

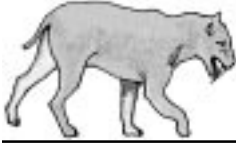
PROCEDURE

1. Set up the orienteering course:
 - Prior to the first class session, copy one set of "Fossil Search Clue Cards" and one "Fossil Search Clue List" for each team.
 - Copy and place the appropriate "Fossil Search Clue Card" at the correct location along the course. As an alternative, place markers at the appropriate locations. These cards or markers will tell the students they have arrived at the correct spot.
 - Place the treasure to be found at the end of the trail.
2. Determine student's average stride:
 - Mark off a straight line that is one hundred feet long.
 - Each student will walk along this line at his or her normal stride. While walking, each student should count the number of paces they take to cover the distance. Remember that a pace equals two normal steps, beginning and ending on the dominant foot. Repeat two more times.
 - The students will calculate the total number of paces walked during their three tries and divide this total by three. This will give the average number of paces per hundred feet.
 - Divide the 100 feet by the average number of paces. This will determine the length of the stride.
 - For example: A student walks the hundred-foot distance in 47 paces one try, 52 paces the second time, and 51 paces the third time. The total number of paces walked is 150 paces. Divide by 3 for an average of 50 paces. Divide one hundred feet by 50 paces and you have an average stride of 2-feet. The students will need to know the length of their stride in calculating the distances and problems.
3. Review the use of a compass:
 - Hold the compass steady at chest level so you can look down and read it easily. The compass housing should be held level - parallel to the ground, and the housing should be turned so that north is pointing away from you.
 - Slowly turn your body so that the North (red) compass needle rests over or points to the North marking of the compass face.
 - Sight across the compass to locate the direction of travel.
 - Follow the direction of travel for the calculated number of paces.
4. Divide the students into groups, three students to a group:
 - One student will read the clues and perform the necessary math
 - One student will use the compass to determine the direction of travel
 - One student will walk the required paces in the correct direction
5. Students will calculate the distances and begin walking the course:
 - After walking the required number of paces in the correct direction, the walking student will stand in the destination spot while the student holding the compass takes a second reading to make certain that the direction is correct. If an error is found, the walking student should return to the starting spot and repeat the pacing for that clue prior to advancing to the next clue.
 - The group will read the second clue and follow the same procedure to the second site.
 - When the students reach the mystery item, they will return to the beginning area to analyze their find.
6. Analyze the treasure: Using the techniques of observation and inferences the students should attempt to provide the following:
 - An accurate description of the article
 - Exactly where it was found
 - What might it have been
 - How it might have been used
 - What was the time frame of its existence
 - Describe the environment in which it existed



This activity adapted from Florissant Fossil Beds National Monument, "Ancient Treasure Hunt", found in *Teaching Paleontology in the National Parks and Monuments: A Curriculum Guide for Teachers of the Fourth, Fifth and Sixth Grade Levels*

FOSSIL SEARCH – CLUE LIST



The Sabertooth Cat was a fierce predator whose remains were found in John Day Fossil Beds National Monument in Oregon. These animals had canine teeth nearly 6 inches long. **Go 240 degrees for 240 fangs.**



The bones of the Giant Sloth (*Megalonyx jeffersoni*) were discovered in Short Cave, which is located within Mammoth Cave National Park. The Giant Sloth stood 19 feet tall. **Go 110 degrees for 3.8 lengths of the Giant Sloth.**



At Hagerman Fossil Beds National Monument in Idaho are found the fossil remains of a Pronghorn Antelope that lived nearly 3.4 million years ago. Modern pronghorns are the fastest land animal in North America and can run 60 miles an hour, or one mile per minute. **Using the scale 1 foot=1 mile, go 200 degrees for the distance the Pronghorn would travel in 2.5 hours.**



The fossil bark of the Lepidodendron has been found in sandstone at Mammoth Cave National Park. This club moss reached a height of 105 feet. **Go 360 degrees for two Lepidodendron heights.**



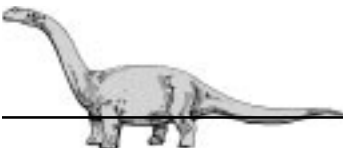
The fossil of a fish, a gar, that is five feet long was discovered at Fossil Butte National Monument in Wyoming. **Go 260 degrees for 6 gar lengths.**



Fossil remains of a *Mesohippus* are found at Badlands National Park in South Dakota. *Mesohippus* was an ancestral horse. It had three toes instead of one (hoof). **Go 10 degrees for a number of feet equal to the total number of toes found on 23 Mesohippus feet.**



Phytosaurs were crocodile-like reptiles that lived 220 million years ago in what is now the Petrified Forest National Park in Arizona. The average length of a Phytosaur was 15 feet. **Go 320 degrees for 5 Phytosaur lengths.**



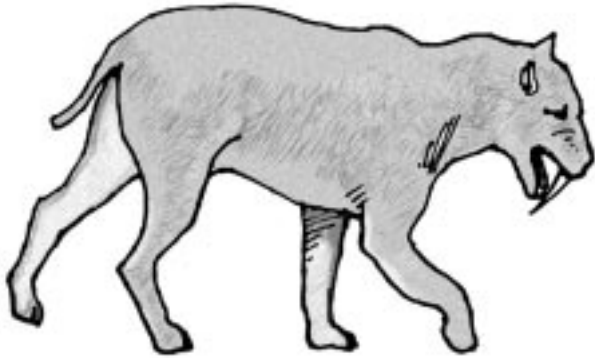
In Dinosaur National Monument in Colorado are found the fossil remains of *Apatosaurus*. It got its name, which means “deceptive lizard,” because of its unbelievable size. Adults were 75 feet long from nose to tail. **Go 160 degrees for two Apatosaurus lengths.**



At Mammoth Cave National Park, a 38,000-year-old *Tadarida brasiliensis* was found. A *Tadarida brasiliensis* is a free-tailed bat. Its wingspan measured 12 inches. **Go 100 degrees for 81 wingspans.**

FOSSIL SEARCH – CLUE CARDS

FOSSIL SEARCH – CLUE NO. 1



The sabertooth cat was a fierce predator whose remains were found in John Day Fossil Beds National Monument in Oregon. These animals had canine teeth nearly 6 inches long. **Go 240 degrees for 240 fangs.**

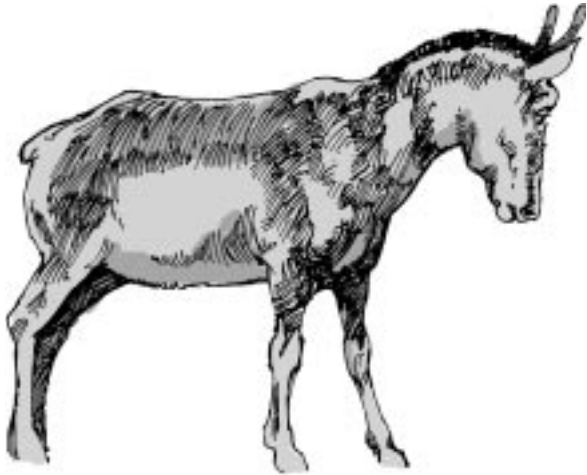
FOSSIL SEARCH – CLUE NO. 2



The bones of the Giant Sloth (*Megalonyx jeffersoni*) were discovered in Short Cave, which is located within Mammoth Cave National Park. The Giant Sloth stood 19 feet tall. **Go 110 degrees for 3.8 lengths of the Giant Sloth.**

FOSSIL SEARCH – CLUE CARDS

FOSSIL SEARCH – CLUE NO. 3



At Hagerman Fossil Beds National Monument in Idaho are found the fossil remains of a Pronghorn Antelope that lived nearly 3.4 million years ago. Modern Pronghorns are the fastest land animal in North America and can run 60 miles an hour, or one mile per minute. **Using the scale 1 foot +1 mile, go 200 degrees for the distance the pronghorn would travel in 2.5 hours.**

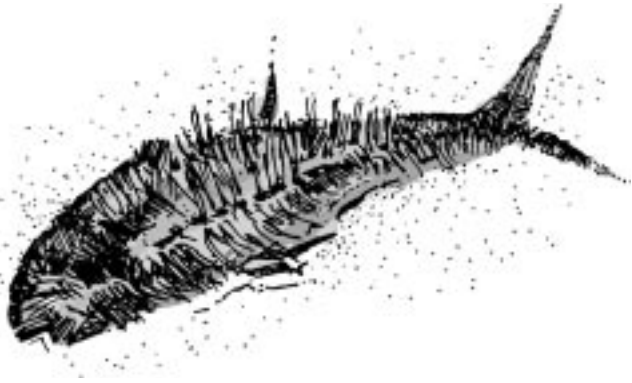
FOSSIL SEARCH – CLUE NO. 4



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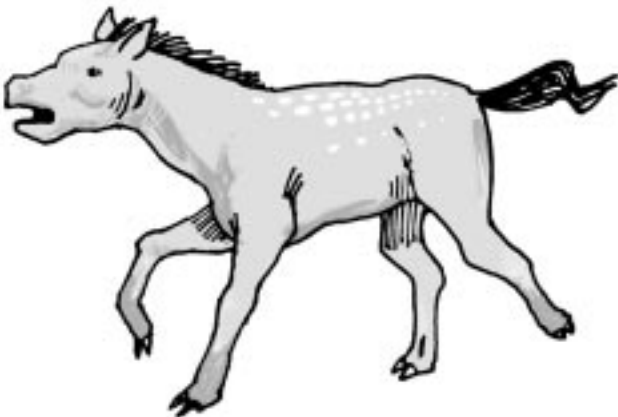
FOSSIL SEARCH – CLUE CARDS

FOSSIL SEARCH – CLUE NO. 5



The fossil of a fish, a gar, that is five feet long was discovered at Fossil Butte National Monument in Wyoming. ***Go 260 degrees for 6 gar lengths.***

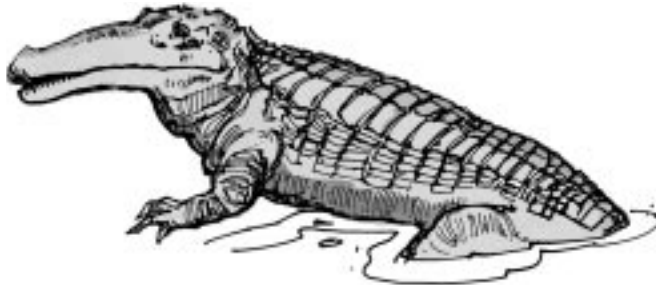
FOSSIL SEARCH – CLUE NO. 6



Fossil remains of a *Mesohippus* are found at Badlands National Park in South Dakota. *Mesohippus* was an ancestral horse. It had three toes instead of one (hoof). ***Go 10 degrees for a number of feet equal to the total number of toes found on 23 Mesohippus feet.***

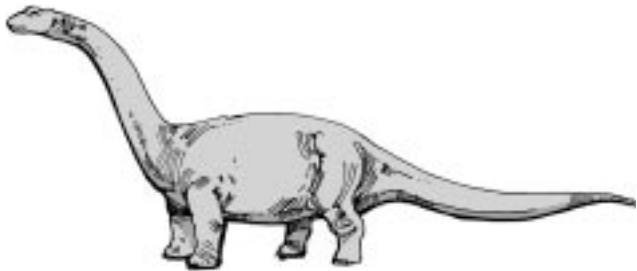
FOSSIL SEARCH – CLUE CARDS

FOSSIL SEARCH – CLUE NO. 7



Phytosaurs were crocodile-like reptiles that lived 220 million years ago in what is now the Petrified Forest National Park in Arizona. The average length of a Phytosaur was 15 feet. ***Go 320 degrees for 5 phytosaur lengths.***

FOSSIL SEARCH – CLUE NO. 8



In Dinosaur National Monument in Colorado are found the fossil remains of *Apatosaurus*. It got its name, which means “deceptive lizard,” because of its unbelievable size. Adults were 75 feet long from nose to tail. ***Go 160 degrees for two Apatosaurus lengths.***

FOSSIL SEARCH – CLUE CARDS

FOSSIL SEARCH – CLUE NO. 9



At Mammoth Cave National Park, a 38,000-year-old *Tadarida brasiliensis* was found. A *Tadarida brasiliensis* is a free-tailed bat. Its wingspan measured 12 inches. **Go 100 degrees for 81 wingspans.**