Name_____ Section#_____ Due Date_____

## SAN DIEGO NATURAL HISTORY MUSEUM

**STUDENT LEARNING OUTCOMES** for this exercise. Students will be able to:
1. Recall information about the animals and plants from this exercise.
2. Examine geology and paleontology exhibits and understand and interpret their meanings.
3. Examine characteristics of organisms and predict the adaptive value of those traits.

**INTRODUCTION**: To be read prior to visiting the museum.
The mission of the San Diego County Natural History Museum (SDNHM) is to promote understanding of the evolution, diversity and environment of southern California and the peninsula of Baja California. Not only does the museum display specimens from their collection, they also conduct research and collecting expeditions, educational classes, and present traveling exhibits as well. Although plants and other organisms are important in understanding evolution and diversity we will concentrate on the animal exhibits.

Your visit incorporates three important aspects of studying the natural history of animals: **Modern day (extant) species, Extinct species** and the **Geology** of their environments. The museum provides a unique opportunity to observe and analyze evidence to study all three of these interconnected aspects of natural history. You will observe the anatomical features of a variety of extant animal specimens. Studying their physical adaptations provides an understanding of how they live and their interactions with the environment. You will also study species now extinct. The study of ancient life is called Paleontology and is primarily based on fossils. Studying prehistoric life helps us better understand their evolution and their and interactions with each other and their environments. Geology is a very important component of paleontology. Geologic processes are involved in the preservation, dating, distribution and components of fossils. Therefore, to understand the history of life, we need to learn about geology as well.

Most exhibits have information cards that will help you answer some of the questions in this exercise. Read all the information posted for each exhibit for which there are exercise questions. Sometimes displays are moved or dismantled. If this is the case, or you simply have trouble finding a display, ask for help at the entrance desk or ask one of museum docents on the floor. If indeed a display is not available, or permanently discontinued, clearly indicate in the answer space that the display was NOT AVAILABLE for observation. Be aware that all other students must also have indicated that the display was not available that day for this to be a legitimate response. Blank answer areas will be graded as incorrect.

**BEFORE YOU GO**:
a. Visit the San Diego Museum of Natural History website http://www.sdnhm.org/ and go to the "Visit" pull-down menu to find information on open hours, directions, a map and more.

b. Bring a valid I.D. and your student I.D. to receive the student discount admission rate.

c. You must verify your visit by stapling your dated receipt or ticket to the first page of this exercise. Also put your name on either in case the verification and the exercise become separated.

d. Be sure you do not duplicate the answers of any other student. It's fine to work with a partner but do not split the work and be careful that all the answers are your own. Duplicate work receives a zero.

e. Visiting the museum is a mandatory lab exercise.

## PRE-VISIT RESEARCH INTERNET ACTIVITY

Before you go to the museum, it will help if you study a few concepts first. You will need access to the internet to do so. Access is available to you in the Technology Mall at Grossmont College. If anyone at the tech. mall asks you for a referral from your teacher, you can find it at the end of this handout under **Tutoring**.

**A. Define these terms before you go to the museum**:
Extinct:

Extant:

Extirpated:

Fossil:

Magma:

Plutonic:

Paleontology:

**B. Questions from Internet sites**
Go to: http://www.grossmont.edu/people/michael-golden/biology-110/default.aspx
and choose NHM to find these links so you don't have to type-in each Web Address:

**1. Geology**
a. Go to this site and explore interactive links prior to visiting the Fossil Mysteries exhibit.
http://www.sdnhm.org/archive/exhibits/mystery/

b. Go to this link and define plate tectonics:
http://www.cotf.edu/ete/modules/msese/earthsysflr/plates1.html

c. Go to this link and answer this question from the Animation of Plate Tectonics:
http://www.ucmp.berkeley.edu/geology/tectonics.html
Has North America always been in its same position relative to the other continents? Explain.

**2. Ammonites**
Go to http://www.sdnhm.org/archive/exhibits/mystery/fg_ammonite.html
and answer the following questions:

a. What group of marine animals do Ammonites belong to?

b. Ammonites are considered to be Index Fossils. What is an index fossil?

**3. Dire Wolves**
Go to http://www.sdnhm.org/archive/exhibits/mystery/fg_direwolf.html
to answer: What is one hypothesis as to the cause of their extinction?

**4. K/T boundary and the End of the Dinosaurs**
Go to http://www.sdnhm.org/archive/exhibits/mystery/exh_more.html#kt
and http://www.psi.edu/epo/ktimpact/ktimpact.html to answer the following questions:
a. What does the K-T boundary represent? What happened?

b. What is Iridium?

c. What is the significance of finding iridium at the KT boundary in many different places on the earth?

d. Give three pieces of evidence that there was a great impact on the earth 65 mya (million years ago).

e. What is one reason why mammals may have survived the impact but dinosaurs would not have?

**5. Geologic Time Periods**
a. **Eras**: Visit http://geomaps.wr.usgs.gov/archive/socal/geology/geologic_history/index.html and place the following **Eras** into their proper chronological order with dates.

**Eras**: Cenozoic, Paleozoic, Mesozoic

| Era | Dates |
|---|---|
| | |
| | |
| | |

b. **Epochs**: Visit http://geomaps.wr.usgs.gov/archive/socal/geology/geologic_history/index.html and place the following **Epochs** into their proper chronological order with dates.

**Epochs**: Pleistocene, Oligocene, Miocene, Paleocene, Pliocene, Eocene

| **Epochs** | **Dates** |
|---|---|
| | |
| | |
| | |
| | |
| | |
| | |

c. To which Era do the above Epochs belong?

**END OF INTERNET ACTIVITY**

## ACTIVITY AT THE NATURAL HISTORY MUSEUM

**Begin upstairs on Level 2**

### I. PALEONTOLOGY AND GEOLOGY

**A. Find the Omni Globe**. Choose the Geology button. Notice how the continents are in constant motion.

1. Approximately how long ago, (use mya which is "millions of years ago") were South America and African connected?

2. What type of plate boundary caused the separation of these two continents? (**Hint**: refer back to your notes from the Internet Activity you completed prior to visiting the museum).

**B. Now go to your right into the Cretaceous Environment**

1. What is the time span of the Cretaceous Period?

2. What group of animals are the Ammonites related to?

3. How many years did the ammonites exist?

4. Did dinosaurs once exist in this region of the planet? Explain.

5. What is the leading theory for the extinction of the ammonites and the dinosaurs?

**C. Go to the Brontothere exhibit**

1. Where was this fossil discovered?

2. What is the closest living mammal to the extinct Brontothere?

3. How can Paleontologists determine the age of a fossil (give at least two examples)?

**D. Find the fossil plants from the Eocene**

1. What is the time range for the Eocene?

2. At one time, plants such as mangroves, bananas, sycamores, and magnolias grew naturally in San Diego County. These types of plants provide evidence that our county had a different climate at one time. What was the climate?

**E. View the short film on natural selection**

1. What was Darwin's theory?

2. What are new traits the result of?

3. Describe how similar the genomes of humans and chimpanzees are.

4. How long ago did humans and chimps share a common ancestor?

**F. Evolution of Form and Function**

Upon observing such a large variety of organisms, one tends to notice at first some of the more unique characteristics they possess (example, webbed feet). These characteristics often develop as a species adapts to a particular niche over many generations through the process of **natural selection**. Such characteristics are called **adaptations**. To the extent that such features allow greater survival of one group over another, they are said to be a **selective advantage** to that group.

**Homologous Structures:** The theory of evolution first proposed by Charles Darwin and Alfred Wallace states that the diversity we see today is the result of changes accumulating over millions of years due to natural selection. Evidence from comparative anatomy such as **homologous structures** (homo=same) provides important evidence for this theory. Organisms that have a common ancestory (such as being a mammal with 2 sets of paired appendages), that have had their features modified in very different ways, are said to have **homologous** features. We see then that homologous structures are features that are common to a wide variety of species but have different functions.

That these structures are morphologically similar in a wide variety of species is what suggests they all share a common ancestor. For instance, the foreleg of a mule deer, the fore flipper of a seal and the forearm of a gibbon are examples of homologous structures. Note that all three of these fore-structures have a humerous, radius, ulna, carpals, metacarpals and phalanges. These are features that are inherited from a common ancestor and have since been modified through natural selection for different functions in different environments are an example of **divergent evolution**.

**Analogous Structures:** Often organisms that are only distantly related may develop physiological, behavioral, or structural characteristics, which are similar. As a result of natural selection, these organisms have solved problems in a similar manner. Butterflies, bats and birds are not closely related, yet all have wings and can fly. They have solved the problem of locomotion in a similar manner. Scorpions, rattlesnakes, and shrews all produce poisons with which they subdue their prey; another example.

Features such as these, that have similar form and/or function are called **analogous** features. This tendency for organisms, which are not closely related, to solve problems in a similar way is called **convergent evolution**. With respect to any one feature alone, the directions of their evolutions have converged.

**Questions about homologous and analogous structures.** Fill in with the correct term from the information you have just reviewed.

**1.** Homologous structures are derived from a _____ancestor but are modified through

_____for different functions.

2. _____ structures have similar form and function but are not derived from a common

ancestor. Analogous structures result from _____evolution not common ancestry.

**G. Observe the exhibit showing mule deer, gibbon, and seal and their homologous structures**

1. Can you find the following on each animal? (See the display illustrating the various bones by color.)
Humerous (same as the upper bone of your arm)
Radius and ulna (same as your forearm)
Carpals (same as the your wrist bones)
Meta carpals and Phalanges (same as the your finger bones)

2. The function of the forelimb in each of these animals is different. What is the function of each of the following?
Mule deer foreleg:

Sea lion forelimb (front flipper):

Gibbon forearm:

3. Note that the gibbon has a ball and socket joint. What other species can you think of that has a ball and socket joint?

4. In the gibbon display, turn the knob to see the action of the radius and ulna. Are these two bones fused together?

5. Look at the mule deer front leg. Are the radius and ulna fused together? Think about the function of the forelimb in the gibbon and deer and **explain** the difference.

6. Now, go search out these same homologous structures (fore-limbs) on the following **extinct** animals scattered around the exhibit on this floor and note their functions:

| Extinct Animal | Function of fore-limb |
|---|---|
| Gray Whale (in display case) | |
| Extinct Sea Cow (hanging from the ceiling) | |
| Extinct Seal (hanging from Ceiling) | |
| Dire Wolf and Saber tooth lion (in display cases) | |

**H. Geologic processes**: **Sea Plate Interactive Map** (computer simulator). Note: mya refers to millions of years ago.

1. Move the dial to place the graphic of earth at the present time. Note the position of Australia today. Turn the dial counter-clockwise (toward the past times) until Australia is connected back with Antarctica. How long ago were these two presently independent continents connected? (in mya)

2. Continue to turn the dial counter-clockwise (going back in time to approximately 380 mya). At that time all of the continents were part of one giant continent. What is the name of that continent?

3. Next, turn the dial clock-wise (moving up in time). How long ago did North America separate? (in mya)

4. How long ago did South America and Africa separate? (in mya)

**I. Pleistocene extinction.** Now move toward the North side of the floor to "Pleistocene Extinction".
**Pieces of the Puzzle**
1. When was the Pleistocene? (in mya)

2. Fossils of frogs, turtles, ducks, capybaras, tapirs, and mastodons have been found within the same deposits in Northern San Diego County. What do these fossils tell us about the past climate and ecosystem of the Pleistocene?

3. As recently as 10,000 years ago, many large mammals roamed North America including here in SD County. What happened to these large mammals?

4. When did humans first arrive in the Americas?

**Reminders:**
**The museum is constantly rearranging their exhibits. If you cannot locate a specimen ask a volunteer. If it is not available, make a note that it was off-exhibit so I will know you did not just skip the question.**

**Keep your receipt for verification of your visit, put your name on it and staple it to the first page of this exercise.**

Fall, 2013