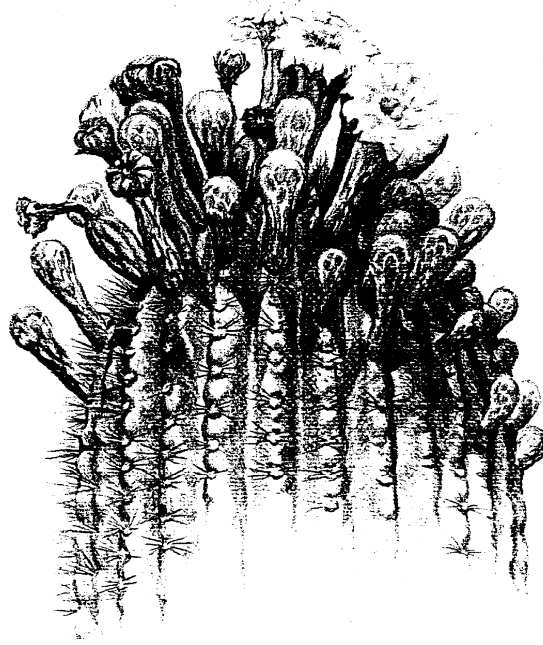


EXPLORER'S GUIDE

For a

SELF-GUIDED VISIT

High School Level



CONTENTS

Exhibit Descriptions	2
Museum Map	4
Instructions	5
Explorer's Guide Answer Key	6

WHAT IS THE DESERT MUSEUM?

The Arizona-Sonora Desert Museum is a world-renowned zoo, natural history museum and botanical garden, all in one place. You will see interpretive displays of living animals and plants native to the Sonoran Desert region, an area encompassing parts of Arizona and California in the United States and the Mexican states of Sonora and Baja California. Within the Museum grounds, you will see more than 300 animal species and 1,200 kinds of plants on display, alive in their natural settings. There are almost two miles of paths traversing 21 acres of beautiful desert. Look closely you may see native animals scurrying across pathways.

WHAT'S TO SEE?

This exhibit listing is organized as if you were to start at the entrance and travel counter-clockwise along the main route, branching off onto secondary paths for specific exhibits.

Reptiles, Invertebrates & Amphibians

Lizards, snakes, scorpions, tarantulas and toads are all safely tucked behind glass so you can take as close a look as you'd like or dare! Make sure you see the Arizona wildflower models they're stunning.

Orientation Room -Don't Miss It!

Learn a bit about deserts, the Sonoran Desert in particular, the Desert Museum itself and what it has to offer.

Overlook

The view from here is breathtaking. The gray-green sea of the Avra Valley separates six mountain ranges. Look west across the Tohono O'odham Indian Reservation and south beyond the Mexican border, 60 miles (97 km) distant.

Earth Sciences

A limestone cave, complete with stalagmites, stalactites, pools and crayfish, this exhibit explains the formation of caves and of the earth itself. Kids especially will enjoy the optional loop trail -a true caving experience with 75 feet of low ceilings, rough footing and tight passages. Also discover one of the finest collections of regional minerals and gemstones anywhere.

Mountain Woodland

Ever get close enough to a mountain lion to count the whiskers on its muzzle? You often can in this exhibit - look for the viewing window just as you enter this area. The animals and plants here represent those found in the mountain "islands" within the Sonoran Desert region.

Desert Grassland

Discover why the grasslands are so important in the Sonoran Desert region. And don't miss the prairie dogs. Their antics delight all ages. Over 100 species of cactus and other desert plants are grown in this landscaped setting.

Cat Canyon

See some of the felines of the region (bobcat and ocelot) along with other canyon dwelling animals. You can view these animals from 2 vantage points, both above and below the exhibit.

Desert Loop Trail

This ½-mile loop offers an intimate desert walk with sweeping views of the Avra and Altar valleys. This is where you will find javelina and coyotes along with other animals that spend their life living on the rocks.

Cactus Garden

Over 100 species of cactus and other desert plants are grown in this landscaped setting.

People and Pollinators

Learn how native peoples have survived in this desert for thousands of years. You can even try to see how successful you are at grinding mesquite beans.

Riparian Corridor

The word “riparian” means stream-side. Yes, there are places where water flows freely in the desert, supporting an abundance of wildlife.

Bighorn Sheep

This exhibit lets you see these large sheep in a naturalistic environment, dancing along rock ledges. Look too for other exhibit residents-rock squirrels and spiny-tailed iguanas.

Walk-in Aviary

Cardinals, Gambel’s quail, ducks, doves and nearly 40 other species of native birds live together in this avian sanctuary. Please move slowly and quietly.

Desert Garden

Do you think that desert-native plants are dull and drab, or that a scarcity of water means no leaves and bare stems? Learn just how colorful desert plants can be.

Life Underground

Quiet please! Discover night-active desert dwellers hiding out during the heat of the day.

Hummingbird Aviary

This world-famous exhibit lets you walk freely among several species of native hummingbirds. These harmless hoverers may whisk past your head or snatch a thread from your sweater to help build a nest. Please move slowly and quietly.

Pollination Gardens

Did you know that a third of our food and 90% of all wild plants depend on animal pollinators such as bees, butterflies, moths and hummingbirds? Learn about these complex creatures and their floral partners in these enchanting gardens.

Warden Aquarium: Rivers to the Sea

Fish in the desert? Yes, in fact, there are 35 native species of native fish in Arizona’s rivers. Also, we are closely interconnected with the Sea of Cortez so this is a wonderful opportunity to visit the sea without leaving Tucson.

EXPLORER'S GUIDE FOR A SELF-GUIDED VISIT

TEACHER/CHAPERONE INFORMATION

Grades 9-12

To the teacher and chaperone

Welcome! The questions in this guide coordinate with our exhibits and are to be used as you tour the Museum grounds with your group. Your students should work on the student handouts during their visit. It may take students between 4 and 5 hours to complete the entire Explorer's Guide. If your class will be spending less time at the Desert Museum, we recommend students complete those sections that best correlate with your science curriculum. Please feel free to modify, add, and/or delete questions to meet the goals of your visit.

INSTRUCTIONS

Prior to Your Visit:

- Select sections of the Explorer's Guide you'd like students to complete.
- Make copies of the selected portions of the Explorer's Guide and the Museum's School Group Map for each student. **Provide copies of the corresponding Explorer's Guide Answer Key and map for each chaperone to review before the trip.**
- Review the Explorer's Guide questions, map, and exhibit descriptions with your students so they know what they are expected to find and complete at the Museum. (For more detailed information on exhibits visit our web site: www.desertmuseum.org)
- Remind students to bring a pencil on the trip!

Suggestions:

- Work with your students to find the answers and generate enthusiasm. Divide them into smaller groups (up to 10 students) – each with an adult chaperone –and provide each chaperone with the Answer Key so they may assist students. Encourage cooperative learning among students.
- An incentive, such as a grade or reward, might help motivate students to complete the handouts.
- **Remind students to make careful observations of plants, animals and geologic features as well as read the signs and labels at each exhibit.**
- Trained Docent Interpreters give a variety of natural history interpretations at different locations throughout the Desert Museum. They provide exciting, hands-on opportunities to learn more about the Sonoran Desert Region. Look for the daily schedule of interpretations at the Orientation area (see map). These are well-worth attending.
- **Review the rules of conduct with your students and chaperones before you begin. Remember, these are living exhibits. Following the rules will make your visit a more positive experience for your students and the Desert Museum's wildlife.**

Enjoy your visit!

EXPLORER'S GUIDE
FOR A SELF-GUIDED VISIT
TEACHER/CHAPERONE ANSWER KEY

Welcome to the Arizona-Sonora Desert Museum!

Instructions: Review the questions in this guide **before** you visit the Desert Museum. You should be able to find all the answers as you tour the Desert Museum if you carefully **observe** animals, plants, and geologic features both inside and outside exhibits, and **read** signs and labels. Docent interpreters are available near many exhibits. They are wearing uniforms and may be available to answer questions about exhibits. **Good luck and enjoy your visit!**

PART 1: ZOOLOGY

CANINES: There are 4 members of the canine (dog) family at the Desert Museum. Find each and list it on the chart below. Describe the habitat of each animal. Remember: habitat is an animal's living space and includes food, water and shelter.

Animal's Name	Habitat (including food)
Gray fox (<i>cat canyon</i>)	<i>canyons and woodlands-eats rodents, birds, reptiles, fruit, carrion</i>
Mexican gray wolf (<i>mountain woodlands</i>)	<i>mountain regions throughout Arizona and Mexican plateau: eats white-tailed deer</i>
Coyote (<i>desert loop trail</i>)	<i>lives almost anywhere from low deserts to the mountains and even within the city-eats almost anything including birds, rodents, fruit, Insects, and plant material</i>
Kit fox (<i>life underground</i>)	<i>desert regions; eats kangaroo rats and other rodents, birds, eggs insects and some plants</i>

1. What do these canines have in common?

(canine teeth, predators, in same family, look like "dogs," etc.)



2. How are they different?

(specific diets differ; habitat of kit fox and coyote includes desert, but gray fox and Mexican gray wolf live primarily in mountain biome; kit fox spends much time in burrow and is primarily nocturnal, etc.) Students may want to research these canines when they return to class.

ANIMAL ADAPTATIONS

Complete the chart as you locate and carefully observe each animal listed below. Describe at least 2 adaptations each displays and tell how each adaptation helps the animal survive in its environment. Think about which adaptations are physical, physiological or behavioral.

Note: Encourage students to observe animals, as all information is not on the signs. Specific animal locations noted under name.

Animal	Adaptations
Desert tortoise (near large aviary)	<i>Burrows in sand to keep cool, ear flaps and overlapping eyelids to keep sand out, long fringed scales on toes provide traction on sand, camouflage coloration, gets moisture from plants.</i>
Javelina (desert loop trail)	<i>Razor sharp teeth for defense and digging food, snout for digging, make produce musk to attract females, runs fast to avoid predators, gets water from cactus and can digest oxalic acid, stays in shade during hot days.</i>
Tarantula (reptiles, invertebrate and amphibian room)	<i>Digs burrow and stays in it to avoid temperature extremes and for protection, pedipalps for catching and holding prey, injects venom into prey through fangs, spins silk to line burrow.</i>
Otter (riparian corridor) 	<i>Shaped for swimming with a streamlined body, short legs, tapered tail, slender body, small head with tiny eyes and ears; its tail and webbed hind legs push it through the water; short, dense fur keeps it dry by trapping a layer of air; it can see well underwater, sensitive stiff whiskers help locate prey.</i>
Elf owl (life on the rocks)	<i>Sharp beak to kill prey (eats primarily scorpions, moths, beetles, centipedes), sharp talons to catch prey, active during cool night, keen eyesight and large pupils for better night vision, excellent hearing, wings for flight.</i>
Sonoran Desert Toad (reptile, invertebrate and amphibian room)	<i>Burrows to escape heat, cold, drought; emerges from burrow during summer monsoons and rapidly reproduces (egg hatches into tadpoles with go through metamorphosis in about 6 weeks) and digs a burrow again as the monsoon rain ends.</i>
Millipede (life underground) 	<i>Spends most of life underground keeping cool and moist feeding on decaying plants and animal matter, secretes acit-like substance for defense, emerges with summer monsoons, exoskeleton protects body.</i>

ANIMAL BEHAVIOR

Find an example of an animal in each category listed below. Carefully observe each animal for at least 4 minutes. Write the name of each animal under the appropriate heading and describe the behaviors you observe. Add a diagram!

Arthropod Name:	Answers will vary:
Reptile Name:	Answers will vary:
Mammal Name:	Answers will vary:
Amphibian Name:	Answers will vary:
Bird Name:	Answers will vary:
Fish Name:	Answers will vary:

PART 2: EXHIBIT-SPECIFIC QUESTIONS

CONVERGENT EVOLUTION GARDEN

1. Take a good look at these plants from different deserts around the world. What adaptations to desert environments do they have in common.

(succulence, green photosynthesizing stems, waxy coatings on leaves and stems, reduced leaf size or no leaves, spines, pale green or gray color)

2. What does convergent evolution mean?

(The evolutionary development of similar characteristics [body forms] in unrelated species from similar environments, but from different geographic locations. This happens because these different species are adapting to the same sort of environment.)

EARTH SCIENCES CAVE

In The Wet Cave

1. Name 4 wet cave users or dwellers.

(crayfish, insects, spiders, ferns, phoebes, barn owl, bats [roots and nurseries], ringtail, bobcat, packrats)

2. Describe the formation of a limestone cavern. Use diagrams too!

Phase I: rainwater becomes weak acid by absorbing CO₂ from air and from decaying matter in soil; seeps into water table and slowly dissolves limestone, leaving water filled caves

Phase 2: water table drops draining cave

Phase 3: stalactites and other formations develop as dissolved limestone from above is slowly deposited in air filled cavern)

In The Dry Cave

1. Describe the environment of this region about 300 million years ago. What evidence exists to support your answer?

(shallow seas flooded and retreated; fossil seashells found in limestone in this area)

2. Find the packrat middens. What are they and how are they helpful to scientists?

(A collection of plant parts, animal remains, debris, and packrat droppings cemented together with urine; packrats occupy the same site for thousands of years building the middens thicker. This leaves a record of the changes in plant and animal life over time. Scientists can use this information to infer climate changes.)

3. a. Locate and describe the hidden Hohokam cave site.

(cave site contains pottery, shards [pottery fragments], beads, a natural rock basin; original site discovered near Tucson in 1973)

b. Who were the Hohokam?

(ancient Native American people of the Sonoran Desert; inhabited this area about 2,000 years ago)

EARTH HISTORY ROOM

Locate and describe the oldest thing found on earth in this exhibit.

(Allende meteorite; 4.6 billion years old; formed before the earth from our solar system's original dust and gas; smooth and hard)

ANCIENT ARIZONA

Describe the environment of this region, including the plants and animals, about 12,000 years ago.

(A massive continental ice sheet covered 1/3 of North America. Here, only the highest peaks were covered with snow and ice, but temperatures were cooler and there was more rain. There were no saguaros, but pines and oak trees dotted the slopes; mammoths, camels, ground sloths, large tortoises, bear and bison roamed the land.)

MOUNTAIN WOODLAND

1. What is meant by the term 'mountain island'?

(a forested mountain surrounded by a "sea" of desert)

2. How is the mountain woodland climate different from that of the desert?

(cooler with more precipitation)

3. Carefully observe the plants in this mountain area. How is this vegetation different from desert vegetation?

(leaves of mountain plants are darker green and generally larger than desert plant leaves; more grasses and less succulent plants; taller trees including pines)

4. a. Look for the Mexican gray wolf. For what reasons is the Mexican gray wolf near extinction today?

(thought to have eaten livestock so it was trapped, poisoned, and shot; fewer than 50 remain in the wild, most are in Mexico)

b. Can any be found in the wild in Southern Arizona today? Explain. *(Yes, a few have been reintroduced, but some of these have been shot – see posted article.)*

DESERT GRASSLANDS

1. a. How does a harvester ant notify others in its colony if it locates seeds?

(Worker ants leave an odor trail which others will follow.)

b. Why should you watch out for these ants?

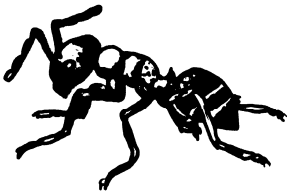
(Those in the genus Pogonomyrmex have one of the most toxic insect venoms known and their sting is painful.)

2. List the 4 traits of a grasshopper mouse that are unexpected in a small rodent.

(strong body, hook-like claws, sharp teeth and a digestive system specialized for meat eating)

3. How many grasshopper species can be found in Arizona? Name 3 species.

(over 60 species are found in Arizona; Green Valley Grasshopper. Horse Lubber Grasshopper, Band-Winged Grasshopper)



3. Look at the SOIL IS ALIVE exhibit.

a. Why are decomposers important?

(They decompose dead plant and animal matter and cycle nutrients so these can be used by plants.)

b. Name 4 decomposers and describe how each is at work in the soil.

(termites: feed on dead plants; isopods (pillbugs, etc.): eat plant and animal debris; nematodes: feed on plant roots; fungi: eat dead and dying roots; bacteria: cause decay; protozoa: eat bacteria)

4. Why can grasses survive fires?

(Growing shoots remain near or under the ground and are not damaged by most fires - most grass seeds also remain unharmed because temperatures just 1cm below the ground are unchanged by fire.)

5. How is the burrowing owl different from other owls?

(live in underground burrows; males are larger than females; can run after prey with their long legs; live in small colonies; both diurnal and nocturnal)

6. What is a cienega and why is it important?

(Cienegas are marshes – places where the water table is at or very near the surface. Cienegas support more kinds and numbers of plant life than surrounding land including many endemic [found only in this area] species.)

MAMMOTH KILL SITE

1. List any evidence of man that you see at this site.

(Clovis projectile points from prehistoric humans; shovel and sieve from modern man)

2. a. What evidence of megafauna is found at this site?

(mammoth mandibles [molars], bones, tusk)

b. List some examples of megafauna that used to live in Arizona.

(giant mastodons, mammoths, bison, ground sloths, beaver the size of bear, horses, camels, pronghorn, American lions, short-faced bear, dire-wolf)

3. How long ago did these people and megafauna live in Arizona?

(Megafauna became extinct about 11,000 years ago; humans are thought to have arrived on this continent around then.)

DESERT LOOP TRAIL

1. Look at the different shade ramadas (structures.) What desert materials are used by the Tohono O’odham to build them?

(varies, but may include: saguaro ribs, mesquite logs, ocotillo stems, agave flower stalks)

2. a. Find the coyotes and javelinas in their exhibits. Where are they and what are they doing?

javelinas: (Answers will vary)

coyotes: (Answers will vary)

b. See how many questions you can answer on the flip-up signs at both exhibits.

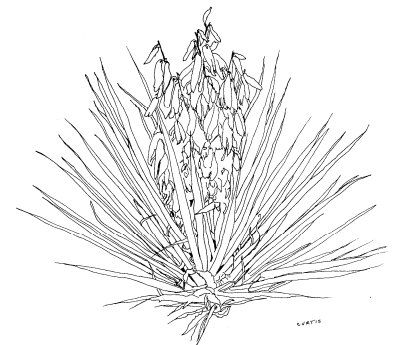
HOHOKAM AGAVE FIELD

1. The Hohokam living nearly 1,500 years ago cultivated agave. Look at this exhibit and describe their agave farming techniques.

(They built rock-lined terraces to slow the runoff of rainwater and planted agave there.)

2. How did the Hohokam use agave?

(roasted the insides for food; processed leaves for fiber)



LIFE ON THE ROCKS

1. What are some reasons animals live in/on/under/around rocks?

(protection from the elements, protection from predators, good lookout site safe place to rear young)

2. How are crystal vein deposits formed?

(Superheated water and magma are forced into naturally occurring cracks and fissures. The intense heat and pressure of these fluids melt s the surrounding rock and widens fractures into veins of varying widths. The fluid cools and the remaining minerals crystalize.)

3. What is the worlds smallest owl and what does it eat?

(The elf owl and it eats arthropods)

CAT CANYON



1. a. Write the name of the cat in this exhibit that is Endangered.

(ocelot or tigrillo)

b. Why do you think it is in trouble?

(habitat destruction and fragmentation, hunted for skins, killed because thought to be threat to livestock)

CACTUS GARDEN

1. List and describe 4 adaptations cacti have to survive and thrive in the desert.

(Succulence: water storage tissue CAM photosynthesis: enables stomates to be opened during cooler, more humid night for gas exchange, reducing potential for water loss)

Poisons: for protection from hungry animals

Spines: for protection, helps shade plant and shield it from drying winds Extensive shallow root system: quickly take up large amounts of water)

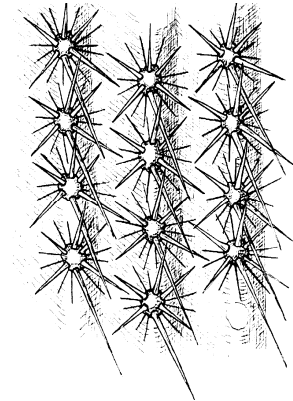
2. Prickly pear and cholla are different species of cacti within the Opuntia genus. Carefully observe both of these cacti.

a. What do they have in common?

(segmented stems, spines, glochids, similar flowers and rounded fruit)

b. How are they different?

(prickly pear have flat stems [pads], cholla have cylindrical stem)



RIPARIAN CORRIDOR

1. Observe the aquatic arthropod tank near the top of the stairs. List any organisms you find. (Answers will vary, but may include: snails, diving beetles, water striders, various larvae, fish, different water plants.)

2. Describe some ways aquatic insects breath, catch food, and hide. (Use specific aquatic insects as examples.)

Behavior	Insect name and description of behavior
Breathe	<i>Diving Beetle: takes air supply in a bubble from surface, carries under wing below water</i> <i>Mayfly larvae: has gills</i> <i>Mosquito larvae: goes to surface to breath and siphon air through a tube</i>
Catch food	<i>Backswimmer: swims upside-down catching insects that fall into the water</i> <i>Waterboatmen: filter algae and other microorganisms</i> <i>Giant water bug: grasps prey with front legs and pierces it with sharp beak</i> <i>Dragonfly nymph: lower lip shoots out to grasp prey</i>
Hide	<i>Many hide in vegetation</i>

3. What are riparian corridors and why are they important?

(Riparian refers to waterways and their banks. Riparian areas provide habitat for a great diversity of wildlife [75% of AZ vertebrate species depend upon these areas], purify air [tree leaves] and water, control erosion, and are beautiful.)

4. Diagram and label a cross-section of a typical riparian corridor (see wall near underwater viewing area).

5. How have riparian corridors been affected by humans? Note: See photos near otter exhibit.

(90% of riparian corridors in AZ have been destroyed or changed; grazing livestock erodes banks and destroys vegetation; water drained for irrigation, mining, urban use; uncontrolled recreation)

6. a. Where is this subspecies of desert pupfish found? (*Quitobaquito Springs in Organ Pipe National Monument*)

b. Describe the special physiological adaptations it has evolved for survival in desert pools.

(It can live in very saline [salty] water and survive temperature extremes from 50°F - 100°F.)

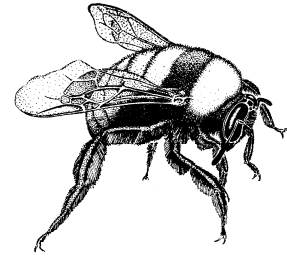
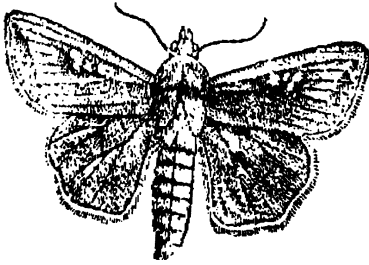
LIFE UNDERGROUND

1. Explain 2 advantages to spending hot summer days in underground burrows or crevices.

(increased humidity, avoid temperature extremes found at the surface)

2. Name 4 animals that burrow.

(kit fox, spadefoot toad, kangaroo rat, millipede, tiger salamander)



POLLINATION GARDENS

1. Describe 2 physical and 2 behavioral differences between moths and butterflies.

MOTH	BUTTERFLY
<i>Robust, thicker body</i>	<i>Slender body</i>
<i>Tapered antennae</i>	<i>Clubbed antennae</i>
<i>Nocturnal (active at night)</i>	<i>Diurnal (active during the day)</i>
<i>Rest with wings open</i>	<i>Rest with wings together</i>

2. Pollination is the process by which pollen is transferred from the male part to the female part of a flower of the same species. Plants need to be pollinated in order to produce seeds. List three ways plants attract pollinators.

(Plants advertise with floral color, patterns and/or fragrance; nectar and pollen are rewards.)

3. Are pollinators important to people? Explain. (Hint: think about the food we eat.)

(Yes! It is estimated that every third bite of food we take is dependent upon a pollinator; much of the fruit we eat is produced only after an animal pollinates the flower)

4. Watch at least 2 pollinators in the gardens for about 3 minutes. Describe what you observe.

(Answers will vary, but students may observe bees, butterflies, moths, wasps, and/or hummingbirds visiting flowers. Encourage detailed observations, such as flower color and animal feeding patterns.)

WARDEN AQUARIUM: RIVERS TO THE SEA

1. What is “Bycatch?”

(Bycatch is where many fishing lines and nets that are intended for one species catch other species by mistake. Turtles, marine mammals, and birds are included in this “bycatch.”)

2. Describe the diversity of the Sea of Cortez.

(The Sea of Cortez is home to more than 6000 animal species, including one-third of the world’s marine mammal species, more than 170 seabird species, and over 900 different fish species.)

3. Read the digital information about the Colorado River and the Colorado River Delta. List at least three ecological issues facing these habitats.

(Dams and diversions have changed the river system from what it once was; all of the native fishes of the Colorado River are threatened or extinct; introduced fish and invertebrates are out-competing native fish species; less than 10 percent of the delta’s wetlands remain; the entire delta is now eroding away due to the forces of tides and storms; fish adapted to fast, turbulent water are poorly adapted to current conditions in the Colorado River)

Tonight

1. Write a paragraph about something new you learned and found particularly interesting on your trip.

2. Describe some things you learned from a docent interpretation.

