REPTILES: THE BEAUTIFUL AND THE DEADLY - ACTIVITY GUIDE

Dear Educator:

Thank you for requesting our **REPTILES: The Beautiful and the Deadly** Activity Guide. I hope you and your students find it both fun and informative.

In this kit you'll find everything you need to prepare lessons and activities to maximize your students' learning experience. This includes lesson plans targeted at grades K-6 and 7-12. Classroom activities are enclosed to prepare your students for the trip to the exhibit. Of course, no one knows students better than teachers and we expect you to modify or discard parts of this package as your particular grade level dictates.

We are proud to support your ongoing efforts to educate students. We would like to hear your reaction to this program, as well as other ideas you may have.

Sincerely,

Clyde Peeling

TABLE OF CONTENTS

REPTILES: THE BEAUTIFUL AND THE DEADLY - ACTIVITY GUIDE

PROGRAM OVERVIEW

This Activity Guide provides comprehensive, multi-level, interdisciplinary lesson plans for educators to use in developing course materials for their classes. The program includes:

- Lesson plans for primary and secondary grades
- An Animal Taxon Registry section describing most of the reptiles that may be seen at the *REPTILES: THE BEAUTIFUL AND THE DEADLY* exhibit.

METHODOLOGY & ORGANIZATION

The lesson plans include purpose, objectives, method, exercises and evaluation.

Every effort was made to make this program complete yet flexible. You can use the lesson plans as step by step guides or customize them to compliment your current curricula objectives and personal teaching style.

Each plan consists of:

- Pre-visit lessons
- Suggestions for the actual visit
- Post-visit lessons

This approach allows you to prepare your students with facts and concepts that will enrich their learning experience and observational capabilities during the visit. It also takes into account that sometimes a field trip is not as orderly and conducive to communicating as a classroom. The post-visit lesson gives the students the opportunity to exchange ideas and apply concepts learned.

TOPICS COVERED

Although the main focus of the program includes a visit to the exhibit, the lessons themselves cover a wide variety of topics:

- Evolution
- Ecology
- Classification
- Adaptation
- Survival Strategies

EDUCATIONAL OBJECTIVES

You will find lesson plans suitable for each grade level from kindergarten through high school. For the younger age groups, the lessons include critical thinking skills activities including:

- Creative Writing
- Vocabulary
- Classifying
- Oral Communication

For secondary students, the focus shifts to applied science and reasoning skills including:

- Adaptation
- Observation

TAXON REGISTRY

To supplement the lesson plans, we have compiled information on most of the species displayed in the **REPTILES: THE BEAUTIFUL AND THE DEADLY** exhibit. The information includes:

- Common name
- Latin name
- Family
- Range
- Habitat
- Size
- Notes of Interest

You may find the Taxon Registry useful during and following your visit to the exhibit. It can enable you to point out interesting facts about the animals, their habits in the wild, and other information guaranteed to hold students' interest. Often students do not take time to read labels and can't retain much that they have read. The Registry should help you to double-check and confirm much of what students observed during their visit.

EDUCATIONAL SERIES

ANIMAL TAXON REGISTRY

As students examine exhibits, encourage them to read display signs and take notes. To which class, order and family does a particular animal belong? Explain that if it isn't a plant, it's probably an animal and belongs to the animal kingdom. Follow the divisions listed below. Explain why reptiles and amphibians are placed in a particular phylum, subphylum, class, order, etc. and why a starfish and a Maple tree (for example) are different. There's no reason to get bogged down with each category. Explain that animals that share certain characteristics are grouped together to show how they are related. Usually, animals that are closely related have many features in common. For example, a snapping turtle and a box turtle (both turtles) are obviously more closely related than a snapping turtle is to an alligator. All reptiles are cold-blooded and come from eggs. Snapping turtles and alligators, therefore, are more closely related to one another than either one is to a dog, which is a mammal that is warm-blooded.

Kingdom: Animalia (animal)

Phylum: Chordata (animal with a rod-like structure under the nerve cord)

Subphylum: Vertebrata (animal with a backbone)

Class: Reptilia (cold-blooded animal covered with scales that comes from an egg)

Order: Chelonia (turtles and tortoises)

Suborder: Cryptodira (hidden-neck turtles)

Family: Chelydridae (snapping turtles)

Common Name: ALLIGATOR SNAPPING TURTLE
Genus and Species: *Macroclemys temminckii*
Size: Up to 26 inch shell length and 200 pounds
Range: Mississippi River delta, north to Iowa and Indiana
Habitat: Deep water rivers and lakes
Food: Fish
Note: The largest fresh water turtle in North America.

Family: Testudinidae

Common Name: STAR TORTOISE
Genus and Species: *Geochelone elegans*
Size: Females up to 10 inches, males up to 6 inches
Range: Ceylon and India
Habitat: Arid country
Food: Grasses and fruits and fallen flowers
Note: Commercially exploitated for food and the pet trade.

Family: Trionychidae (softshelled turtles)

Common Name: SOFT-SHELLED TURTLE
Genus and Species: *Trionyx sp.*
Size: 5 to 18 inches
Range: Much of the eastern United States
Habitat: Marshy creeks, farm ponds, rivers, lakes
Food: Crayfish, other small invertebrates
Note: Females get twice the size of males.

Suborder: Pleurodira (Side-neck turtles)

Family: Chelidae

Common Name: SNAKE-NECKED TURTLE
Genus and Species: *Chelodina mccordi*
Size: Up to 10 inches in shell length
Range: Roti Island, southeastern Indonesia
Habitat: Rice paddies, soft bottomed rivers, lakes and ponds
Food: Variety of plants and small animals
Note: Protects head by folding it to the side unlike most turtles.

Order: Crocodilia (alligators, crocodiles and the gharial)

Family: Crocodylidae

Subfamily: Alligatorinae

Common Name: AMERICAN ALLIGATOR

Genus and Species: *Alligator mississippiensis*

Size: Females up to 9 feet; males up to 12 feet or more

Range: Southeastern United States

Habitat: Lakes, rivers and swamps

Food: All appropriately sized animals

Note: Eggs incubated above 90 degrees F. produce all males; cooler temperatures produce all females.

Order: Crocodylia (alligators, crocodiles and the gharial)

Family: Crocodylidae

Subfamily: Crocodylinae

Common Name: NILE CROCODILE

Genus and Species: *Crocodylus niloticus*

Size: Up to 16 feet, occasionally longer

Range: Most of tropical Africa

Habitat: Lakes, rivers and coastal waters

Food: Fish, birds and mammals including large mammals

Note: This is one of the few crocodile species that occasionally eats humans.

Order: *Squamata* (lizards and snakes)

Suborder: **Lacertilia (lizards)**

Family: Gekkonidae (geckos)

Common Name: LEAF-TAILED GECKO

Genus and Species *Uroplatus henkeli*

Size: Up to 10 inches

Range: Madagascar

Habitat: Forested areas

Food: Insects, snails

Note: Toepads are covered with microscopic hairlike hooks

Family: Chamaeleonidae

Common Name: VEILED CHAMELEON

Genus and Species: *Chamaeleo calyptratus*

Size: Females 13 inches; males 24 inches

Range: Yemen, Saudi Arabia

Habitat: Coastal plains, mountain slopes, high plateaus

Food: Insects, spiders

Note: Changes skin color to express mood or aid camouflage.

Family: Agamidae (dragons)

Common Name: BEARDED DRAGON

Genus and Species*: Pogona vitticeps*

Size: 18 to 24 inches

Range: Inland eastern Australia

Habitat: Sandy semi-desert

Food: Insects

Note: Named for their ability to extend the skin under the throat creating a beard-like display.

Family: Helodermatidae (beaded-scaled lizards)

Common Name: GILA MONSTER

Genus and Species: *Heloderma suspectum*

Size: 18 to 24 inches

Range: Southwestern United States

Habitat: Desert – under rocks and in burrows

Food: Eggs, small birds and mammals

Note: 98% of its life is spent underground to avoid desert heat – the remainder is spent in search of food and mates.

Family: Varanidae (monitors)

Common Name: WATER MONITOR

Genus and Species: *Varanus salvator*

Size: More than six feet in length

Range: Southeast Asia

Habitat: Vegetation beside rivers

Food: All forms of small animal life

Note: Smells with its long forked tongue

Suborder: Serpentes (snakes)

Family: Colubridae (common snakes)

Common Name: RED SIDED GARTER SNAKE

Genus, Sp, Subsp: *Thamnophis sirtalis parietalis*

Size: 18 to 51 inches

Range: Western Canada south through the Great Plains

Habitat: Wet meadows, damp woodland, farms, parks

Food: Minnows, frogs, earthworms

Note: Hibernates in large numbers in community dens

Common Name: MANGROVE SNAKE

Genus and Species: *Boiga dendrophila*

Size: 5 feet

Range: Southeast Asia

Habitat: Mangrove swamps

Food: Lizards

Note: Mildly venomous and rear-fanged

Common Name: PUEBLAN MILK SNAKE

Genus and Species: *Lampropeltis triangulum campbelli*

Size: 4 feet

Range: Central southern Mexico

Habitat: Semi-desert

Food: Small rodents and lizards

Note: An example of a species that is highly variable in color and pattern

Family: Boidae (boas and pythons)

Common Name: GREEN TREE PYTHON

Genus. and Species: *Morelia viridis*

Size: 4 to 6 feet

Range: New Guinea, Northern Australia

Habitat: Tropical rainforest trees

Food: Small birds, rodents

Note: Heat-sensitive pits within the lip scales enable the snake to detect warm-blooded prey.

Common Name: BURMESE PYTHON

Genus, Species, Subspecies: *Python molurus bivittatus*

Size: Up to 16 feet

Range: Southeast Asia

Habitat: Forest

Food: Small to medium-sized warm blooded animals

Note: Although usually tame, not a good pet due to size

Family: Elapidae (cobras and their relatives)

Common Name: ASIAN COBRA

Genus and Species: *Naja sp.*

Size: 4 to 6 feet

Range: Southeast Asia

Habitat: Forested areas

Food: Snakes, rodents, birds, lizards

Note: The snake charmers snake. It "dances" to the movement of the snake charmer, not the music. Snakes are deaf.

Family: Viperidae (vipers)

Common Name: WESTERN DIAMOND-BACK RATTLESNAKE

Genus and Species: *Crotalus atrox*

Size: Up to seven feet

Range: Southwestern United States

Habitat: Dry brush country

Food: Mammals and birds

Notes: Extremely dangerous due to size and disposition. The second longest venomous snake in the United States.

Common Name: GABOON VIPER

Genus and Species: *Bitis gabonica*

Size: 5 feet

Range: Western, central and eastern Africa

Habitat: Forest floor

Food: Mammals and birds

Notes: The largest species of viper. Fangs can exceed two inches in length.

Grades K-3

LESSON: TAXONOMY - WHAT IS A REPTILE?

PRE-VISIT

Purpose:

To identify the basic characteristics that define all reptiles and each of the four groups of reptiles.

Objectives:

- To define a "reptile."
- To distinguish different features that all reptiles have in common.
- To list and give examples of the four groups of reptiles.

Introduction:

To understand the world around us we name living and non-living things. Then we put things that share similar characteristic into groups. Some animals are more closely related than others are. It is a good bet that even the youngest students will know that a snake is more like a lizard than it is a dog.

Introduce the group of animals called reptiles. Have children collect or draw pictures of various kinds of reptiles (turtles, crocodiles, lizards and snakes). A *Reptile Puzzle* provides a good introduction to the external characteristics of reptiles for younger students. Cut their pictures into irregular puzzle shapes. Have students reassemble the pieces and use the opportunity to talk about the scales that cover each reptile, the size of the reptile, its shape and what it might eat. Use the pictures to help students to identify some of the characteristics that all reptiles share.

- They breathe air through nostrils; they have lungs
- They have scales on their skin
- The lay eggs on land

Other characteristics of reptiles that students can't see include the fact that reptiles have bones and can not produce body heat.

VISIT

Attempt to have the students stay with you the first time through the exhibit. Use the introductory signs to reinforce the characteristics that answer the questions, what is a reptile, a turtle, a crocodilian, a lizard and a snake?

After you have taken students through the exhibit in the logical sequence, encourage them to use the interactive exhibits on their own. Stay close by to help them understand what each exhibit is attempting to convey.

- Crawl through a giant tortoise shell. How would your life be different if you couldn't leave your shell? Would be it be good protection?
- Look at the different shapes of turtle and tortoise shells. Which one would be best for life in the water? Which one would be best for life on land? Why?
- Examine a turtle shell and see how turtles are put together.
- Examine a crocodile skull.
- Guess which is a crocodile skull and which is an alligator
- Listen to crocodilian sounds
- Read the questions on Lizard Wizard and ask children to guess the answers. Lift flaps for the correct answers
- "Milk" venom from a model viper head to see where venom comes from and how it is injected

- Turn a knob and watch how a model viper skull opens wide and closes
- Listen to sounds of a rattlesnake
- Gently touch a live snake

POST-VISIT

Have students list all the reptiles they saw during their visit. Which of their listed reptiles are turtles, crocodilians, lizards or snakes? How have they made the determination?

Flash Reptile card game. Use pictures of reptiles from magazines and hold them up. Have the students guess, which are lizards, turtles, snakes, etc.

A Paper Bag Reptile activity is a fun craft that can be used to review the characteristics of reptiles: scales, colors, etc. Create reptile puppets by having students color pictures of their favorite reptile on small hand-size bags.

Grades 4-6

LESSON ONE: WHAT IS AN AMPHIBIAN? WHAT IS A REPTILE?

PRE VISIT

Purpose:

To introduce students to the concept that animals are grouped together because they have certain characteristics in common.

Objectives

- To explain which animals are called amphibians.
- To explain how amphibians reproduce.

Introduction:

For this age group it is sufficient to explain that there are many living things in the world. Plants are living as well as animals. Some animals, like insects, do not have backbones. But the animals we are most familiar with do have backbones and they include fish, amphibians, reptiles, birds and mammals. Frogs, toads and salamanders are amphibians. These animals are different from fish because they spend at least part of their lives out of water. They are different from reptiles because reptiles have dry skin and amphibians often have slimy skin. They are different from birds because they don't have feathers and they're different from mammals because they don't have hair.

Amphibians and reptiles are "cold-blooded." They are approximately the same temperature as the air around them. Birds and mammals are "warm-blooded" and can make heat inside their bodies.

The amphibians that live in the United States usually lay a cluster of eggs in a gelatin-like mass. Then the male fertilizes the eggs and the eggs hatch into fish-like tadpoles. After a period of growth the tadpoles go through metamorphosis and become baby frogs, toads or salamanders.

Turtles, crocodiles and alligators, lizards and snakes are reptiles. Reptiles come from eggs that are enclosed within a sac. The egg sac is often surrounded with a hard or leathery shell. Some female snakes, however, keep the eggs inside the body until they are ready to hatch.

Procedure:

Make two lists side by side on the board – one for living things and the other for non-living things. Ask the class to name some things that are living (ex. - trees, grass, dogs, cats, etc.) and some things that are non-living (ex. - stones, sand, water, etc.). Ask if people are more like dogs and cats or more like sand and stones? Living things like dogs, cats, bears, goldfish, etc. are called animals. Ask students if all animals have a backbone? Erase the list of non-living things and make a list of animals with backbones and animals without backbones. Do houseflies have a backbone? No. Jellyfish? No. Mosquitoes? No. Do the students have a backbone? Yes. Do fish, frogs, snakes, parrots and dogs have backbones? Yes. Some may not think that a snake has a backbone, but ask them to touch the back of a snake when they *visit REPTILES: THE BEAUTIFUL AND THE DEADLY* exhibit. Ask them to gently feel along the top of the snake's back and they will find something very hard. That is the snake's backbone. Do they think that they are more like an animal with a backbone or one without a backbone? Hopefully they will conclude that since fish, amphibians, reptiles, birds and mammals have a backbone and people have backbones, we are more like them than we are like insects and jellyfish.

Frogs, toads and salamanders are called amphibians and they are a little like fish and a little like reptiles. Why? Because fish are cold-blooded and reptiles are cold-blooded and so are amphibians. Ask students to touch a reptile when they visit *REPTILES: THE BEAUTIFUL AND THE DEADLY* and try to remember if it is warm or cool. If it feels warm, encourage them to ask the exhibit staff person why a "cold-blooded" reptile might feel warm? The answer is that reptiles snuggle against a warm heat mat in the zoo habitats since they can't make their own body heat.

How are frogs, toads and salamanders (amphibians) different from lizards, snakes, turtles and alligators? Lizards, snakes, turtles and alligators are reptiles with dry skin covered with scales. Alligators can lie in the sun without drying out. Some lizards, turtles and snakes can live in very dry places – even deserts. Amphibians are slimy and their skin has many very tiny holes so they don't hold water very well. They have to live in cool moist places so they don't dry out.

There is one other important difference between amphibians and reptiles. Reptile babies usually come from eggs with a shell - similar to bird eggs. Inside the shell there is food so that the baby can grow. The food is called the yolk.

Amphibian babies come from eggs too. The egg is very soft and tiny and it doesn't have a shell and there is no food for the baby. The baby hatches into a tadpole very soon after the mother lays the egg and at first the baby lives like a fish and eats things that fish eat. After the tadpole grows large enough it changes into a frog, toad or salamander.

Questions:

1. What is one thing that makes us like frogs and toads? *A. We both have backbones.*

2. What about a frog, toad or salamander is like a fish? *A. They live in water part of their lives.*

3. What about an amphibian is different from fish? *A. Fish can never leave the water but amphibians can during the second part of their lives.*

4. If you were a zookeeper would you keep frogs, toads and salamanders in moist leaves or on dry sand? *A. Moist leaves.*

5. Why can reptiles live in dry places? *A. They are covered with dry scales like shingles that help to keep them from drying out.*

6. What do we mean when we say an animal is "cold-blooded? *A. It can not make its own body heat so it is approximately the same temperature as its surroundings.*

VISIT

This is usually a difficult time for teachers to do more than simply keep track of students. Children are often excited. Teachers can, however, encourage students to touch a live reptile and remind them to gently feel for the backbone and test whether it feels cool or warm to the touch.

Students possessing writing skills can make a list of reptile names beginning with A through Z seen during their visit. This tends to encourage them to read exhibit labels. There may not be an animal with a name beginning with every letter of the alphabet, but students should attempt to list as many as possible.

POST VISIT

Purpose:

To reinforce the pre-visit lesson and connect it with what they observed during the visit to *REPTILES: THE BEAUTIFUL AND THE DEADLY*.

Objectives:

1. To further understand how we classify animals.
2. To understand why we place animals into groups.
3. To define an amphibian.
4. To define a reptile.

Introduction:

We name animals so that we can talk about them and study them. We try to show how certain animals are related. Here are some things that make amphibians and reptiles alike and some other things that make them different.

Amphibians live a two-stage life. They hatch into tadpoles and live a fish-like existence, and then pass through a change called metamorphosis and become frogs, toads or salamanders. They have moist skin and lose body fluids quickly if they are exposed to the sun. Finally, amphibians are “cold-blooded.”

Like amphibians, reptiles are also “cold-blooded.” They are different, however, because reptiles come from an enclosed egg. The egg contains enough food - the yolk - to permit the baby reptile to by-pass the tadpole stage. When the baby emerges from the egg it looks like its parent – a snake, turtle, crocodile or lizard. Reptiles are also different from amphibians because they are more waterproof. The shingle-like scales prevent loss of water so they can live in dry places that an amphibian could not survive.

Procedure:

Survey the class and ask which reptiles they liked best. Make four lists on the board. Write “crocodilian,” “turtle,” “lizard,” and “snake” at the top of each column. Ask the students to remember as many different reptiles from their trip as possible. As they call out each reptile ask if it is a crocodilian, turtle or tortoise, lizard or snake? List each reptile under the appropriate category. Quiz them as to why they believe it should be in one category or the other. Suggest that even some reptiles are more alike than others are. Can they remember from their visit whether an alligator is more like a crocodile or more like an iguana?

Questions:

1. A bird has scales on its legs. Is it a reptile? Why not? *A. It has feathers and it is warm-blooded.*

2. Can you remember one thing that makes amphibians and reptiles alike? *A. They are “cold-blooded.”*

3. Can you list some things that make reptiles and amphibians different? *A. Reptiles have dry scales; amphibians have slimy skin. Reptiles look much like their parents when they hatch; amphibians hatch into tadpoles and later become frogs, toads or salamanders.*

4. Why do we name animals? *A. So that we can talk about them and study them.*

5. Can you guess whether a Boa Constrictor is more closely related to a Garter Snake or an alligator? *A. Garter Snakes and Boa Constrictors are both snakes and are more closely related.*

6. Is a tortoise more closely related to an alligator or a water turtle? *A. Water turtle.*

Grades 7-12

LESSON ONE: ECOLOGY

PRE-VISIT

Purpose:

To identify the basic components of an ecosystem and to define "ecology."

Objectives:

- To define "ecology."
- To distinguish different types of ecosystems.
- To list and give examples of the three basic forms of interrelationships that occur between a reptile and its environment.

Introduction:

Ecology is the study of relationships that occur within an ecosystem. An **ecosystem** is a defined area that is composed of specific types of living things and their physical environment. Ecosystems can be as simple as a fish aquarium with a few living plants or as complex as the whole earth with all its living things. The living earth is called our **biosphere**.

Major ecosystems that cover thousands of square miles with similar climate conditions and vegetation are called biomes. Some of the major biomes include the tropical rain forests, grasslands, deserts, deciduous forests and coniferous forests.

Most ecosystems are open, that is, interactions often occur across the boundaries of two ecosystems. An ecosystem that allows for nothing to enter or leave is called a **closed ecosystem**.

Procedure:

Divide students into cooperative groups. Groups are to decide on an ecosystem (forest, desert, lake, ocean, mountain, etc.) Have them list living and non-living factors that are usually found or associated with that ecosystem. For example, in a desert living factors include snakes, cactus, lizards, etc. and non-living factors include sand, hot temperatures, little or no precipitation, etc.

Each group should list at least 10 living and 5 non-living components. Students should then think about ways all of these factors interact and describe at least two relationships for each of the following types of interactions:

Living to living	Non-living to living	Non-living to non-living
1.		
2.		

Have each group give a brief report to the rest of the class and discuss any similarities and differences.

Questions:

1. What is ecology?
2. What is an ecosystem? What are its components?

3. What is a biosphere?

4. Name each type of interaction found in an ecosystem and give an example of each.

5. Can anything be removed from an ecosystem without affecting the rest of the components? Explain.

LESSON TWO: THERMAL ECOLOGY

PRE-VISIT

Materials:

A set of 27 children's' play blocks.

Sheet of black paper

Sheet of white paper

Purpose:

To understand how reptiles regulate body temperature.

Objectives:

- To define "cold-blooded" and "warm-blooded."
- To define "surface to volume ratio." (Not as difficult as it sounds).
- To understand the importance of color in regulating temperature.
- To understand the importance of behavior in regulating temperature.

Introduction:

Temperature is probably the most important single physical factor in the ecology of reptiles and amphibians and a great portion of the daily activity of many species is devoted to responding to the thermal environment. Unlike mammals and birds that internally produce large quantities of metabolic heat (warm-blooded), most reptiles have to rely on the external environment as a heat source (cold-blooded).

All of the heat that enters or leaves an animal's body passes through the body surface that is exposed to the outside world. The more surface that is exposed, the more heat can enter or leave. The smaller the surface area, the less heat can enter or leave.

The amount of heat stored in the body is determined by body volume. The larger and bulkier the animal, the more heat it can store.

An important factor in heat exchange with the outside environment is the surface of an animal's body compared to the body volume. For a given shape (a cube for example), as size increases the surface to volume ratio decreases.

Reptiles often position themselves to either gain the most heat possible (example: exposing the whole side of the body to the sun) or to minimize the heat from the sun (exposing the narrowest part of the body to the sun). Upon reaching the ideal temperature, a reptile may seek relief from the heat by crawling into a shaded area or into water.

Color is important to reptiles for various reasons. Light colors are often found in populations where heat from the sun is intense; light colors reflect heat. Dark colors are often found in animals from cooler areas; dark absorbs heat. Many reptiles can change the skin color from light to dark.

Procedure #1:

Explain the concept of surface to volume ratio with children's play blocks. One block has 6 sides so its surface to volume ratio is 6:1. Now arrange 27 blocks of equal size into a larger cube-shape. Now the surface to volume ratio has changed to 54:27 (54 exposed sides: 27 blocks) or when the numbers are reduced it becomes a surface to volume ratio of 2:1.

Ask students to imagine that a single block is a reptile – maybe a tortoise. The single block with the 6:1 ratio has a greater surface to volume ratio and would heat up rapidly in the direct sun. Also with its small volume, it would not hold heat for an extended period.

Ask students to imagine the larger block that you have created with the 27 small blocks is a larger tortoise. The larger block (created from the 27 smaller blocks) has a smaller surface to volume ratio (2:1) and would take a longer period of time to heat up and due to its greater volume would hold the heat longer also. So this larger "tortoise" could stay in the sun much longer than could the smaller one.

Now arrange the 27 blocks in a straight line and ask students to imagine it is a snake. Have students try to figure the surface to volume ratio (Answer 110:27 or a little more than 4:1). Ask them to consider how shape is important. The "snake" could not withstand periods in the sun as long as the larger block "tortoise" even though the total volume (number of blocks) is the same because it surface to volume ratio is larger.

We know this may be difficult for some students to totally understand but in all probability they will get the general idea. Surface to volume ratio is essential to understanding an animal's size and shape.

Procedure #2:

Place a thermometer under a sheet of black paper and place it in the sun or under a heat lamp. Place another thermometer under a sheet of white paper. Show that temperatures under the black paper are warmer. Explain that reptiles like crocodiles may be light tan to reflect heat because they live in the tropics; alligators, on the other hand, live in the cooler sub-tropics and may have darker skin to absorb heat.

Use a cutout of a black paper lizard. Demonstrate that if the cutout is positioned perpendicular to the sun it absorbs the full impact of the sun's heat. If it is turned so that the length of the paper lizard is parallel to the rays of the sun (only the thickness of the paper is exposed to the heat), it remains cooler.

Questions:

1. Think about surface to volume ratio. What could be one reason that baby tortoises are not seen in the sun as often as adults?

2. How does an animal's shape change the surface to volume ratio? Hint: think about the large cube-shaped pile of 27 blocks as a tortoise and the long line of 27 blocks as a snake. What happens to the surface to volume ratio?

3. What could be one reason that no reptile gets as large as an elephant? How long might it take for an elephant-sized reptile to warm up? Or cool down?

4. On a cool May morning in Pennsylvania, would a baby or an adult timber rattlesnake heat up more quickly? Which one would have to retreat to a shaded area first?

5. Why do most reptiles and amphibians in cold climates "brumate" (hibernate) during winter months? Why is it possible for most mammals to stay active? Remember cold-blooded reptiles rely on outside temperatures to stay warm.

6. How can a reptile adjust its temperature by behavior?

7. A reptile must have heat to digest food. How does the size and shape determine how quickly it can digest food?

8. Reptile eggs require heat. In cool northern climates, many female reptiles hold the eggs inside their body until the babies are fully developed and then the young are born alive. Why is size and shape important for a snake that holds its eggs (hint: the mother snake positions herself in the sun for warmth)?

9. What could be one explanation as to why alligators are darker in color than most crocodiles? Remember crocodiles live in warmer climate than alligators.

LESSON THREE: SALT AND WATER AS AN ECOLOGICAL FACTOR

PRE VISIT

Purpose:

To encourage students to think about the importance of water to all living things and consider how reptiles and amphibians deal with the problems of too much or not enough water.

Objectives

- To explain water and salt as ecological factors.
- To explain the effects of temperature and humidity.

Introduction:

About 65 to 75 per cent of the weight of adult reptiles is water. The roles of salts and water are closely interconnected in the ecology of reptiles, as both are involved in the maintenance of a proper concentration of body fluids. The osmotic concentration of such fluids can be altered by changes in the content of either salt or water. In order to maintain body water at a level at which vital processes can occur, animals must be able to get rid of excess water in water-rich environments and secure enough water when moisture is scarce. They must also have a mechanism to expel excess salts.

Humans rid their bodies of excess salts in perspiration and urine. Many reptiles don't urinate. Instead, they produce uric acid which is nearly insoluble (it doesn't dissolve in water) and is excreted in semi-solid form with the feces (solid waste). These reptiles expel excess salts through tear ducts or by sneezing salts from the nostrils. Consequently, reptiles need less water in their excretion process than other back-boned animals that excrete ammonia and urea. However, some reptiles get rid of excess water in the form of liquid urine and some tortoises, turtles and crocodilians excrete ammonia and/or urea.

There are two major avenues of evaporative loss: (1) through the skin; and (2) from the respiratory surfaces (lungs).

Reptiles and amphibians obtain moisture: (1) by drinking; (2) from their food; (3) as a by-product of metabolism; and (4) through the skin. Desert reptiles get most or all of their water from the last three.

Amphibians have skin that is permeable (water can pass through it easily) and therefore they generally stay out of direct sunlight and live in moist areas and absorb moisture through the skin. Reptiles, on the other hand, are covered with dry horny scales that make them somewhat waterproof. Due to the scales, reptiles can bask directly in the sun to warm their bodies without losing body fluids.

Amphibian eggs are usually laid in moist leaves or in water. Reptile eggs, on the other hand, have a shell surrounding the egg sac and can withstand dryer conditions. But even reptile eggs must be surrounded by slightly moist material.

Procedure:

Ask the class to observe the environments for the reptiles on display at the REPTILES: THE BEAUTIFUL AND THE DEADLY exhibit. How have the moisture requirements been accounted for? Students may notice a light-colored residue surrounding the nostrils of some lizards. This is dried salt; these lizards expel excess salt through the nostrils. Also look for the tears around the eyes of the tortoises; another method of expelling excess salt.

Questions:

1. Why are many desert reptiles light colored and forest reptiles darker?

2. Why do you think there are hidden heat mats under the alligator land area? How do you think the alligators make use of them?

3. If you were a keeper at a zoo what are some methods you might use to allow reptiles to regulate their body heat?

4. What methods do reptiles use to expel excess body salts?

VISIT

Encourage students take notes and ask questions. Have them critically examine reptiles in the exhibits. What type of habitat? Desert, rainforest, etc. How are thermal requirements met in captivity? What significance might there be in the color and shape of the animal?

LESSON FOUR: NATURAL SELECTION

PRE-VISIT

Purpose:

To explain the Theory of Natural Selection

Objectives:

1. To define evolution

2. To list the assumptions upon which Charles Darwin based his Theory of Natural Selection

3. To define natural selection

Introduction:

Change is a normal and natural process. Clothes, music, cars, hairstyles and living things all change. Evolution is change. The diversity of life that exists is thought to be the result of biological evolution. Charles Darwin developed the Theory of Natural Selection, an idea that carefully explains how life could change or evolve. Darwin was impressed with both the diversity of life and the similarities that existed among the many forms he observed.

Darwin based his Theory of Natural Selection on the following assumptions:

1. **Overproduction** – All living things produce more offspring than are necessary to replace existing populations.

2. **Variation** – No two offspring are exactly alike or exactly like their parents.

3. **Competition** – The number of offspring usually exceeds the supply of living space and available food. As a result, competition among offspring develops.

4. **Survival of the Fittest** – Offspring struggle for existence and those with the most favorable variations will most often survive to reproduce.

5. **Variations often are inheritable** – Favorable characteristics can be passed on from parents to offspring.

Darwin stated that the environment determines what is a favorable variation. However, the “fittest” doesn’t necessarily mean the strongest, biggest or fastest. A snake living in green foliage might

benefit from green coloration. Any snake born with another color might have a “less fit” color and be eaten by a predator while the green snake blends into its surroundings and is more often overlooked by predators.

Nature selects the “fittest” to survive. As the environment changes over long periods of time, changes in traits within a population will be selected for. This adaptation to the environment is evolution. Within a population there usually exists a normal distribution of traits. When the traits are graphed, they look like an evenly proportioned bell. This bell-shaped curve can sometimes be modified if changes in the environment occur. A change in the shape of the curve for a particular trait within a population would be evidence that evolution in occurring.

Procedure:

Survey the class and list the shoe size for everyone in the class. Combine the results from several classes and then graph the totals.

Questions:

1. What kind of curve does the graph show?

2. What does the normal distribution curve indicate about a population?

3. If only large shoe-sized children survived and had children, what would happen to the normal distribution curve?

4. What factors may affect shoe size?

5. If a normal distribution curve changes, what does this indicate is happening?

6. Remember what we learned about surface to volume ratio. If temperatures in the southeastern United States became warmer, do you think natural selection would favor darker or lighter-colored alligators? Larger or smaller body size? Why?

(#6 has no right or wrong answers. Many factors have to be considered and the question is designed only to stimulate thinking. Remember that light colors reflect heat; dark colors absorb heat. Large bodies take more time to warm up and once warmed store heat longer; small bodies heat more quickly and store it for less time.)

VISIT

Encourage students to look for adaptations that make each reptile uniquely suited to its environment. Notice the apposable toes of a chameleon’s foot that allow it to grasp a branch; the toes of the gecko – designed for climbing smooth surfaces; the toes of the Bearded Dragon – adaptations for life on land. Note the differences among aquatic turtles, soft-shelled turtles and tortoises.

POST-VISIT

Have students list the reptiles they remember seeing and features they think are helpful to their survival.

Review Darwinian evolution. This is the basis for all modern biology and unfortunately is often given little attention in the classroom.

REFERENCES

For Teachers and/or Secondary Students:

Behler, John L. and King, F. Wayne, *The Audubon Society Field Guide to North American Reptiles and Amphibians,* New York: Alfred A Knopf, Inc., 1979

Behler, John L., *National Audubon Society First Field Guide Reptiles*, New York; Chaunticleer Press, Inc., published by Scholastic Inc. 1999

Behler, John L. and Deborah A., *Alligators & Crocodiles*, Stillwater, MN: Voyageur Press, Inc., 1998

Carr, Archie. *Handbook of Turtles*. Ithaca, NY: Cornell University Press, 1952.

Carr, Archie. *The Reptiles*. New York: Time-Life Books, 1968.

Conant, Roger A. *A Field Guide to Reptiles and Amphibians of Eastern and Central North America.* New York: Houghton-Mifflin, 1957.

Pritchard, Peter C.H., *Encyclopedia of Turtles*. Neptune, NJ: T.F.H. Publications, Inc. Ltd., 1979.

Ross, Chares A., *Crocodiles and Alligators*, New York: Facts On File, Inc., 1989

Mattison, Chris, *The Encyclopedia of Snakes*, New York: Facts On File, Inc., 1995

For Primary Students:

Smith, Trevor. *Eyewitness Juniors Amazing Lizards*. Borzoi Book. New York: Alfred A Knopf, Inc., 1990

McCarthy, Colin. *Eyewitness Books Reptile*. Borzoi Book. New York: Alfred A Knopf, Inc., 1991

Stoops, Erik D. and Stone, Debbie Lynne. *Alligators and Crocodiles*. New York: Sterling Publishing Co., Inc., 1996.

Snedden, Robert. *What is a Reptile?* Sierra Club Books for Children. London: Belitha Press Limited, 1994.

Matero, Robert, *Eyes on Nature Reptiles*, Chicago: Kids Books Incorporated, 1993.