

**LIFE ON EARTH  
UNIT FOUR  
SUMMARY**

**UNIT FOUR MATERIAL**

**The videotapes to watch for this unit are:**

Video Program 7 - VICTORS OF THE DRY LAND

Video Program 8 - LORDS OF THE AIR

**Read the CONCEPTS in the study guide:**

CONCEPTS FOR EPISODE 7

CONCEPTS FOR EPISODE 8

**Answer the QUESTIONS in the study guide:**

QUESTIONS FOR EPISODE 7

QUESTIONS FOR EPISODE 8

**OVERVIEW OF LEARNING OBJECTIVES**

**Video Episode 7**

To become acquainted with:

1. characteristics of the reptiles
2. the various groups of reptiles and their features
3. adaptations to life on land (solutions to problems), including the development of a waterproof egg and scales
4. "cold blooded" versus "warm blooded" animals
5. dinosaurs and possible reasons for their demise
6. social behavior of crocodiles
7. turtles and tortoises
8. lizards
9. snakes and their special adaptations

**Video Episode 8**

To become acquainted with:

1. the feather and its properties (suitability for flight and insulation)
2. characteristics of birds
3. *Archaeopteryx* and its characteristics
4. the development of the beak
5. adaptations to flight
6. migration and navigation
7. courtship and behavior
8. flightless birds

## CONCEPTS FOR EPISODE 7: VICTORS OF THE DRY LAND

### REPTILES

There are two major evolutionary advances associated with the ancestors of the reptiles: a skin waterproofed with **scales** and eggs protected from drying out by a **leathery shell**. With these changes, reptiles were no longer tied to living in a moist environment or close to water. (See below for the big picture.)

Modern reptiles include the tuatara (from New Zealand), turtles and tortoises, crocodiles and alligators, lizards, and snakes. All living reptiles have scales. They depend on the outside environment for their source of heat as opposed to producing heat internally. Gas exchange occurs across lungs.

On the reptile evolutionary tree, many of the branches lead to extinct groups, such as aquatic mosasaurs. (A mounted mosasaur found in Onion Creek can be seen at the Texas Memorial Museum on the UT campus.) One branch leads to the ancestors of the mammals. One branch leads to the turtles. One branch leads to pterosaurs, dinosaurs, crocodiles and birds. One branch leads to modern snakes, lizards and the tuatara.

### DINOSAURS

People have been fascinated with dinosaurs for years, even before movies such as *Jurassic Park*. The science of paleontology is quite controversial and new theories arise constantly about the lifestyle, physiology and behavior of dinosaurs. An enormous debate still rages about whether dinosaurs were "cold blooded" or "warm blooded" animals. You will find numerous books and magazine articles about dinosaurs; some magazines, such as *Discover*, have dinosaur related items appearing almost monthly.

While it is beyond the scope of this course to examine the great diversity of dinosaurs that existed, we would like to point out a couple of interesting evolutionary relationships. The archosaurs (ruling reptiles) is a group that contains the traditional dinosaurs, pterosaurs, all crocodiles and birds. The dinosaurs are typically divided into two groups: the "birdhipped" dinosaurs and the "lizard-hipped" dinosaurs. The "lizard-hipped" group contains such familiar dinosaurs as *Apatosaurus*, *Tyrannosaurus*, and *Velociraptor*. The "birdhipped" group contains stegosaurs and *Triceratops*. (Bird-hipped? Lizard-hipped? There's a good explanation with pictures at these websites:

<http://www.ucmp.berkeley.edu/diapsids/saurischia/saurischia>

<http://www.ucmp.berkeley.edu/diapsids/ornithischia/ornithischia.html>

While certain members of the archosaurs became extinct, the crocodiles and birds are still alive today. Most paleontologists feel that birds are modified meat-eating dinosaurs and should be considered living dinosaurs.

---

#### Dinosaur Websites:

[http://www.amnh.org/exhibitions/expeditions/treasure\\_fossil/](http://www.amnh.org/exhibitions/expeditions/treasure_fossil/)

(Then click on "Dinosaurs & Descendants")

<http://www.nmnh.si.edu/paleo/blast/index.html>

---

## THE CHANGING NATURE OF SCIENCE

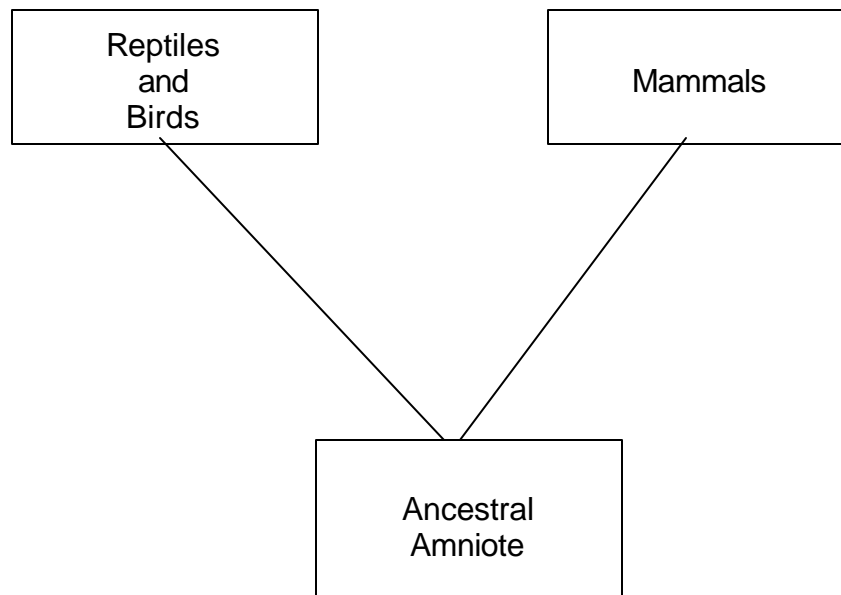
Somewhere along the way, two major adaptations evolved in terrestrial vertebrates. We call this revolutionary organism an **amniote**. These two adaptations were:

1. an egg that does not need to be laid in water because it contains its own little “pond” inside a shell, and
2. a waterproof skin.

From this ancestral stock arose two main lines: one leading to mammals, the other to reptiles and birds. If you saw this organism today, you would probably call it a reptile. However, scientists don't call it a reptile because there are subtle differences in bone structure that make it different from living reptiles.

Also, from a different perspective, calling the ancestral amniote a reptile would mean that all its descendents would also have to be reptiles. This means birds would be reptiles and mammals would be reptiles. *(There was a tremendous controversy about linking humans and apes. Just imagine if scientists wanted to call all mammals, including humans, reptiles.)* This is a real sore point for some scientists, particularly the ones that study birds. The molecular data is clear on these relationships but names are labels applied by humans. And humans get very attached to their labels. Thus, we still use the terms reptiles, birds and mammals.

### EVOLUTIONARY TREE OF THE AMNIOTES





d. geckos

5. What is the function of pigmentation in the reptilian skin?

**Locator:** Galapagos Islands

6. Describe the Galapagos tortoise and its life style.

7. Describe the marine iguana and its life style.

8. What does "cold blooded" mean? (**Note:** another term for "cold blooded" is **ectothermy**.)





16. Describe the variety of forms that developed in the dinosaurs.

**Locator:** Utah

17. What dinosaur fossils have been found in Utah? Why are these fossils significant?

=====

**ADDITIONAL INFORMATION:** There is an interesting article on dinosaur eggs in the *National Geographic* issue of May 1996. Also, you can check out this website for dinosaur eggs: <http://www.nationalgeographic.com/features/96/dinoeggs>

=====

18. What reasons have been postulated to explain the enormous size of some of the dinosaurs?

19. Describe a possible method used by the dinosaurs to control their internal temperature.

=====

**CHANGING NATURE OF SCIENCE:** There is a fascinating web page that shows how scientific views of dinosaurs have changed since the fossils were first discovered. This web page presents a grid that outlines how viewpoints have changed concerning the environment, anatomy, behavior and physiology of dinosaurs.

<http://search.eb.com/dinosaurs/dinosaurs/grid.html>

Were the dinosaurs cold-blooded or warm-blooded? The arguments continue among paleontologists. See the December 1996 *Discover* for an argument for cold-blooded dinosaurs. See the December 2000 *Discover* for an article which mentions the pros and cons of each, while discussing a highly controversial fossilized dinosaur heart. A web-based discussion can be found at: <http://www.ucmp.berkeley.edu/diapsids/metabolism.html>

=====

20. Describe the following dinosaurs:
  - a. *Apatosaurus* (formerly called *Brontosaurus*)

b. *Triceratops*

21. Be able to discuss the various explanations that have been suggested to explain the demise of the ruling reptiles.

=====

**AUTHORS' NOTE:** At the time Attenborough made the videos, the global catastrophe theory was not given much credence by scientists. Today, the theory generally accepted to explain the demise of the dinosaurs is based on a global catastrophe. Walter Alvarez proposed the asteroid impact hypothesis. 65 million years ago, an asteroid plunged into the Gulf of Mexico near the Yucatan Peninsula. This impact created a dust cloud that enveloped the earth, blocking out sunlight and preventing plants from photosynthesizing. Then as now, the plants were the base of the food chain. Without the plants providing food for these massive reptiles, they became extinct. (Also, other scientists feel this would have significantly dropped surface temperatures, which might have also been a factor in the demise of the dinosaurs.) You can get more information about the asteroid impact hypothesis at these web sites:

<http://www.nmnh.si.edu/paleo/blast/>

<http://www.pbs.org/wgbh/nova/sciencenow/3313/01.html>

Does this mean that everyone accepts the asteroid impact hypothesis? Of course not. In the January 1997 issue of *Discover*, you will find an interesting theory based on global changes in carbon dioxide levels that attempts to explain the mass extinction of marine species that occurred at the same time as the extinction of the dinosaurs.

=====

22. What mammal co-existed with the dinosaurs?
23. If a change in the climate was responsible for the demise of the dinosaurs, why did other reptiles, such as the crocodiles, survive?



=====

**AUTHORS' NOTE:** Since Attenborough made the video, fossils have been discovered that show that some dinosaurs not only laid eggs in nests but also took care of their young. (Shades of *Jurassic Park II*.) The grid referred to above also has information about dinosaur parental care: <http://www.britannica.com/dinosaurs/dinosaurs/grid.html>

=====

26. What are the characteristics of the lizards?

=====

**AUTHORS' NOTE:** "Losing their legs" is not a major characteristic of lizards. In fact, lizards are much more likely to lose their tails. This is a defense mechanism to distract predators. The tail falls off and thrashes around; the predator investigates the tail; the lizard leaves.

Since Attenborough doesn't spell out the characteristics of lizards, we are going to expand on this section. Most lizards have four legs (unlike their close cousins, the snakes), although some have two legs and others have none. You can tell a legless lizard from most snakes because the lizard will have internal traces of limb girdles. (However, some snakes still have evidences of limbs.)

Most lizards have visible ear openings and eyelids. In fact, most have a third eyelid, the nictitating membrane, that slides over the eye to protect it. Lizards cannot separate the two halves of their lower jaws. (Snakes can. In fact, they have to because they swallow their prey whole. This is why an anaconda can swallow an entire pig, even though the pig is much fatter than the anaconda.)

Lizards and snakes do share many characteristics, including the presence of hemipenes which are essentially a pair of penises. We will spare you the boring bone details that show the close relationship between lizards and snakes.

Attenborough shows you lots of lizards in this episode. There are many web sites about lizards.  
<http://www.sandiegozoo.org/animalbytes/t-lizard.html>  
<http://animal.discovery.com/guides/atoz/snakes.html>

=====

27. What is unusual about the following lizards?

a. Australian blue-tongued skink

b. South African skink

c. Australian scaly foot

28. 100 million years ago, the lizard ancestors of the \_\_\_\_\_ took to burrowing.

=====

**ADDITIONAL INFORMATION:** There is an interesting article on the basilisk lizard (also known as the Jesus Christ lizard) in the *National Geographic* issue of March 1997, in the Earth Almanac section. You can also see a quicktime movie of the basilisk lizard at:

[http://www.cnn.com/EARTH/9603/leapin\\_lizards/lizard.mov](http://www.cnn.com/EARTH/9603/leapin_lizards/lizard.mov)

=====

29. What evidence of limbs is found in the pythons and boas?

30. Describe the different methods of movement used by the snakes.

31. Describe the different feeding adaptations that have developed in the snakes.

**Locator:** Canada

32. What advanced evolutionary traits are seen in the prairie garter snake?

33. What group of snakes is thought to be the most advanced?



## CONCEPTS FOR EPISODE 8: LORDS OF THE AIR

### BIRDS

Birds are the second most numerous group of vertebrates alive today, second in number only to the bony fishes. Among **living** vertebrates, the birds are most closely related to crocodiles.

For many years, biologists have classified birds on the basis of one single characteristic: the presence of feathers. While feathers are important for flight, they can no longer be considered as uniquely avian (birdlike) features. There are 125 million year old fossils from China that clearly have feathers. These are dinosaur fossils, not bird fossils. Furthermore, true bird fossils are found in the same deposits. Many paleontologists use this fossil evidence today to support the view that birds are living dinosaurs. In other words, all dinosaurs did not become extinct 65 million years ago. The birds survived and should be classified with dinosaurs, not isolated as a separate group. *(And here's where the feathers start flying when you get a group of paleontologists together. Scientists have very strong opinions about this issue and are not shy about sharing them with others.)*

At present, the first non-controversial bird fossil is *Archaeopteryx*, dated at 145 million years old. *Archaeopteryx* had feathers, teeth, a long tail and was most likely a decent flier. There is a fossil named *Protoavis* (a Texas fossil) from rocks near Lubbock that are 220 million years old. *Protoavis* was originally described as a bird fossil but this specific specimen is so fragmentary that no good conclusions can be drawn. Is it a bird or not? Most paleontologists are skeptical. Since there are no feathers on this *Protoavis* specimen, the arguments revolve around other anatomical features, such as bone and skull structures.

So, why did the feather evolve in reptiles? Well, that's another controversy. The majority opinion today is that reptile feathers were used for insulation. (By the way, this is evidence that supports the idea that some dinosaurs were warm-blooded.) As mentioned above, fossils of feathered dinosaurs have recently been found in China.

---

#### Websites:

<http://www.ucmp.berkeley.edu/diapsids/birds/birdfr.html> (*Protoavis* information)  
<http://www.ucmp.berkeley.edu/vertebrates/flight/enter.html> (vertebrate flight)  
[http://news.bbc.co.uk/1/hi/english/sci/tech/newsid\\_1081000/1081677.stm](http://news.bbc.co.uk/1/hi/english/sci/tech/newsid_1081000/1081677.stm) (feathered dinos)  
<http://www.dinosauria.com/jdp/jdp.htm> (dinosaur and bird info)

---

Today, all animals with feathers are birds. Most of us still associate feathers with flight, a lifestyle that has evolved in the vertebrates only with birds, bats and pterosaurs. But feathers have many other uses besides flight. Some feathers are modified for insulation, as exemplified by down feathers used in jackets and sleeping bags. Other feathers are used for courtship and display; just think of the magnificent peacock or birds of paradise. Birds are warm-blooded and produce their own heat internally. This requires them to eat a great deal of food; to eat "like a bird" is to eat very large quantities of food daily.

Other changes are found in the bird body, probably as a result of the demands of flying. The heavy jaw with teeth has been replaced by a light-weight horny beak. A muscular gizzard has been added to the digestive tract; birds often swallow small pebbles that lodge in the gizzard and are used to grind up food. The large intestine is very short, which prevents the bird from storing heavy wastes in its body. (Despite the commercials, birds do not release wastes deliberately onto the clean hood of your car. Wastes are released as food is processed by the digestive tract.)

The bones of a bird are hollow, which considerably lightens the load. A female bird lays her eggs outside her body and sits on the eggs to provide the developing young with heat. The bird egg houses the developing embryo surrounded by a protective calcium-based shell. (Some dinosaurs also had hollow bones.)

You can find more information about bird adaptations at:

<http://www.ucmp.berkeley.edu/vertebrates/flight/aves.html>



**QUESTIONS FOR EPISODE 8: LORDS OF THE AIR**

1. Describe the feather.
2. According to Attenborough, what single trait is required in order to classify an animal as a bird? (See previous discussion.)
3. What is the significance of the fossil feather found in Solnhofen, Bavaria?
4. Describe the fossil *Archaeopteryx*. What is important about *Archaeopteryx*?











22. Describe the natural history of the European stork.
23. Discuss the various methods used by the birds to claim a territory and attract a mate of the proper sex and species.

=====

**ADDITIONAL INFORMATION:** This brings up another subject that Darwin introduced to science – sexual selection. Think of a male peacock with its big gorgeous tail. The dowdy peahen can certainly locate the male easily but so can every predator. This reduces his chances of longevity. So, why is the male peacock advertising itself?

Remember the concept of natural selection. The idea is to leave as many offspring as possible. Males need to find mates and then persuade the females to choose them. So, for males, getting mates is more important from an evolutionary standpoint than living long lives. Male peacocks are “flashy dressers” in order to attract females.

No flash = no mate = no offspring = evolutionary dead-end for his genes.

=====





=====

**ADDITIONAL INFORMATION:** Texas is a very important state for birds, with a high diversity of resident birds and a major route for migratory birds. Check out the following web sites for more information:

<http://www.tpwd.state.tx.us/huntwild/wild/birding/migration> This great booklet describes the bird migrations that come through Texas each spring and fall. You'd be surprised how many birds come through here each year. Last fall, for example, birdwatchers counted over 500,000 broad-winged hawks migrating along the coast IN ONE DAY!

<http://www.tpwd.state.tx.us/huntwild/wild/birding/> This page links to scads of information on the birds of Texas, and where and how to find and watch them. There are links to booklets like the one above and to information about Texas Parks and Wildlife's bird conservation programs, in many of which amateur birders are involved.

=====

31. Describe the migratory pattern of the Arctic tern.

32. Describe the ostrich, a bird that has abandoned flight to adopt a ground-dwelling life style.

=====

**ADDITIONAL INFORMATION:** The ratites, great flightless birds, are all found on southern continents: South America, the rhea; Australia, emus and cassowaries, New Guinea, cassowaries; Africa, ostrich; New Zealand, extinct moas; and Madagascar, extinct elephant birds. There is also fossil evidence that these land masses were once a supercontinent called Gondwana (Gondwanaland).

See these websites for more information:

<http://www.scotese.com>

(amazing animated paleogeographic & paleoclimatic maps, showing Gondwana)

<http://www.kiwirecovery.org.nz/>

(information about kiwis, including evolutionary information)

=====

33. Why do birds abandon flight?

34. How does the ostrich protect itself?