

Evolution of Land Vertebrates

Key Words

lungs:	primary internal organs of the respiratory system of land vertebrates
external fertilization:	fertilization that takes place outside a female animal's body, usually in water
internal fertilization:	fertilization that takes place inside a female animal's body
endothermic:	having an internal body temperature that stays constant regardless of the temperature of the environment

KEY IDEAS

One of the greatest changes in the kinds of animals on the earth occurred when vertebrates moved from the water onto land. This movement to life on land required major changes in vertebrates' structures and ways of living.

Scientists have a number of ideas about which vertebrates were the first to live on land. One idea is that the first land vertebrates were fishes that developed lungs and strong front fins. When the water in which the fishes lived was low in oxygen, they could rise to the surface and gulp air. These adaptations were successful because they allowed the fishes to move to new sources of water. The lungs and fins also helped the fishes move onto land located between pools of water. The fact that these adaptations helped vertebrates to survive on land proved to be an advantage.

Benefits of Life on Land. Scientists believe the move of vertebrates from life in the water to life on land occurred more than 350 million years ago. Living on land offered many advantages over living in the water. The land provided many new sources of food and places to live. Air has at least 200 times more oxygen to breathe than an equal volume of water. Land also has more protection and shelter in which to raise offspring.



1. What are three benefits to life on land? _____

Adaptations to Life on Land. In addition to offering many benefits, living on land also has many problems. Life on land is very harsh compared to life in the water. Animals need water, or moisture, for breathing and reproduction. Different kinds of vertebrates developed different adaptations to life on land. Some vertebrates developed internal lungs for breathing instead of external gills. **Lungs** (luhngz) are the primary internal organs of the respiratory system of land vertebrates. The liquids inside a vertebrate's body keep its lungs moist. Vertebrates that breathe with lungs include amphibians, reptiles, birds, and mammals.



2. What are lungs? _____

Reproduction. Some vertebrates that moved to land changed the way they reproduced. Most vertebrates that live in or near water have external fertilization. Recall that fertilization is the joining of sperm and egg. **External fertilization** (ehks-TER-nuhl fuhrt-uhl-ih-ZAY-shuhn) is fertilization that takes place outside a female's body. In this process, the sperm moves through water to join with the eggs.

Most land vertebrates adapted a different way to reproduce. They developed internal fertilization. **Internal fertilization** (ihn-TER-nuhl fuhrt-uhl-ih-ZAY-shuhn) takes place inside a female's body. Water is not needed to move the sperm to the egg. Instead, the sperm moves through moist mucus inside the female's body to the egg.

In some land vertebrates, the young develop inside the mother's body. Other vertebrates lay eggs. Many vertebrates that live in or near the water lay their eggs in the water. These eggs do not dry out. However, eggs laid on land will dry out. An adaptation of land vertebrates is an egg with a leathery or hard outer shell. These kinds of shells protect the eggs from drying out.

Skin Protection. Land vertebrates also face the problem of their bodies drying out. These vertebrates evolved ways to prevent their bodies from losing water. Amphibians, for example, have special glands in their skin that produce a slimy substance called mucus to keep their skin moist. Reptiles are protected from drying by a covering of tough outer scales.

Body Support. Another problem of life on land is that air provides less support to the body than water. Vertebrates that moved to land evolved to have strong skeletons to support their bodies. Land vertebrates also evolved to have legs, instead of fins, to allow for better movement on land.



3. Why did vertebrates that moved to land need a strong skeleton?

Body Temperature. Another difference between water and land environments is the temperature. On land, temperatures change more frequently than in water. Water environments have a nearly constant temperature from day to night. There are only slight temperature changes from one season to another. On land, the temperature can change greatly from day to night and from season to season.

Recall that most vertebrates that live in the water are ectothermic. Their body temperatures change with the temperature of the water. Many vertebrates that live on land are endothermic. **Endothermic** (ehn-doh-THUHR-mihk) animals maintain a constant internal body temperature regardless of the temperature of their environment. Unlike ectothermic vertebrates, endothermic vertebrates do not need to absorb heat from their surroundings. Thus, endotherms can survive greater changes in temperature than ectotherms. Of all the vertebrates, only birds and mammals are endothermic.

**TAKE
ANOTHER
LOOK**

Fig. 34-1 compares the characteristics of some vertebrates that live in water to some of those that live on land.

Fig. 34-1

Characteristics	Vertebrates that live in water	Vertebrates that live on land
Fertilization	External fertilization	Internal fertilization
Eggs	Jelly-like eggs	Eggs with a hard outer shell
Skin protection	Skin protected by water, mucus, and/or scales	Skin protection includes mucus and hard scales
Breathing structure	Gills	Lungs
Body temperature	Most ectothermic	Endothermic, ectothermic
Limbs	Fins or flippers	Strong skeleton with legs

Check Your Understanding

Write a sentence explaining the connection between each pair of words.

4. external fertilization, internal fertilization _____

5. endothermic, ectothermic _____

Fill in the blanks in the paragraph using the following terms:
food, lungs, oxygen, shelter, skeletons, endothermic, water

Life on land offered new sources of (6) _____ and (7) _____.
The air also has more (8) _____ than water. Vertebrates that moved
to live on land developed (9) _____ for breathing and strong
(10) _____ to support their body weight. (11) _____ land
vertebrates have a constant internal body temperature.

12. What are two ways that some land vertebrates keep their bodies from
drying out? _____

13. In what two ways did the reproduction of many land vertebrates
change from that of vertebrates that live in water? _____

14. You have just read about how vertebrates evolved to live on land.
Imagine that in the future, humans were forced to live in water. How
would the human body have to change for humans to be able to live in
water? _____

