

# An Introduction to Earthworms



Earthworms

# The Amazing Earthworm

- Aristotle called earthworms “nature’s plows” and “the intestines of the earth.”
- Worms help to fertilize crops, mix and aerate the soil, moderate pH, and break down plant and animal waste.
- When the U.S Department of Agriculture tested fertilizer against earthworms, they found that grass grew four times faster in the sample with earthworms.

# The Amazing Earthworm

- Earthworms can cover an acre of land with as much as 18 tons of new soil each year.
- By eating and breaking down large pieces of decaying matter, earthworms play a key role in increasing humus in soil, thereby increasing the soil's ability to hold water and feed plants.
- As they burrow through soil, worms keep it loose, allowing water and air to reach plant roots and improving soil conditions for beneficial bacteria and micro-organisms.

# The Amazing Earthworm

- When an earthworm feeds, they take bits of rock and organic matter, digest what they can, and deposit the rest as castings.
- Castings are close to neutral in pH, so they help neutralize the soil.
- Castings are rich in minerals and nutrients.
- Castings increase humus content by 65 to 70%.

# The Amazing Earthworm

- Earthworms can compost organic matter faster than any composting system.
- Some species eat as much as half their body weight in food each day.
- Approximately 70% of the material we send to landfills can be used to feed worms. If we did feed this material to worms, we'd get back 60% of the volume as vermicomposted fertilizer.

# Earthworm History

- Charles Darwin wrote, “It may be doubted whether there are many other animals in the world which have played so important a part in the history of the world.”
- Earthworms are found in all regions of the world, except in deserts and frozen Arctic areas.
- Most scientists agree that earthworms have been on the Earth for about 120 million years.

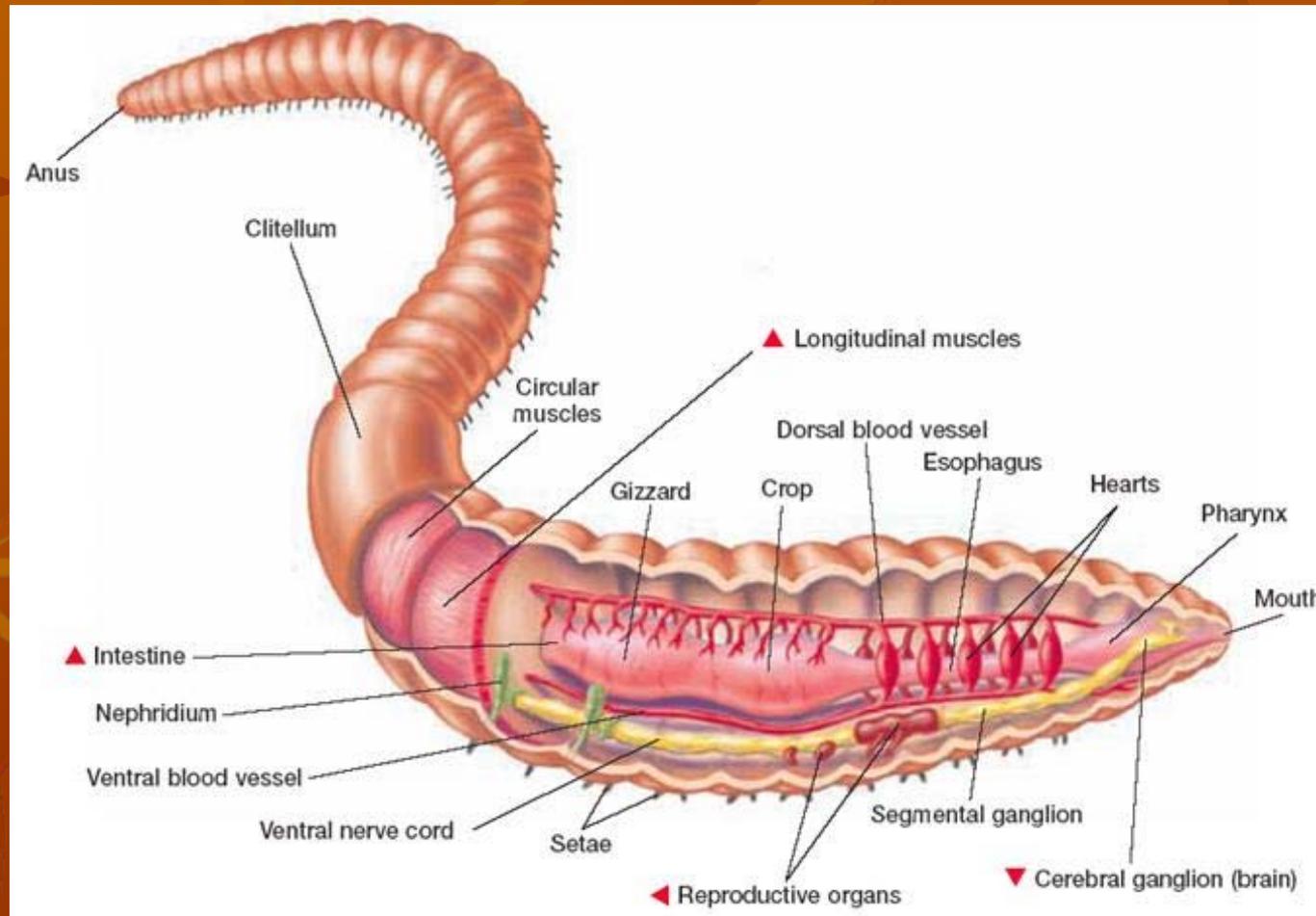
# Earthworm History

- In North America, it is believed that earthworm species were killed in the last ice age, about 10 to 50 million years ago.
- They were reintroduced to North America by European settlers, and they spread.
- A study of earthworms in Chile found that all the species originated in Europe.
- Of the 19 species found in Canada, only two are indigenous.

# Earthworm Anatomy

- Earthworms belong to the phylum Annelida, segmented worms.
- They are cold-blooded invertebrates.
- Their bodies are broken down into segments which vary in width, with the largest being in the front region.
- Segments are numbered, and scientists use the numbers to differentiate among species.

# Earthworm Anatomy

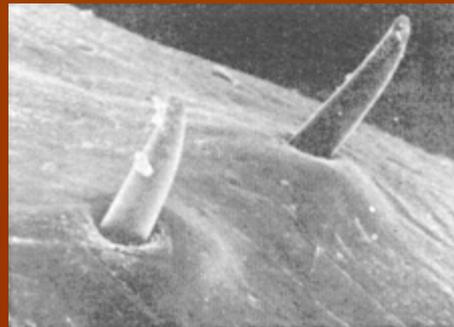


# Earthworm Anatomy

- Mature worms have a structure called the clitellum.
- It is the glandular portion of the epidermis, which is associated with cocoon formation.
- Its appearance and position on the body differs between species.

# Earthworm Anatomy

- On every segment, earthworms have bristles, called setae. They can be extended and retracted.
- They vary by number per segment, shape and length between species.
- Their primary function is locomotion, but they are also important for reproduction.

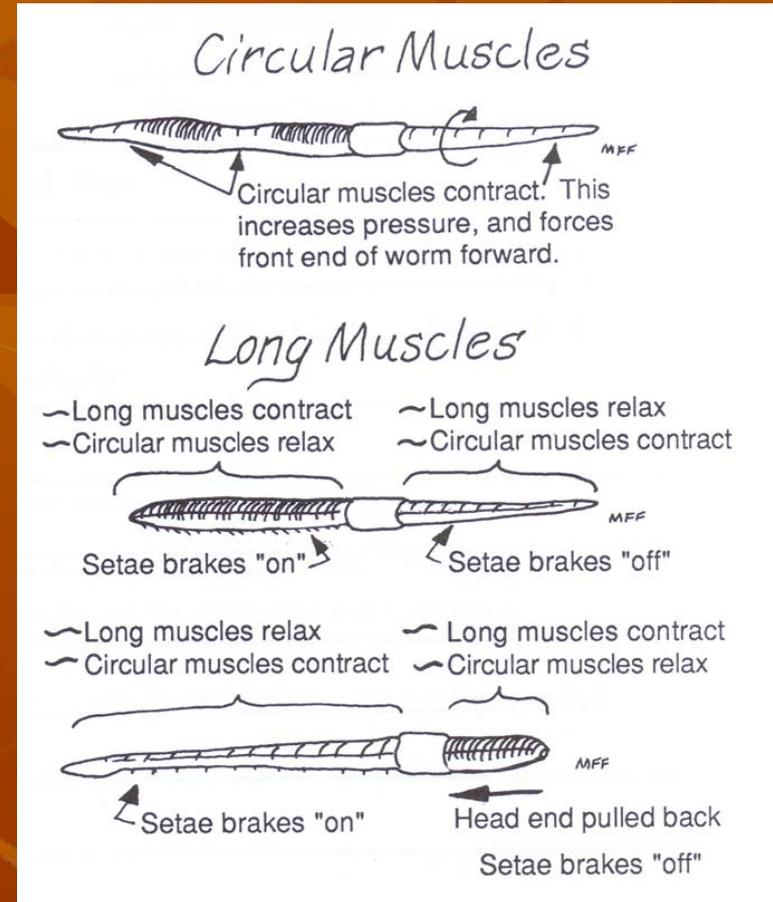


# Earthworm Anatomy

- As the worm moves, it anchors its body with its setae, and then contracts its body using its longitudinal and circular muscles.
- The circular layer goes around the worm's body and the thick longitudinal layer that runs along the length of the body.
- When circular muscles contract, the earthworm becomes thinner and longer, squeezing the front end forward.
- When longitudinal muscles contract, they pull the segments closer together. The body shortens and swells.

# Earthworm Anatomy

- Worms move by contracting and relaxing their muscles in waves, creating pressure on its body fluids.
- The worm moves forward by first lengthening itself and then drawing the tail section towards the head.
- During this process each segment can move forward about 3 cm.
- The worm can takes 7 to 10 “steps” per minute.

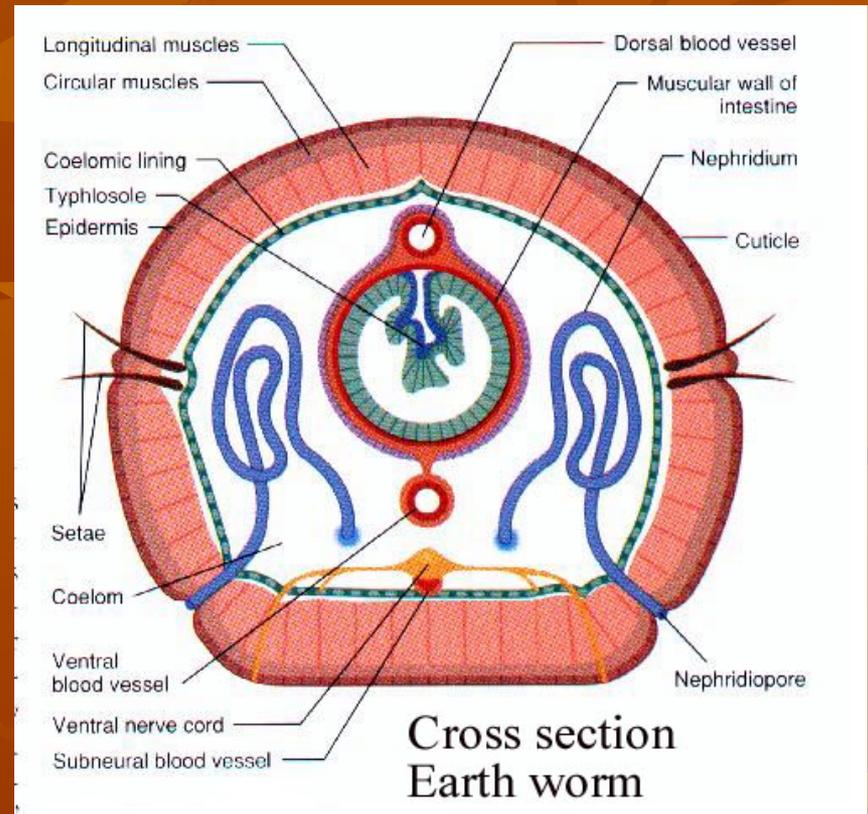


# Earthworm Anatomy

- There are several types of pores located on a worm's body.
- Worms usually have two types of pores for reproduction, dorsal pores for excretion of coelemic fluid, and nephridiopores for excretion of liquid waste.

# Earthworm Anatomy

- The body wall consists of an outer cuticle that helps prevent water loss.
- Mucus cells produce the mucus that covers the worm's body.
- Under the cuticle is a layer of nervous tissue.



# Earthworm Anatomy

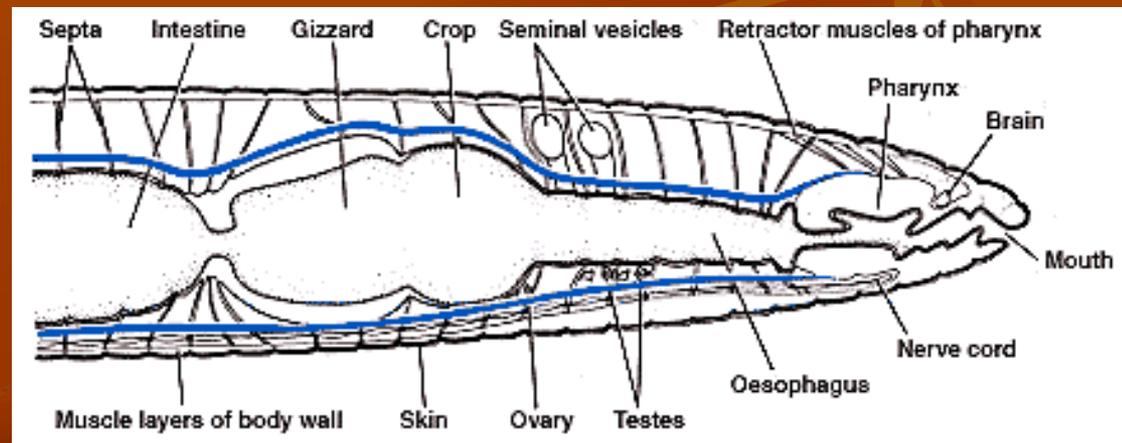
- Earthworms have a mass of neurons called a ganglion.
- It is connected to a pair of longitudinal nerve cords that run the length of the worm's body.
- In each segment there is another pair of ganglia that are connected to the longitudinal nerve cords.
- Nerve fibers run from the ganglia out to the skin and sensory organs.

# Earthworm Anatomy

- Worms do not have eyes or ears.
- They can sense light intensity through photoreceptor organs in the skin.
- Epithelial sense organs give them a sense of touch.
- They use their setae to sense vibrations.
- They have nerve receptors that taste chemical changes.

# Earthworm Anatomy

- Food enters the mouth and gets pulled into the alimentary canal.
- The thick, muscular pharynx acts as a suction pump, drawing in food and pushing it down the canal.
- The crop stores food and gizzard grinds the food up.
- Nutrients are absorbed in the intestine, passing into blood vessels running the length of the body.
- Waste is excreted by the anus.



# Earthworm Anatomy

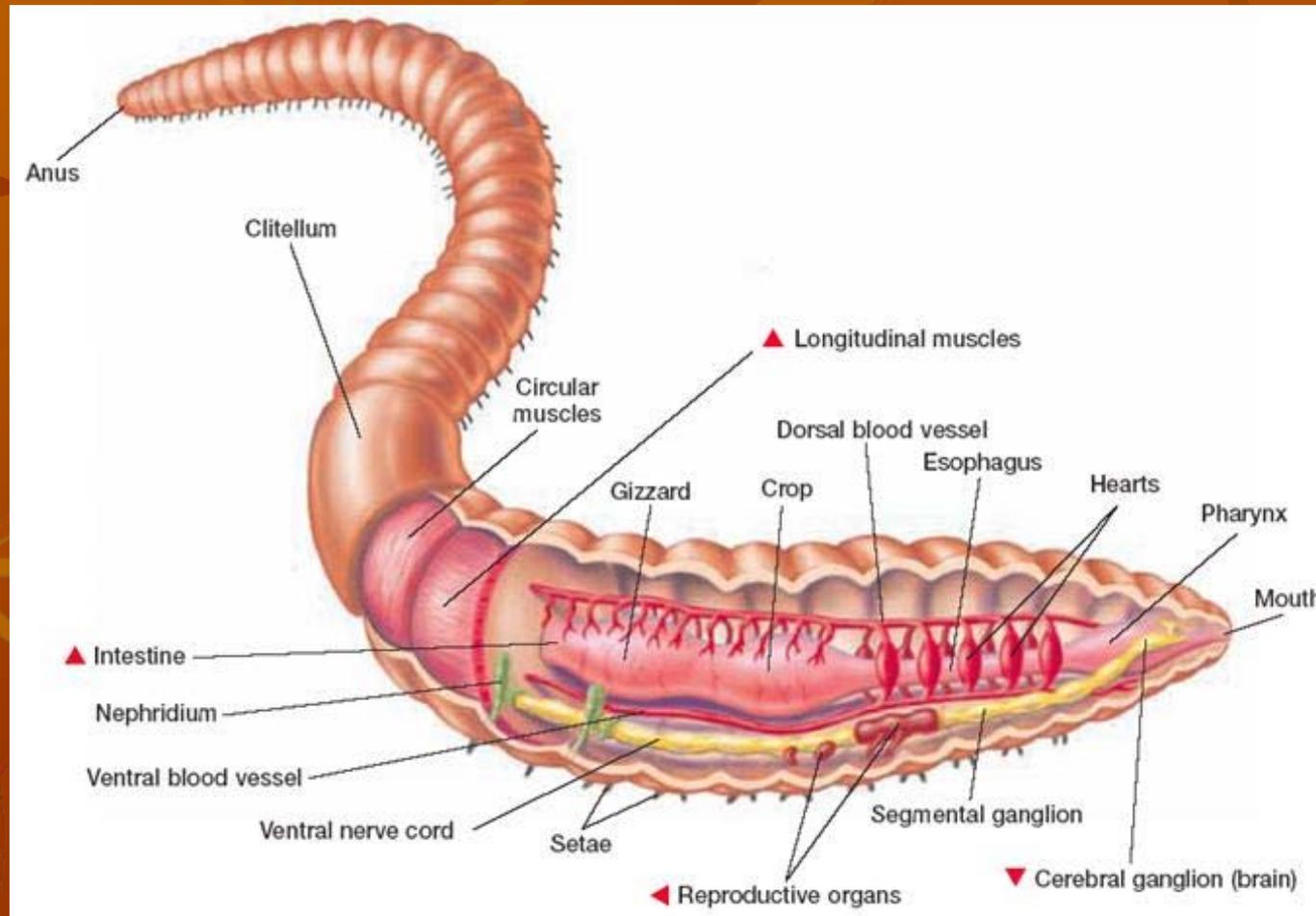
- Between the blood vessels in the upper quadrant of the worm's body can be found anterior loops of vessels.
- These enlarged vessels are called hearts, and can contract.
- The number varies by species.
- Worms have red blood containing hemoglobin.
- Worms are cold-blooded. Their body temperature depends on the temperature of their surroundings.



# Earthworm Anatomy

- Worms do not have lungs.
- Oxygen is brought into the body by dissolving the oxygen through the body surface, which is kept moist by mucus glands.
- Blood vessels pick up the oxygen and carry it throughout the body.
- Earthworms need a lot of water, both to keep moist and to replace large amount of water lost to urination.

# Earthworm Anatomy



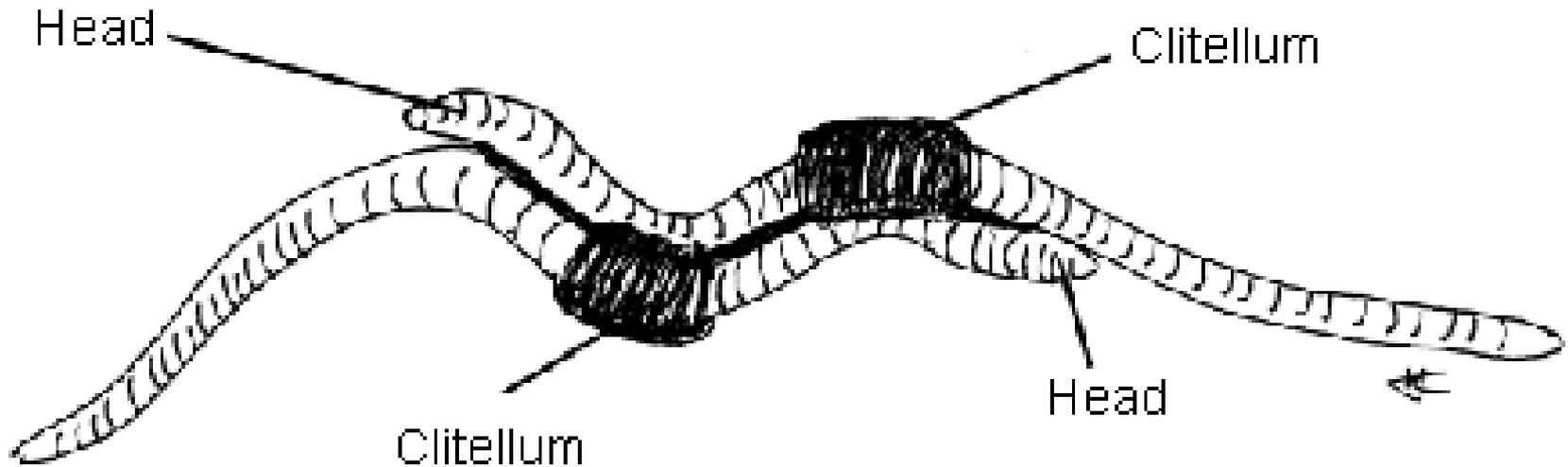
# Earthworm Reproduction

- Earthworms have both male and female sex organs, making them hermaphroditic.
- The clitellum has glands that produce mucus for copulation, to secrete the wall of the cocoon and to secrete albumin in which the eggs are deposited in the cocoon.
- Worms typically mate in Spring and Fall, but in captivity, kept at constant temperatures, they can reproduce throughout the year.

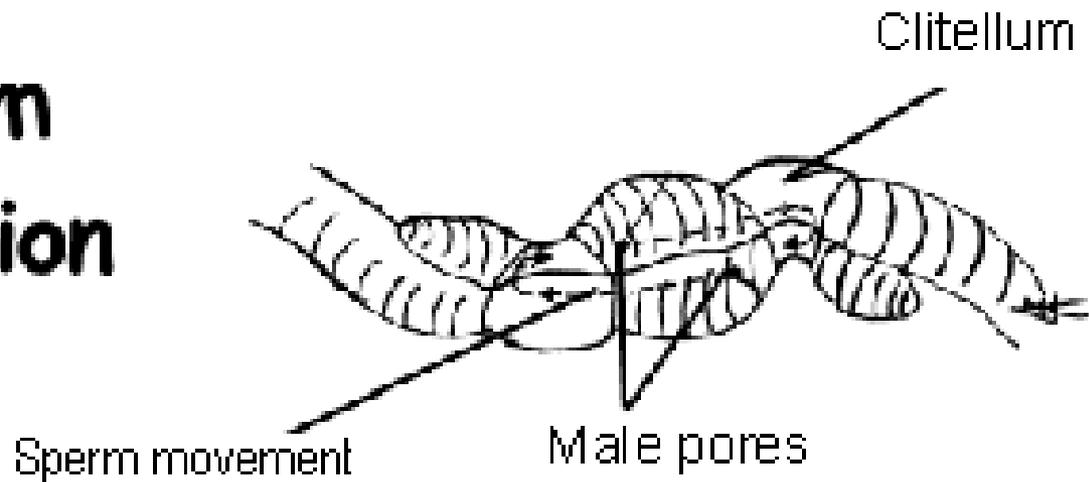
# Earthworm Reproduction

- To mate, one earthworm will position itself pointing in one direction while the other will position itself in the opposite direction.
- They anchor themselves with their setae.
- The clitellum produces a mucus coats around both worms, holding them in place.
- One worm excretes semen from its male pores, which travels to the female pores of the other worm. Sperms is stores in the seminal receptacles.
- The process usually takes 2 to 3 hours.

# Earthworm Reproduction



## Earthworm Reproduction

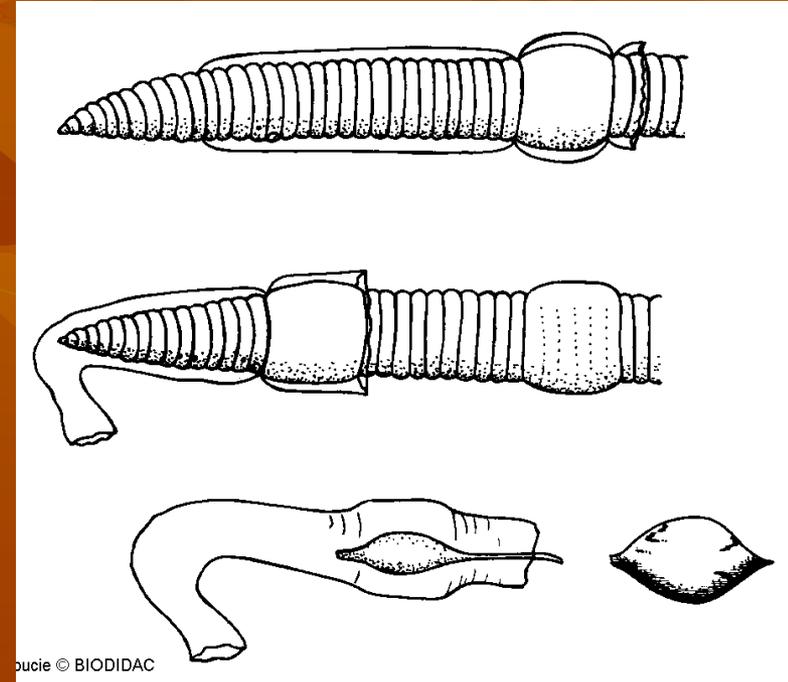


# Earthworm Reproduction

- A few days after mating, the worm secretes a cocoon in which the eggs are deposited.
- To produce a cocoon, a mucus tube is secreted around the anterior segments, near the clitellum.
- The clitellum produces a tough material that becomes the cocoon.
- Albumin is secreted for the eggs.

# Earthworm Reproduction

- The cocoon slips forward, and the eggs are deposited by the female gonopores, and then the sperm is deposited by the seminal receptacles.
- The cocoon slips over the head and seals itself.
- Cocoons can contain from one to twenty eggs, depending on the species of worm.
- Adult worms can mate and produce cocoons every 3 to 4 days, depending on conditions.



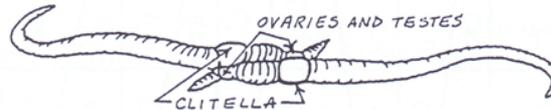
# Earthworm Reproduction

## EARTHWORM MATING AND COCOON FORMATION

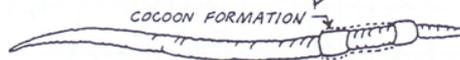
EACH WORM HAS BOTH OVARIES AND TESTES.



TWO WORMS JOIN BY MUCUS FROM THEIR CLITELLA. SPERM THEN PASS FROM EACH WORM TO THE SPERM STORAGE SACS IN THE OTHER WORM.



LATER, A COCOON FORMS ON THE CLITELLUM OF EACH WORM. THE WORM BACKS OUT OF THE HARDENING COCOON.



EGGS AND SPERM ARE DEPOSITED IN THE COCOON AS IT PASSES OVER OPENINGS FROM OVARIES AND SPERM STORAGE SACS.



AFTER BEING RELEASED FROM THE WORM, THE COCOON CLOSES AT BOTH ENDS. EGG FERTILIZATION TAKES PLACE IN THE COCOON.



TWO OR MORE BABY WORMS HATCH FROM ONE END OF THE COCOON.

# Classification

- Earthworms are members of the phylum Annelida, segmented worms.
- The phylum has three classes, with earthworms belonging to the class Oligochaeta, of which there are about 6,000 known species. Most are aquatic.
- Scientists estimate that earthworms have been on the planet for at least 120 million years.

# Classification

- The earthworm family of Lumbricidae has hundreds of species, but less than a dozen are important to cultivation.
- Worms can range in size from a few millimeters to three meters.
- The preferred diet of the earthworm consists of decomposing plant or animal matter, bacteria, fungi, and nematodes.

# Classification

- Terrestrial earthworms are classified into one of three groups: the litter dwellers (epigeic), the shallow-soil dwellers (endogeic) and the deep-burrowers (diageic).
- Litter dwellers live in thin litter, the fallen leaves from the trees of the forest, for example.
- Shallow dwellers live in the top 12 inches of soil, and don't build permanent burrows.
- Deep dwellers build permanent, vertical burrows that extend 6 feet into the soil.

# Nightcrawlers

*Lumbricus terrestris*

- Color: Red, brown, or a combination of these colors.
- Length: Up to 12 inches
- Life Span: Up to 10 years
- Habitat: Vertical tunnels up to 6 feet deep
- Food Preferences: leaf litter and mulch



# Redworms

*Lumbricus rubellus*

- Color: Somewhat iridescent on top, dark red to maroon, bright yellow underside
- Length: Up to 3 inches
- Habitat: Prefers the top 6 to 12 inches of soil
- Food Preferences: Rich compost and decaying plant and animal material



# Red Wigglers

*Eisenia fetida*

- Color: Rust brown, alternating bands of yellow and maroon
- Length: Up to 3 inches
- Habitat: First few inches of soil
- Food Preferences: very rich compost, manure piles and decaying plant and animal material



# Red Tiger

*Eisenia andrei*

- Color: Dark red or purple
- Length: Up to 3 inches
- Habitat: First few inches of the soil and under mulch
- Food Preferences:  
Manure, rich compost,  
and decaying plant and  
animal material



# Blue Worms

*Perionyx excavatus*

- Color: Anterior is deep purple, posterior is dark red to brown
- Length: Up to 6 inches
- Habitat: Lives just under mulch
- Food Preferences:  
Compost, decaying plant or animal material



# The End

- References:

- *The Worm Book* by Loren Nancarroa and Janet Hogan Taylor
- *Worms Eat Our Garbage* by Mary Appelhof, Mary Frances Fenton and Barbara Loss Harris