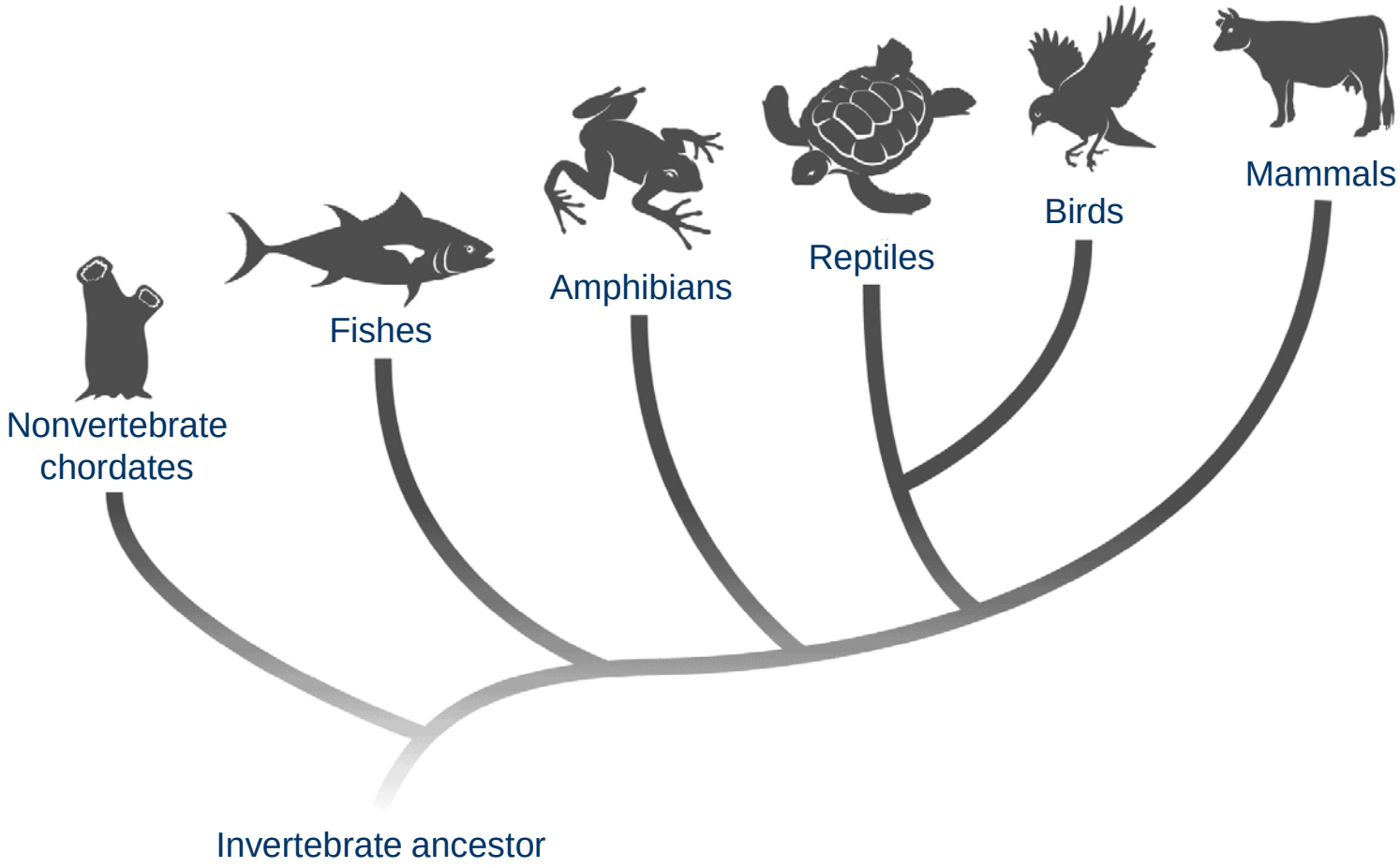
Animal Kingdom
Vertebrates

Biology 11

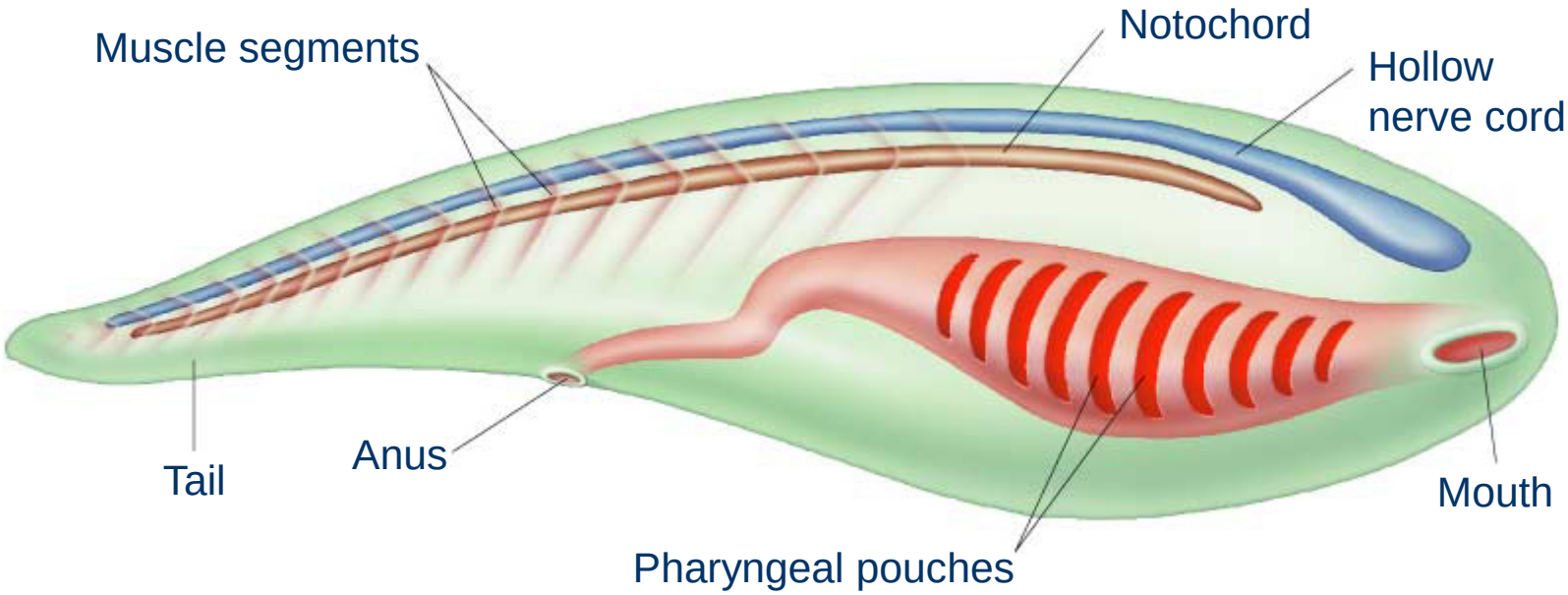
What is a Chordate?

- All chordates have 4 basic features that are present at some point during their life cycle
  - Hollow Nerve Cord – Nerve cord in which nerves branch out at regular intervals
  - Notochord – Long supporting rod that runs throughout body
  - Pharyngeal Pouches – Paired structures in throat
  - Muscular Tail – Extends beyond anus
- Only 4-5% of animals are chordates
- Examples = Fish, Amphibians, Reptiles, Birds

Chordate Cladogram



The Generalized Structure of a Chordate

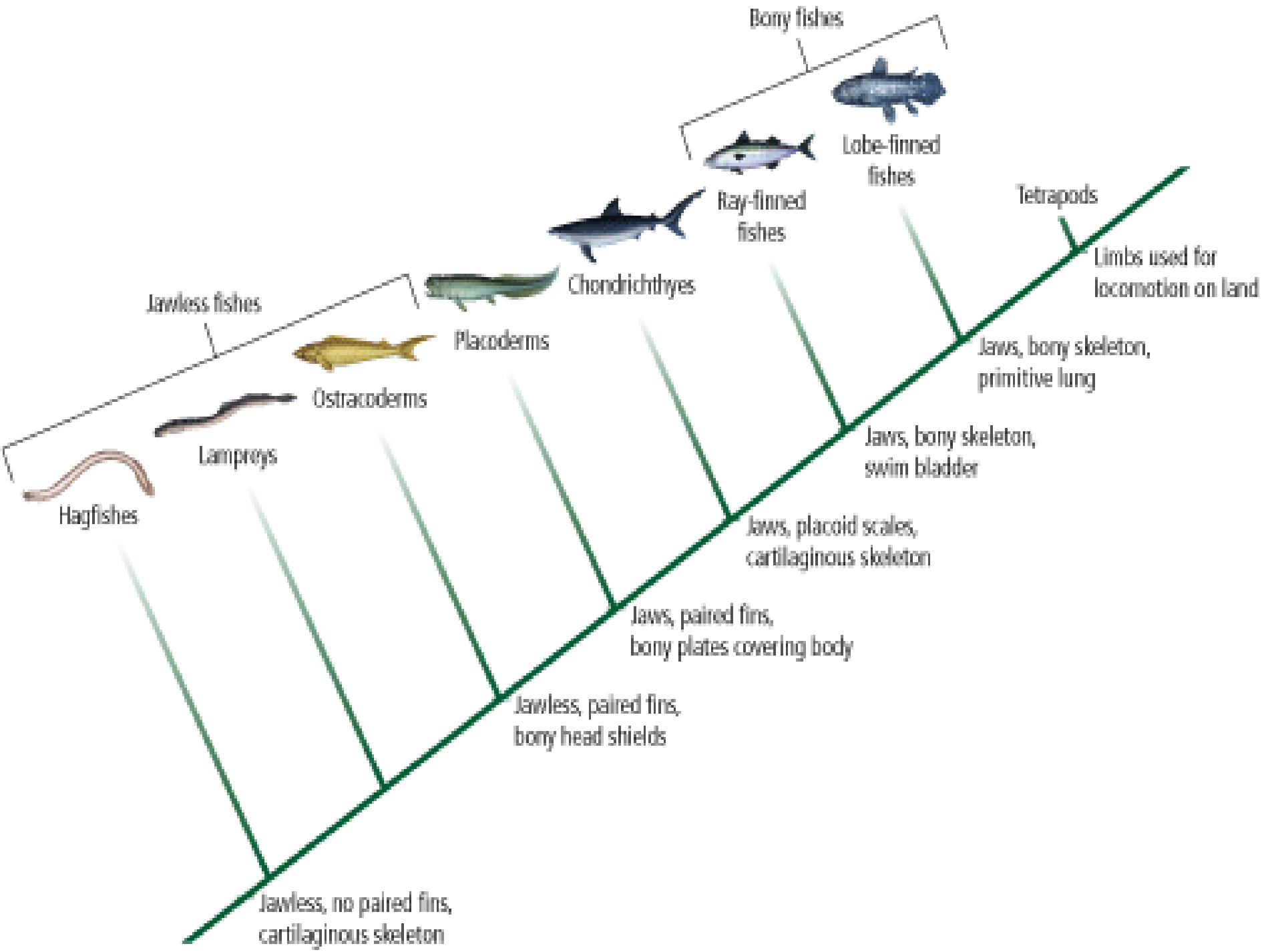


Fish – Basic Facts

- Fish live in nearly every single aquatic habitat imaginable
- Fish are aquatic vertebrates characterized by fins, scales, and gills
- Fish were the first vertebrates to evolve
- Fish bring in Oxygen rich water through gills and remove oxygen poor water through gill slits
- Closed circulatory system
- Four chambered heart
- Swim bladder controls buoyancy
- Most are egg laying
- Most move by contracting opposite muscles (S Shaped)

Groups of Fish

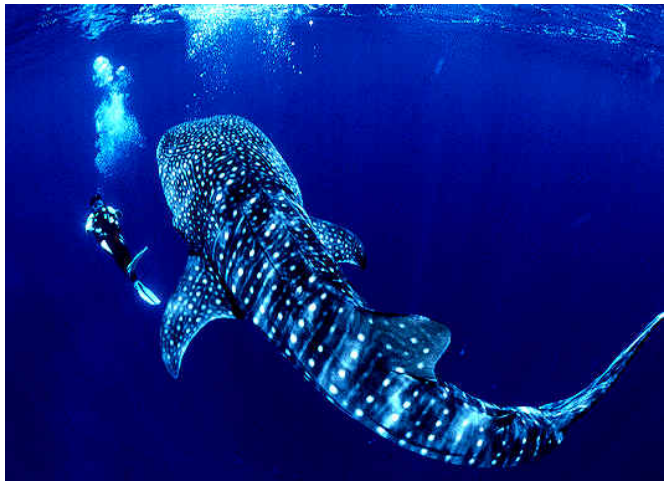
- Jawless Fish –
  - Have mouths of soft tissue with no true teeth.
  - Have no bones
  - Only vertebrates with no vertebral column as adults
  - Lampreys, Hagfish
- Chondrichthyes –
  - Skeleton built entirely of cartilage
  - Sharks, sea rays
- Osteichthyes –
  - Bony Fish
  - Majority of fish fall in this order
  - Carp, sea horse, perch, etc.


Bony fishes
Lobe-finned fishes
Ray-finned fishes
Tetrapods
Limbs used for locomotion on land
Chondrichthyes
Jaws, bony skeleton, primitive lung
Jawless fishes
Placoderms
Ostracoderms
Jaws, bony skeleton, swim bladder
Lampreys
Hagfishes
Jaws, placoid scales, cartilaginous skeleton
Jaws, paired fins, bony plates covering body
Jawless, paired fins, bony head shields
Jawless, no paired fins, cartilaginous skeleton

Lamprey – Jawless Fish

Sea Ray - Chondrichthyes

Catfish - Osteichthyes

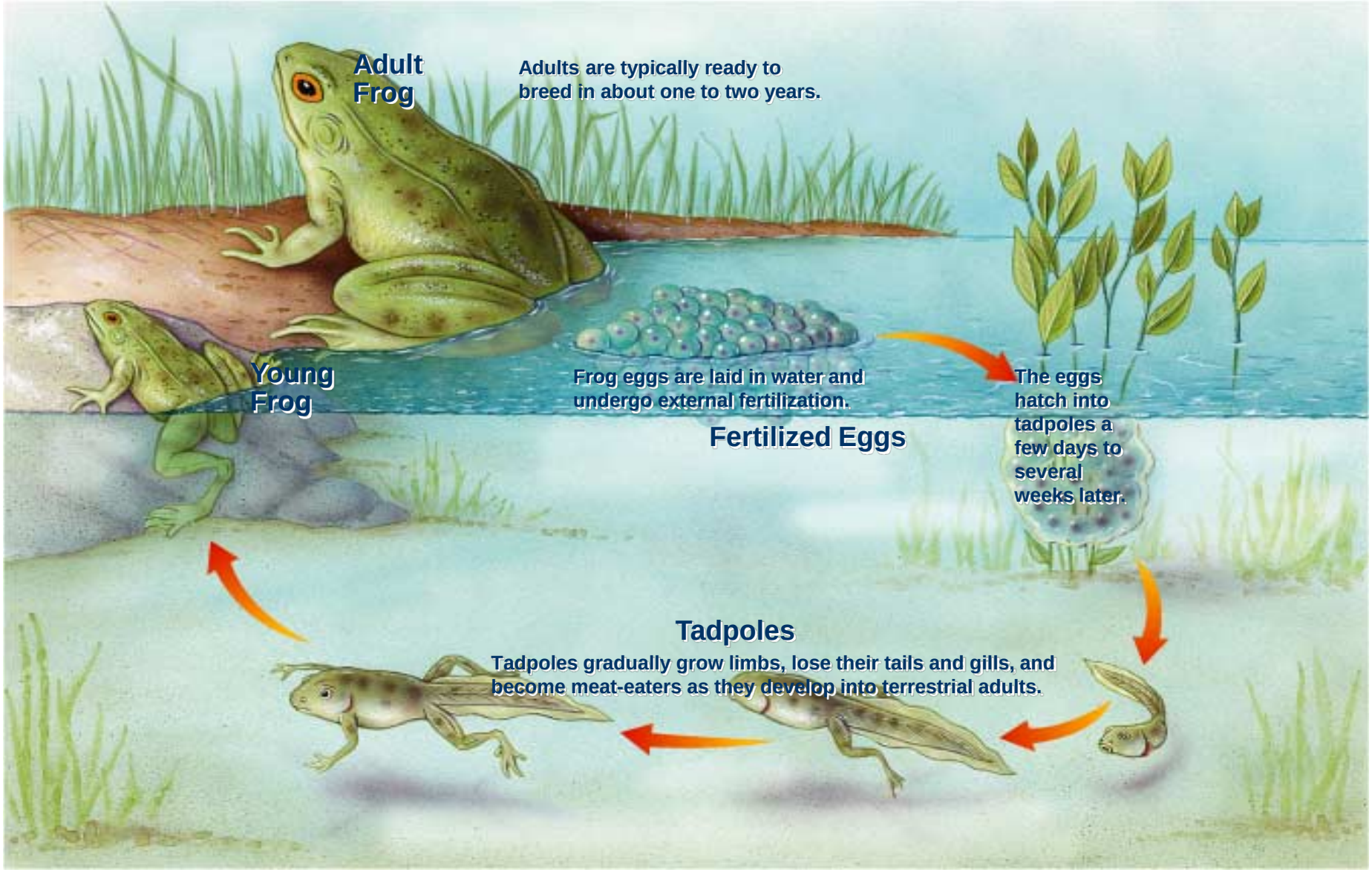


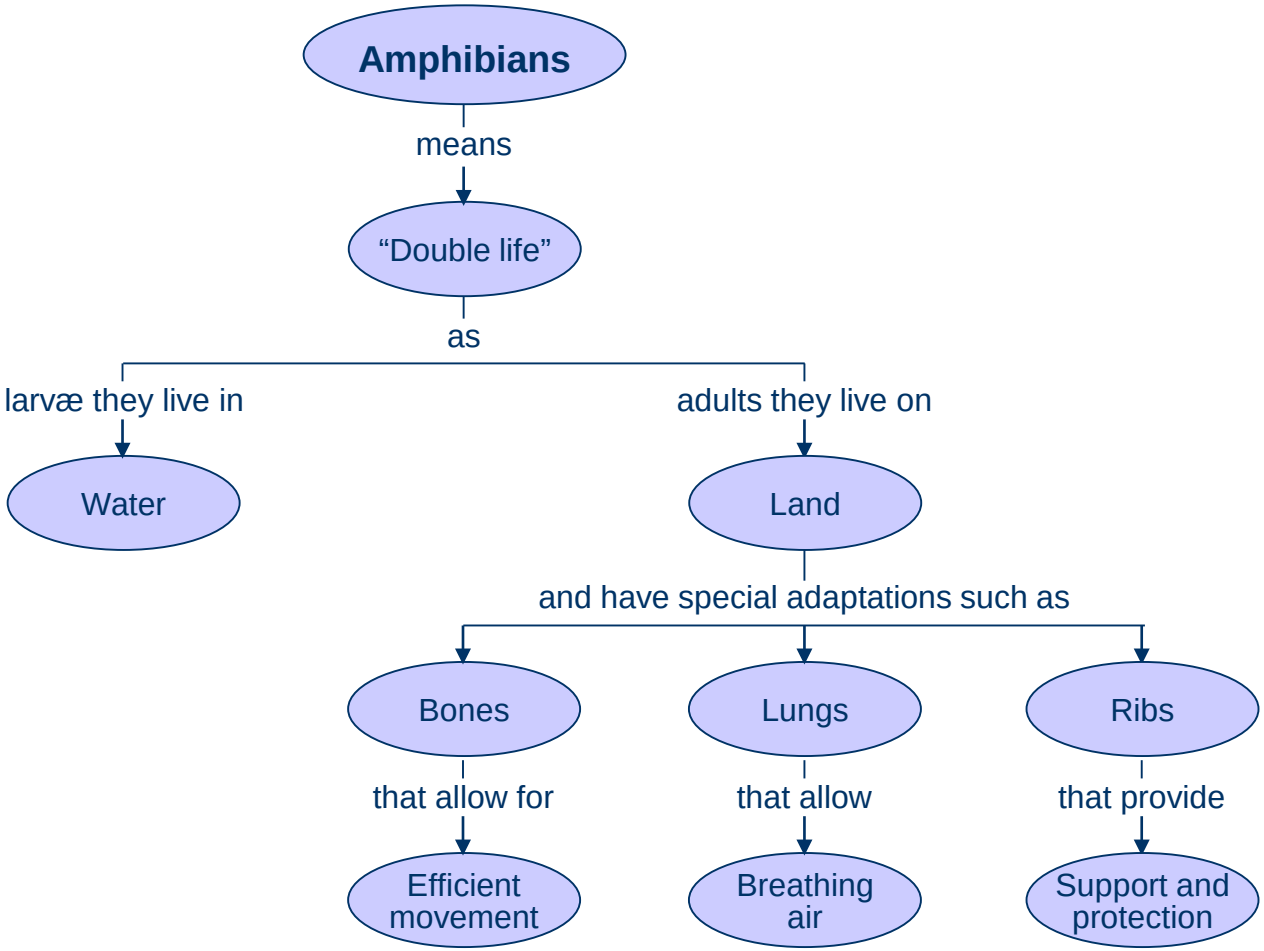
Whale Shark - Chondrichthyes

Amphibians – Basic Facts

- Amphibian = “double life”
- Live in both water and land
- Most larvae are fishlike; adults are terrestrial carnivores
- Larvae respire through skin/gills; Adults use lungs
- Descendants of ancestral organisms that evolved some, not all, adaptations for life on land
- First appeared 360 million years ago
- External fertilization
- Closed circulatory system; three chambered heart

The Life Cycle of a Frog




Amphibians
means
“Double life”
as
larvæ they live in
adults they live on
Water
Land
and have special adaptations such as
Bones
Lungs
Ribs
that allow for
that allow
that provide
Efficient movement
Breathing air
Support and protection

Groups of Amphibians

- Salamanders –
  - Long bodies and tails
  - Adults are carnivorous
  - Usually live in moist woods
- Frogs and Toads –
  - Lack tails
  - Frogs have long legs and are usually tied to water
  - Toads have shorter legs and not as closely tied to water
- Caecilians –
  - Legless animals that burrow in moist soil
  - Have fishlike scales

Spotted Salamander

Poison Dart Frog

Fire Bellied Toad

Caecilian

Reptiles – Basic Facts

- All reptiles have:
  - Dry, scaly skin – helps prevent loss of body water in dry environments
  - Terestrial eggs – first animals to develop amniotic eggs that didn't need to be deposited in water
- Respire using lungs
- Internal Fertilization; Most are egg-laying
- Ectotherms – cannot internally regulate body temperature; cannot live in cold climates
  - Behavior controls body temp. (swimming, burrowing, basking, etc.)
- Closed circulatory system
  - Double loop;
  - Heart = two atria/one or two ventricles

Groups of Reptiles

- Lizards and Snakes
  - Have legs & clawed toes (lizards) external ears, moveable eyelids
  - Highly evolved specialized forms (venom)
- Crocodiles and Alligators
  - Long, typically broad snout and squat appearance
  - All are carnivorous
  - Protective of young; carry hatchlings in their mouth
  - Live in tropics and subtropics
  - Alligators live in freshwater
  - Crocodiles live in fresh or saltwater

Groups of Reptiles (con.)

- Turtles and Tortoises –
  - All are shelled
  - Turtles are aquatic; tortoises are terrestrial
- Tuatara –
  - Primitive reptiles found on small, remote islands

Coral Snake

Sea Turtle

Galapagos Tortoise

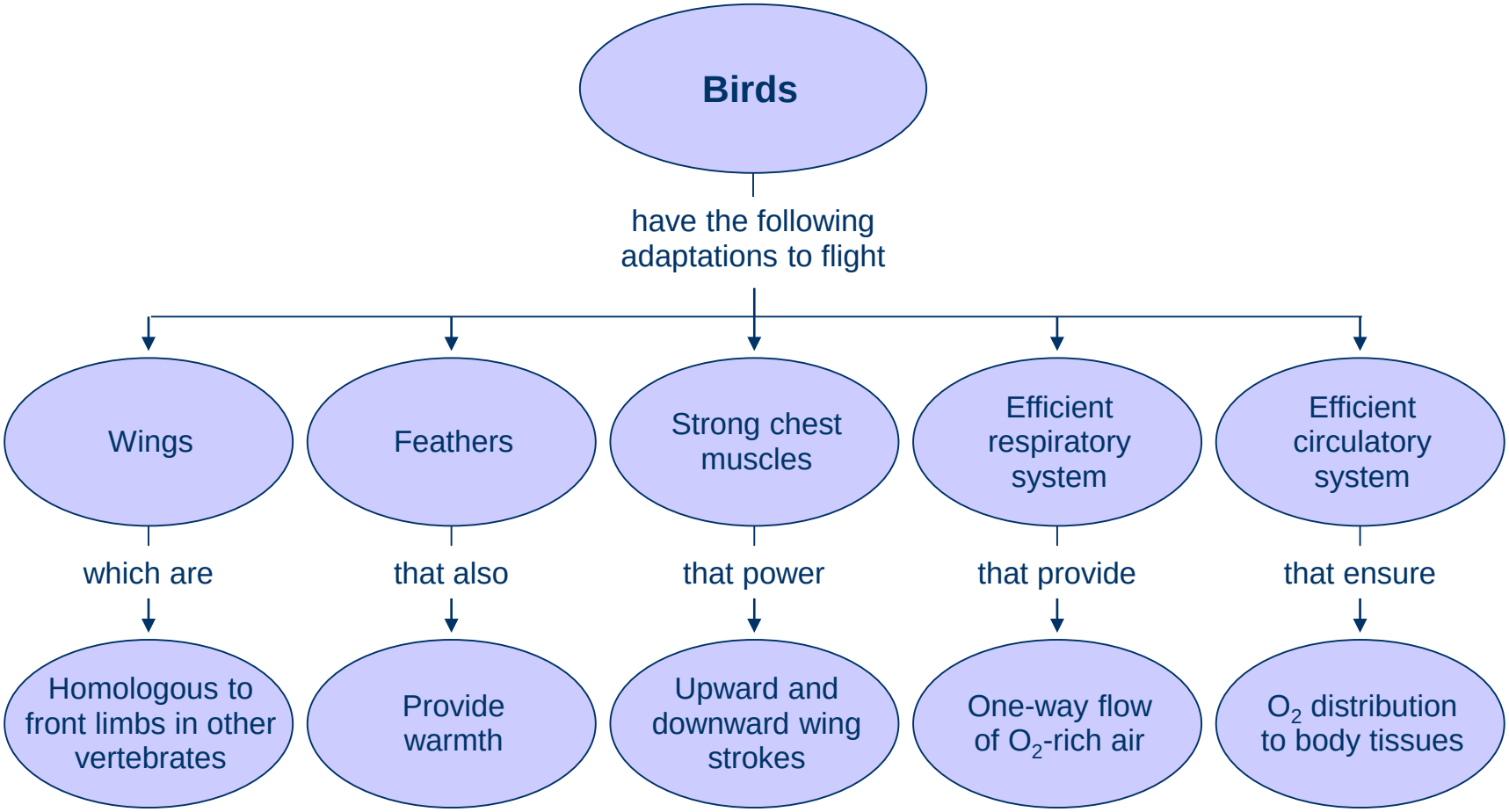
Tuatara

Nile Crocodile

North American Alligator

Birds – Basic Facts

- Nearly 10,000 modern bird species
- Birds are closely related to reptiles (scales on legs)
- Have outer covering made of feathers, two legs used for walking or perching, and forelimbs modified into wings
- Feathers separate birds from all other animal species
- Feathers provide insulation for warmth; can generate own body heat
- Beak/Bills adapted to type of food they eat
- Highly efficient respiratory system; lungs only exposed to Oxygen rich air
- Internal fertilization; amniotic eggs; many mate for life


Birds
have the following adaptations to flight
Wings
Feathers
Strong chest muscles
Efficient respiratory system
Efficient circulatory system
which are
that also
that power
that provide
that ensure
Homologous to front limbs in other vertebrates
Provide warmth
Upward and downward wing strokes
One-way flow of O_2-rich air
O_2 distribution to body tissues

Groups of Birds

- More than thirty orders of birds
- Some of the most common
  - Perching Birds – largest order; many are songbirds (sparrows, crows, cardinals, etc.)
  - Birds of Prey – fierce predators with hooked bills; large talons (condors, hawks, owls, eagles, etc.)
  - Herons & Relatives – Wade in aquatic habitats (storks, herons, cranes)
  - Ostriches & Relatives – flightless birds move by running or swimming (ostriches, emus, etc.)

Purple Finch

Stork

Red-Tailed Hawk

Emu

Mammals – Basic Facts

- First true mammals appeared 220 million years ago
- Mammals flourished after dinosaurs became extinct – 65 million years ago
- Basic characteristics
  - Hair
  - Mammary glands – produce milk to nourish young
  - Breathe air
  - Four chambered heart
  - Endotherms – can generate own body heat
  - Internal fertilization; care for young

Orders of Placental Mammals		
Order	**Characteristics**	**Examples**
Insectivores	Long, narrow snouts, sharp claws	Shrews, hedgehogs, moles
Sirenians	Water-dwelling, slow-moving	Manatees, dugongs
Cetaceans	Live and breed in ocean, come to surface to breathe	Whales, dolphins
Chiropterans	Winged, capable of true flight	Bats
Rodents	Single pair of long, curved incisor teeth in upper and lower jaws	Mice, rats, voles, squirrels, beavers, porcupines, chinchillas

Orders of Placental Mammals		
Order	**Characteristics**	**Examples**
Perissodactyls	Hoofed, with an odd number of toes on each foot	Horses, tapirs, rhinoceroses, zebras
Carnivores	Sharp teeth and claws	Tigers, hyenas, dogs, foxes, bears, raccoons, walruses
Artiodactyls	Hoofed, with an even number of toes on each foot	Cattle, sheep, goats, pigs, ibex, giraffes, hippopotami, camels
Proboscideans	Trunks	Asian and African elephants, mastodons and mammoths

Orders of Placental Mammals		
Order	**Characteristics**	**Examples**
Lagomorphs	Two pairs of incisors in upper jaw, hind legs allow leaping	Snowshoe hares, rabbits
Xenarthrans	No teeth (or very small teeth in the back of the jaw)	Sloths, anteaters, armadillos
Primates	Highly developed cerebrum and complex behaviors	Lemurs, tarsiers, apes, gibbons, macaques, humans

Great Transitions

- The first tetrapods
  - https://vimeo.com/153551383

Chordate Cladogram