ORIGIN AND EVOLUTION OF CHORDATE(PART 2)

(PG SEMESTER 1{Paper 2} ZOOLOGY)

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Reptiles

- The reptile includes lizards, snakes, turtles, crocodilians, birds, and some extinct groups
- Reptiles have scales that create a waterproof barrier
- Most reptiles lay shelled eggs on land

- Most reptiles are ectothermic, absorbing external heat as the main source of body heat

Reptilian heritage is evident in all amniotes

1. Scales of keratin, waterproof skin - prevent dehydration. - Reptiles cannot breathe through skin, so all gas exchange occurs via lungs.

2. Shelled amniotic eggs require internal fertilization. Shell forms around fertilized egg in the reproductive tract.

3. Reptiles don't use metabolism to regulate body temperature; they are ectotherms. Ectotherms absorb external heat (i.e. sunlight) Reptiles are able to survive on about 10% of calories required by mammals.

4. Oldest reptiles are from the late Carboniferous (about 300 million years ago) dinosaurs and pterosaurs.

5. Modern reptiles include 6,500 species that are in four groups:

6. a. Testudines – Turtles - Some species returned to water; all lay eggs on land.

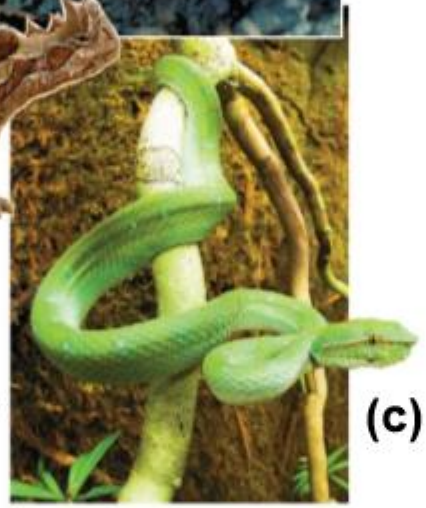
   b. Sphenodontia – Tuataras

c. Squamata – Lizards, snakes - Lizards are the most numerous group. - Snakes are descendants of lizards and have vestigial pelvic and limb bones.

d. Crocodilia – Crocodiles, alligators - This is the group most closely related to dinosaurs

(a) Tuatara (*Sphenodon punctatus*)

(b) Australian thorny devil lizard (*Moloch horridus*)



(c) Wagler's pit viper (*Tropidolaemus wagleri*)

(d) Eastern box turtle (*Terrapene carolina carolina*)

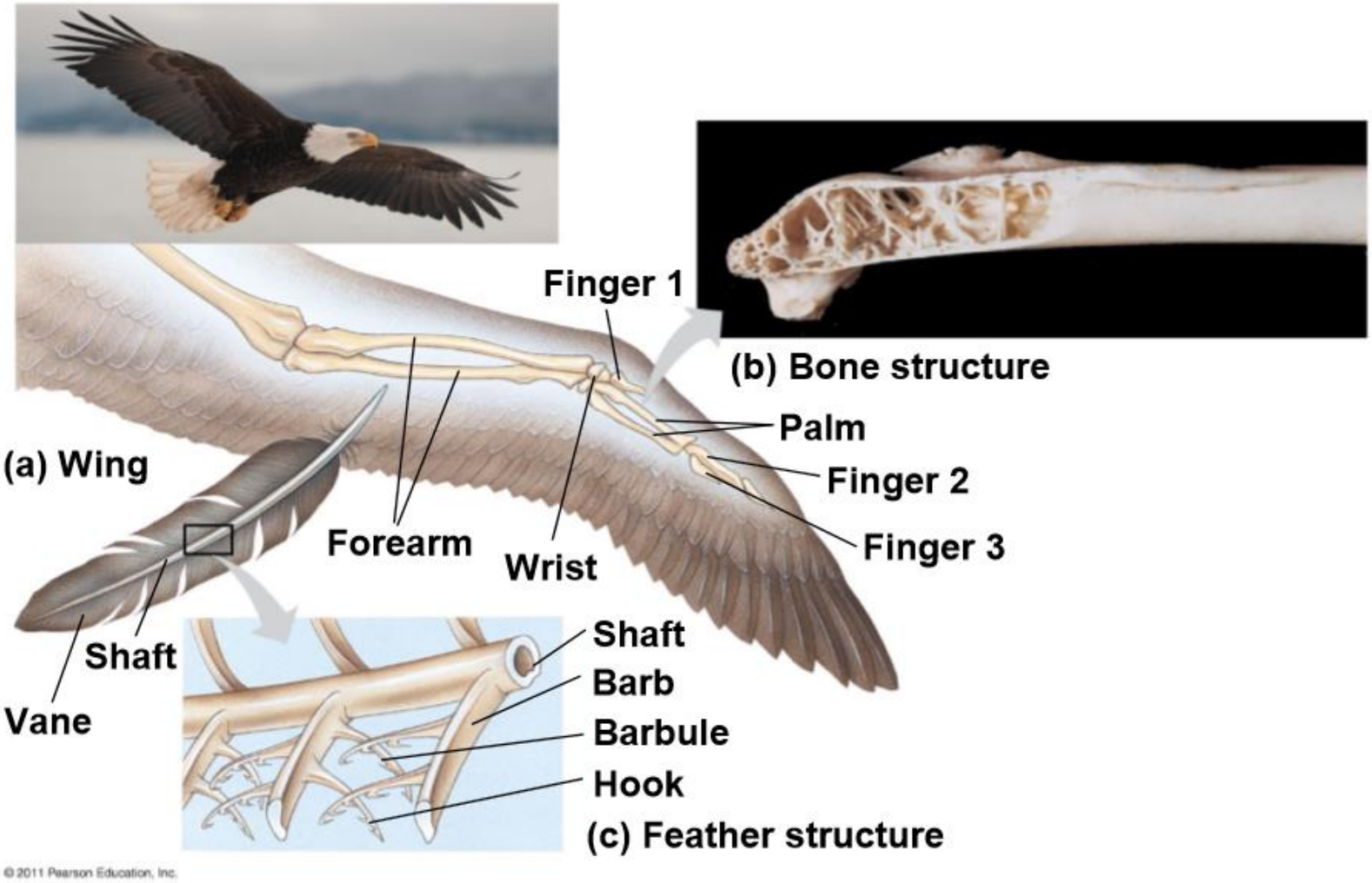
(e) American alligator (*Alligator mississippiensis*)

Birds

- Birds are archosaurs, but almost every feature of their reptilian anatomy has undergone modification in their adaptation to flight.
- Birds are endothermic, capable of keeping the body warm through metabolism.

Derived Characters of Birds

- Many characters of birds are adaptations that facilitate flight
- The major adaptation is wings with keratin feathers
- Other adaptations include lack of a urinary bladder, females with only one ovary, small gonads, and loss of teeth



Birds began as feathered reptiles , evolved to fly:

1. Honeycombed skeletons are light and strong – good for flight.

2. Toothless for weight reduction.

3. Endothermic = use metabolic energy to generate h eat.

- Feathers provide insulation.

- Efficient circulatory system supports high rate of metabolism necessary for flying.

4. Acute vision -
   Large brains that allow complex behavior.

5. Wings -
   Flight enhanced the ability to hunt and scavenge, scape predators, and move with changing seasons .
6. Theropods were the closest dinosaur relative of bi rds. Example: Velociraptor

7. Modern birds include about 8,600 species.

Some are flightless = ratites.

Mammals

- Mammals are amniotes that have hair and produce milk
- Mammals, class Mammalia, are represented by mo re than 5,300 species
- Derived characters of mammals:

– Mammary glands, which produce milk

– Hair

– A high metabolic rate, due to endothermy

–larger brain than other vertebrates of equivalent size

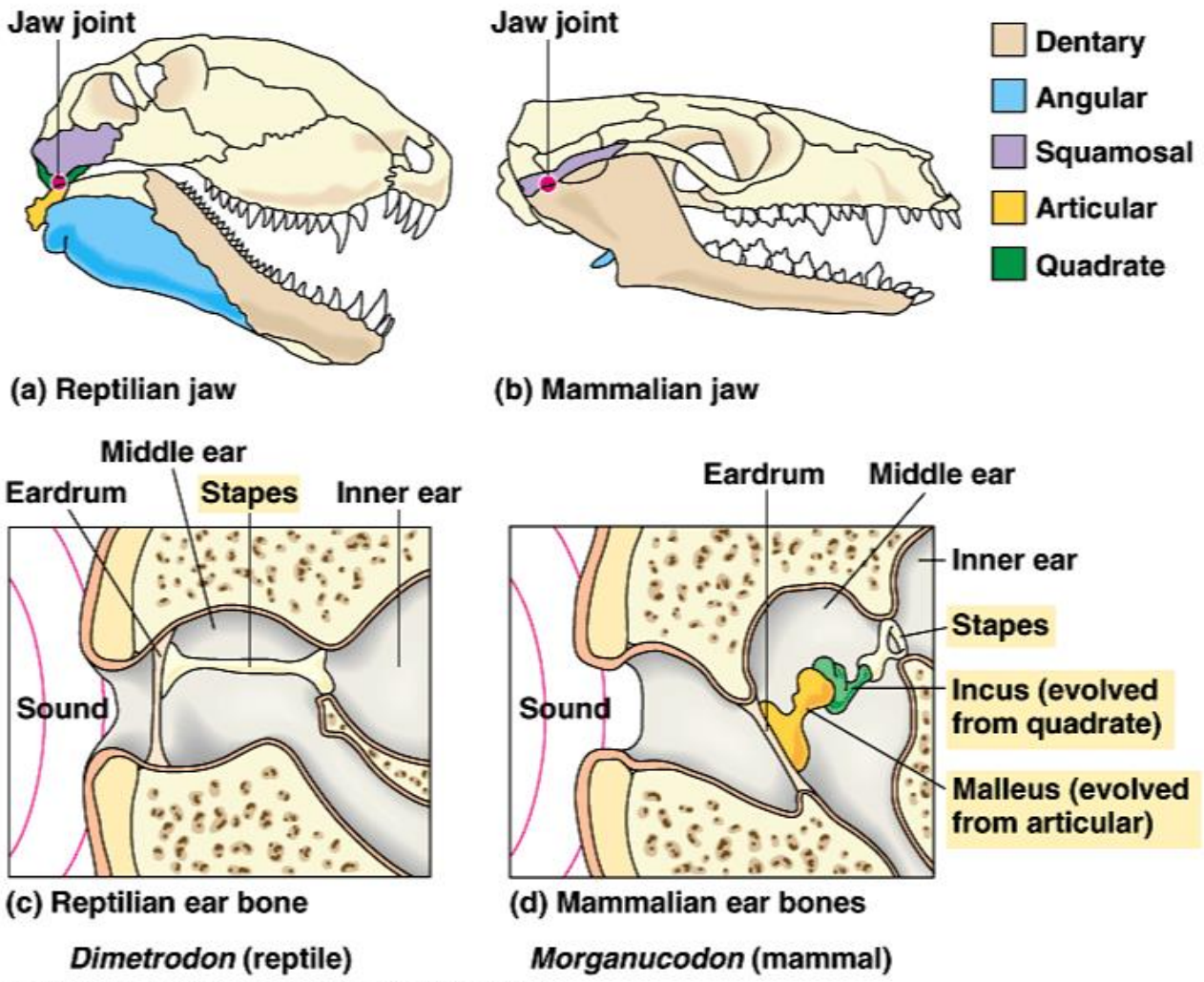
- Differentiated teeth

- Mammals diversified extensively in the wake of t he Cretaceous extinctions

- 1. Radiation of mammals occurred during two events:

a. Extinction of dinosaurs
b. Fragmentation of continents

2. There are about 4,500 species of extant mammals



4. The earliest mammals evolved from reptiles about 220 million years ago. Therapsids gave rise to mammals. Early example is the Morganucodon in previous figure.

5. Major groups of mammals:

a. Monotremes –
lay eggs and produce milk, but have no nipples.

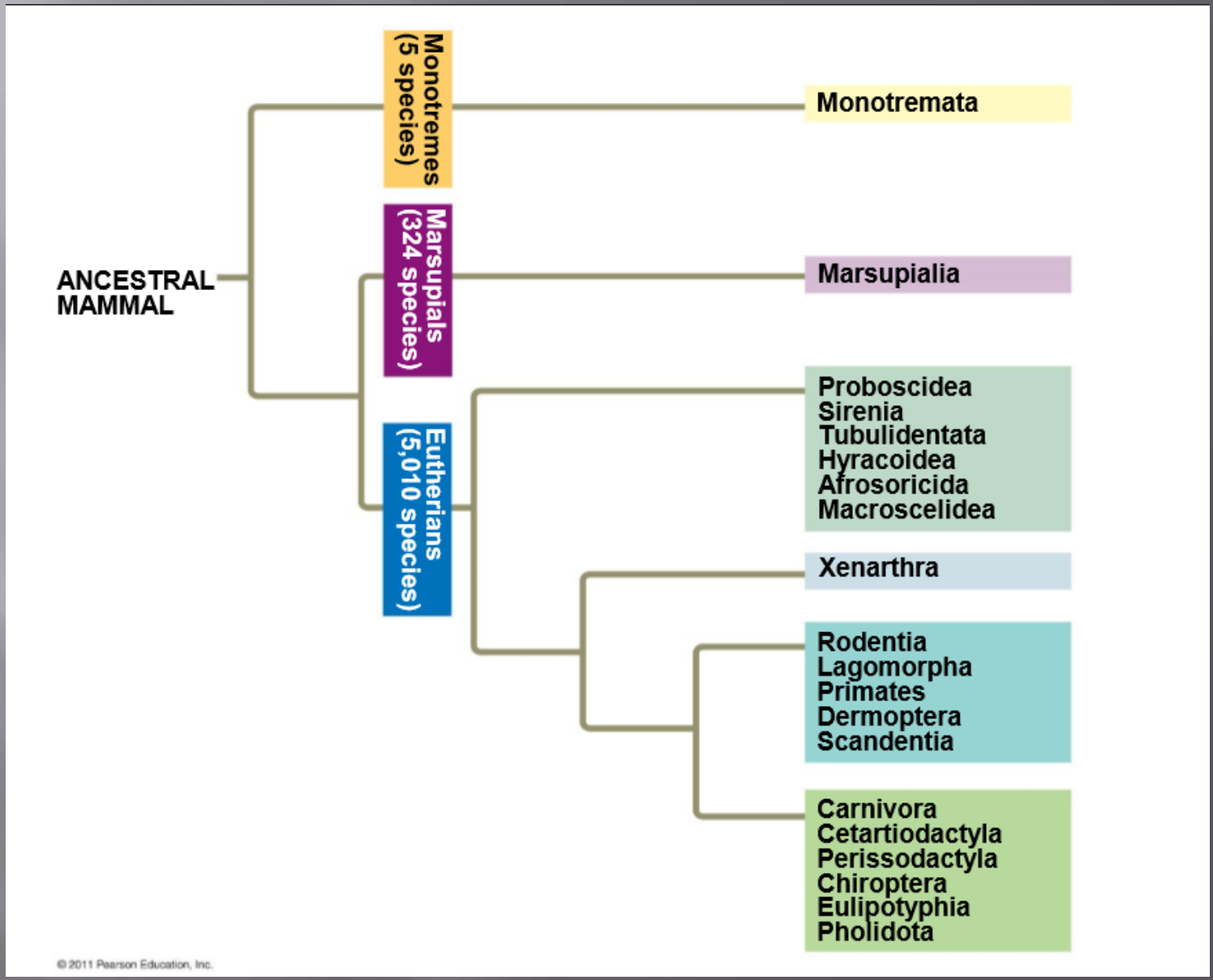
- Platypus, echidna

b. Marsupials –
born early in embryonic development; climb to mother's pouch and attach to a nipple.

- Opossum, kangaroo

Monotremes

- Monotremes are a small group of egg-laying mammals consisting of echidnas an d the platypus.
  - The embryo develops within a placenta in the mother's uterus
  - A marsupial is born very early in its development
  - It completes its embryonic development wh ile nursing in a maternal pouch called a ma rsupium



Primates and the evolution of Homo sapiens

A. Primate evolution provides context for unders tanding human origins.

1. Hands and feet adapted for grasping. Possess opposable thumb.

2. Large brains allow complex social behavior.

Derived Characters of Primates

- – Hands, feet for grasping
- – Flat nails
- – A large brain and short jaws
- – Forward
  looking eyes close together on the face, providi
  ng depth perception –
  Complex social behavior and parental care –
  A fully opposable thumb
  (in monkeys and apes)

Living Primates

- There are three main groups of living primates

  – Lemurs, lorises, and pottos

  – Tarsiers

  – Anthropoids (monkeys and apes)

B. Hominid lineage diverged from other primates about 7 million years ago. Humans compared to other hominids:

a. Brain size –
large size allows development of language and social behavior

b. Jaw shape – shortened to give a flatter face.

c. Bipedalism = walking on two legs.

- Frees hands to do other things.
- Eyes set higher; can see farther.

d. Females smaller than males

e. Extended parental care changes family structur
e and enhances learning and social behavior.

Humans are mammals that have a large brain and bipedal locomotion

The species Homosapiens is about 200,000 years old, which is very young, considering that life has existed on Earth for at least 3.5 billion years.

Derived Characters of Humans

- A number of characters distinguish humans from other apes
- Upright posture and bipedal locomotion

- Larger brains capable of language, symbolic thought, artistic expression, the manufacture and use of complex tools
- Reduced jawbones and jaw muscles
- Shorter digestive tract
- The human and chimpanzee genomes are 99%
- identical

- Misconception: Early hominins were Chimpanzees

Correction: Hominins and chimpanzees shared a common ancestor

Misconception: Human evolution is like a ladder leading directly to Homo sapiens

Correction: Hominin evolution included many branches or coexisting species, though only humans survive today

Homo Sapiens

Homo sapiens appeared in Africa by 195,000 years ago .

All living humans are descended from these African ancestors

- The oldest fossils of Homo sapiens outside Africa date back about 115,000 years and are from the Middle East.

- Humans first arrived in the New World sometime before 15,000 years ago

- In 2004, 18,000 year old fossils were found in Indonesia, and a new small hominin was named: Homo floresiensis

- Homo sapiens were the first group to show evidence of symbolic and sophisticated thought .

- In 2002, a 77,000-year-old artistic carving was found in South Africa

Chordates: notochord; dorsal, hollow nerve cord; pharyngeal slits; post-anal tail

Craniates: two sets of *Hox* genes, neural crest

Vertebrates: *Dix* genes duplication, backbone of vertebrae

Gnathostomes: hinged jaws, four sets of *Hox* genes

Osteichthyans: bony skeleton

Lobe-fins: muscular fins or limbs

Tetrapods: four limbs, neck, fused pelvic girdle

Amniotes: amniotic egg, rib cage ventilation

Clade	Description
Cephalochordata (lancelets) 	Basal chordates; marine suspension feeders that exhibit four key derived characters of chordates
Urochordata (tunicates) 	Marine suspension feeders; larvae display the derived traits of chordates
Myxini (hagfishes and relatives) 	Jawless marine organisms; have head that includes a skull and brain, eyes, and other sensory organs
Petromyzontida (lampreys) 	Jawless vertebrates; typically feed by attaching to a live fish and ingesting its blood
Chondrichthyes (sharks, rays, skates, ratfishes) 	Aquatic gnathostomes; have cartilaginous skeleton, a derived trait formed by the reduction of an ancestral mineralized skeleton
Actinopterygii (ray-finned fishes) 	Aquatic gnathostomes; have bony skeleton and maneuverable fins supported by rays
Actinistia (coelacanths) 	Ancient lineage of aquatic lobe-fins still surviving in Indian Ocean
Dipnoi (lungfishes) 	Freshwater lobe-fins with both lungs and gills; sister group of tetrapods
Amphibia (salamanders, frogs, caecilians) 	Have four limbs descended from modified fins; most have moist skin that functions in gas exchange; many live both in water (as larvae) and on land (as adults)
Reptilia (tuataras, lizards and snakes, turtles, crocodilians, birds)  	One of two groups of living amniotes; have amniotic eggs and rib cage ventilation, key adaptations for life on land
Mammalia (monotremes, marsupials, eutherians)  	Evolved from synapsid ancestors; include egg-laying monotremes (echidnas, platypus); pouched marsupials (such as kangaroos, opossums); and eutherians (placental mammals, such as rodents, primates)

THANK YOU