Reading guide for exam 2

Chapter 7 – Cranial skeleton – pp. 233-239, 249-255, 259-266

Not responsible for developmental details of chondrocranium or different jaw suspensions (autostylic, amphistylic, etc). I won’t ask about specific names of bones except for those I’ve mentioned in class – we will cover the skull bones in lab. Not responsible for amphibian skull. Understand change in jaw joint from reptiles to mammals.

Chapter 8 – Axial skeleton – pp. 269-272, 276-277, 279-291

Not responsible for details on vertebral development (p.272), nor holospondylous, rhachitomous, embolomerous, etc. terms (p.280), nor snake skeleton (p. 284). I won’t ask about the details of Box 8-2 although it has helpful information.

Chapter 9 – Appendicular Skeleton – pp. 294, scan 296-312, 360-388

The chapter is divided into sections on our different vertebrate groups, giving details on the appendicular skeleton of each group. Although I do discuss each group, I do not go into the detail that the book does – so I ask you to scan most of the chapter and read parts that correspond to the bones and evolutionary changes that I talked about in class. Know the broad evolutionary changes that occurred to the pectoral girdle – know endochondral vs. dermal bones. Not responsible for origin of appendicular skeleton (fin-fold hypothesis, etc.) starting on p.294. I also include in here pages from chapter 11 on locomotion. Applicable are the discussions on cursorial adaptations (fusions, gaits, postures, etc.), jumping, limbs as lever systems (out-levers, in-levers), amphibian/reptile limb motion vs. that of mammals, flight and lift. Not responsible for archer’s bow vs. violin bow (p.362), ligament arrangements, stay mechanisms (p.364), muscle recruitment (p.368), gaits (p.370)(although you should understand suspensatory phases in gaits), lever equations (p. 373-), paraxonic, mesaxonic, lift equations (383), muscle actions in flight (p.387). You should understand lift and drag in flight, but not frictional drag vs. pressure drag vs. induced drag (p.383)

Chapter 10 – Muscular System – pp. 316, 318-324, 355-357

If you have not had classes covering the basic physiology of muscles (actin, myosin, etc.) the beginning of the chapter is helpful. We discussed only skeletal muscles in class and not smooth or cardiac muscles – you are not responsible for the differences between these types. Know basic muscle anatomy (section on structure starting on p.318), types of muscle actions (p.322), differences between fast and slow twitch muscles (starting on p.322) and muscle architecture (p.324). The later part of the chapter discusses specific muscles, but I leave that info to be learned in lab so you are not responsible for these sections (starting on p.329). These sections may be helpful in lab, however. The only later section that applies is the section on electric organs (p.345) which discusses the specially modified muscles that produce electrical currents for predation, communication or navigation. I also include here pages from chapter 11 on locomotion – specifically axial muscles of fish. Not responsible for different modes of swimming (anguilliform, carangiform, etc).
Helpful things to know for exam 2: The information is found in your notes from class

Know the three regions of the skull and what areas of the skull are formed from each region. Which are endochondral or dermal? Which region adds in later?

Where does the chondrocranium form? How is the chondrocranium of a shark different than that of other vertebrates? Can you name a chondrocranium bone?

What is the evolutionary history of the splanchnocranium? What was its original function in protostomes, what function did it later have in jawless fish? What does the splanchnocranium include in gnathostomata? What did a jaw evolve from?

What is the palatoquadrate, Meckel’s cartilage, hyomandibula, ceratohyal? What happens to the palatoquadrate and Meckel’s cartilage in bony fish, reptiles, birds, amphibians (same basic story for all of these)?

What are the two main ways to attach a jaw to the skull in modern jawed vertebrates? What happened to the hyomandibula once it was no longer used to attach the jaw? What is it now free to become? What style of jaw suspension is used in sharks?

What bones meet at the jaw joint for bony fish, reptiles, amphibians, birds? (same for all)

What was modified to become the columella? What does the columella do in tetrapods? How is it oriented?

Where is a hyoid bone found – is it part of the splanchnocranium?

What happened to the articular and quadrate bones during the evolution of early mammals from reptile ancestors? What bones grew to take their place at the jaw joint? How did the dentary change in shape? Why did the dentary change in shape? What did the change in shape do in regards to forces along the jaw? Is endothermy involved? How did this influence the articular and quadrate? What bones of mammals are homologous to the articular and quadrate? What happened to the columella in mammals? How does having three earbones help in mammal hearing?

What is a temporal fenestra? Know the four skull types in regard to temporal fenestra. How does the presence of temporal fenestra influence where muscles to close the jaw will be placed in/or on the skull? Know the location of braincase and jaw muscles for anapsid type organism. How is the braincase different for organisms that are either diapsid / synapsid? Know a type of organism that has an anapsid, diapsid or synapsid skull. What type do you have?

Know the function of the secondary palate – made of hard and soft palate together. What bones make the hard palate? What creatures have a secondary palate? Is endothermy involved?

Know the main parts of a vertebra – centrum, neural arch, hemal arch. What creatures have a hemal arch and why? Know what somites are and what tissues are formed from parts of a somite. What does a dermatome, sclerotome, myotome become during development?

Know the basic shapes of amphicelous, procelous, opisthocelous, acelous, heterocelous centrum shapes. How do these types function for the organisms that have them?
Know dorsal vs. ventral ribs. Do tetrapods have dorsal or ventral ribs? Where do dorsal vs. ventral ribs develop? How are ribs of amniotes different from those of a fish?

How does the design of fish vertebrae help with the lateral forces that fish experience when they swim? How do hemal arches, amphicelous vertebrae, neural spines, hemal spines help?

What types of vertebrates also have a lot of lateral flexion when they move? How is that different from how mammals move their limbs?

Know why torsion is a force that tetrapods experience – know how zygapophyses prevent torsion.

What are the regions of the axial skeleton for a mammal vs. a fish? What regions first appear in early tetrapods (like Labyrinthodonts)?

Know atlas and axis. Which are more flexible, lumar or thoracic vertebrae? How can adjustments to relative lengths of regions (like lumar vs. thoracic) influence strength or flexibility of a skeleton? How can neural spines be altered for strength or flexibility?

What modifications occurred to the axial skeleton to allow aquatic tetrapods (like alligators, whales, dolphins) to better move in water (since their ancestors had typical tetrapod structure)?

How is the axial skeleton of birds modified for flight? Consider synsacrum, keel of sternum, uncinated processes

What part of the skeleton is included in the appendicular skeleton? Know the two girdles and where they are.

Know radials vs. axials in fish fins

How are the fin bones of Tiktaalik different from those of a typical lobe finned fish? What did the joints along their fins allow them to do?

Know the main dermal and endochondral bones of the pectoral girdle, esp. clavicle, coracoid, scapula, cleithrum. Which bone touches the axial skeleton? How has the number of pectoral girdle bones changed from early bony fish to modern tetrapods? What type of bones (endochondral vs. dermal) have mainly been lost over evolutionary time?

Know relationship between pectoral girdle and skull in bony fish (they’re attached together with dermal bones).

Know how limb arrangement (sprawled limbs vs. limbs directly under body) can allow for the loss of ventral bones.

What is a furcula? What animals have one

What bones might be found in a mammal pectoral girdle? Do they all have the same number of bones?

Know bones of pelvic girdle – which touches the axial skeleton?
Know cursorial, arboreal, saltatorial, fossorial, aerial type of locomotion – how are they moving?

How can cursorial creatures increase their stride length? Their stride frequency? Know three posture types. How do posture changes influence stride length and frequency.

How is losing the clavicle related to scapula orientation? How is speed increased by doing this?

How might speed and flexibility tradeoff when trying to increase stride frequency?

How do the relative lengths of in-lever and out-lever influence the speed or strength that you get from movement of a bone (like a lever)? Where is the muscle insertion and fulcrum (joint where bone turns) in relation to in-lever and out-lever? (see diagram)

How do arborial mammals have a skeleton designed for moving in trees?

What modifications to the basic primate skeleton occurred to allow for upright bipedalism in humans? How did the axial skeleton and pelvis have to change? How does the lumbar curvature, angle of femur, gluteus maximus specifically help in upright bipedalism? How did the later evolution of large brain size cause a conflict in design for the human pelvis?

What is a skeletal feature that helps with saltatorial locomotion? Aerial locomotion for a bat or bird? Where does lift come from along a bird wing?

Know origin vs. insertion, flexion vs extension, adduction vs. abduction, supination vs. pronation.

Know difference between red/slow twitch/oxidative muscle cells vs. white/fast twitch/glycolytic muscle cells. How might there be differences in where these types of muscles are located in different creatures?

What is a bipennate muscle shape – how does it increase force? What property do longer muscles have compared to short ones?

Know epaxials vs. hypaxials. Know examples of hypaxials in tetrapods. What hypaxial muscles are only found in amniotes? What is only found in mammals?

Why are the myomeres of fish arranged in a zigzag or W shape? What fish would have red fibers instead of all white fibers? How are red vs. white fibers arranged for efficient long distance swimming? How are they arranged in endothermic fish like white sharks?

What do electric organs basically do?

**Example questions for exam 2**

1. Vertebrae that have __________________________ shape of their centra articulate with each other like a ball in socket.

2. The __________________________ is a splanchnocranium bone that is homologous to the columella.
3. The evolution of the palate (hard palate or secondary palate) is seen in a series of fossils leading to this vertebrate group ________________________________

4. A long strap-like muscle provides more force / speed (circle one) because it contracts over a longer / shorter (circle one) distance in the same amount of time compared to a short muscle. (one point each)

5. What skeletal feature helps with arboreal locomotion? ________________________________

6. Name a hypaxial muscle found in both amphibians and mammals ______________________

7. Straightening a knee or uncurling fingers are examples of ____________________________ (muscle action)

8. There are ______ (number) cervical vertebrae in a bony fish.

9. The __________________________________ is an example of an anatomical feature for upright bipedalism that babies are not born with and instead develops in children as they age.

10. Name a way that the shape of vertebrae of an aquatic mammal (like a whale) would differ from vertebrae of a typical 4-legged mammal ________________________________

11. These structures prevent the twisting or torsion between vertebrae ______________________

Answers:

1. procelous or opisthocelous  2. Hyomandibula or stapes or epibranchial  3. Mammals  4. Speed; longer
5. Parallel radius and ulna or tibia and fibula, or clavicle, or large lumbar region (clingers and leapers), or other possibilities  6. External oblique or internal oblique or transversus abdominus or rectus abdominus
7. Extension  8. Zero  9. Lumbar curvature or bicondylar angle or femur angle or cervical curvature  10. Fused or lost cervical vertebrae or hemal arch or reduced zygapophyses  11. zygapophyses

(6 points) What is a difference in function for amphiceolous vs. proceolous vertebrae? (i.e. what type of organisms have these types of vertebrae and how do these centra shapes specifically aid in their type locomotion?)

(4 points) In a migratory fish, why are slow twitch fibers located superficially (a lateral stripe) and not deep in muscle?

(6 points) How does foot posture affect cursorial locomotion (give two ways).

(5 points) Contrast the physiological and functional differences between red (type I) and white (type IIb) muscles.

(5 points) What is a benefit to having a secondary palate? Name a vertebrate that has a secondary palate and one that does not have one.

(5 points) Describe a characteristic of a skeleton of a cursorial mammal that helps increase stride rate
(5 points) What evolutionary trends do you see regarding the number of bones and type of bone when comparing pectoral girdles of a mammal and a bony fish?