Image and text from Gilbert, S.F. 2000. *Developmental Biology*, 6th edition. Available at http://www.ncbi.nlm.nih.gov/.

Evolution of the mammalian middle ear bones from the reptilian jaw. The **quadrate** and **articular** bones of reptiles were part of the lower jaw. Sound could be transmitted from these bones via the large **stapes**. When the dentary bone grew and took over the jaw functions of these two bones, the articular bone became the **malleus** and the quadrate bone became the **incus**. (After Romer 1949).

Provide the names of two derived middle ear bones found in mammals. What bones did they evolve from?

1. FRONTAL BONE OF SKULL
2. TEMPORAL
3. MANDIBLE
4. HUMERUS
5. ULNA
6. RADIUS
7. CARPALS
8. PHALANGES
9. METACARPALS
10. TARSALS
11. METATARSALS
12. PHALANGES
13. ZYGOMA
14. MAXILLA
15. CLAVICLE
16. SCAPULA
17. STERNUM
18. RIBS
19. VERTEBRAL COLUMN
20. INNOMINATE
21. SACRUM
22. PUBIC SYMPHYSIS
23. FEMUR
24. PATELLA
25. TIBIA
26. FIBULA
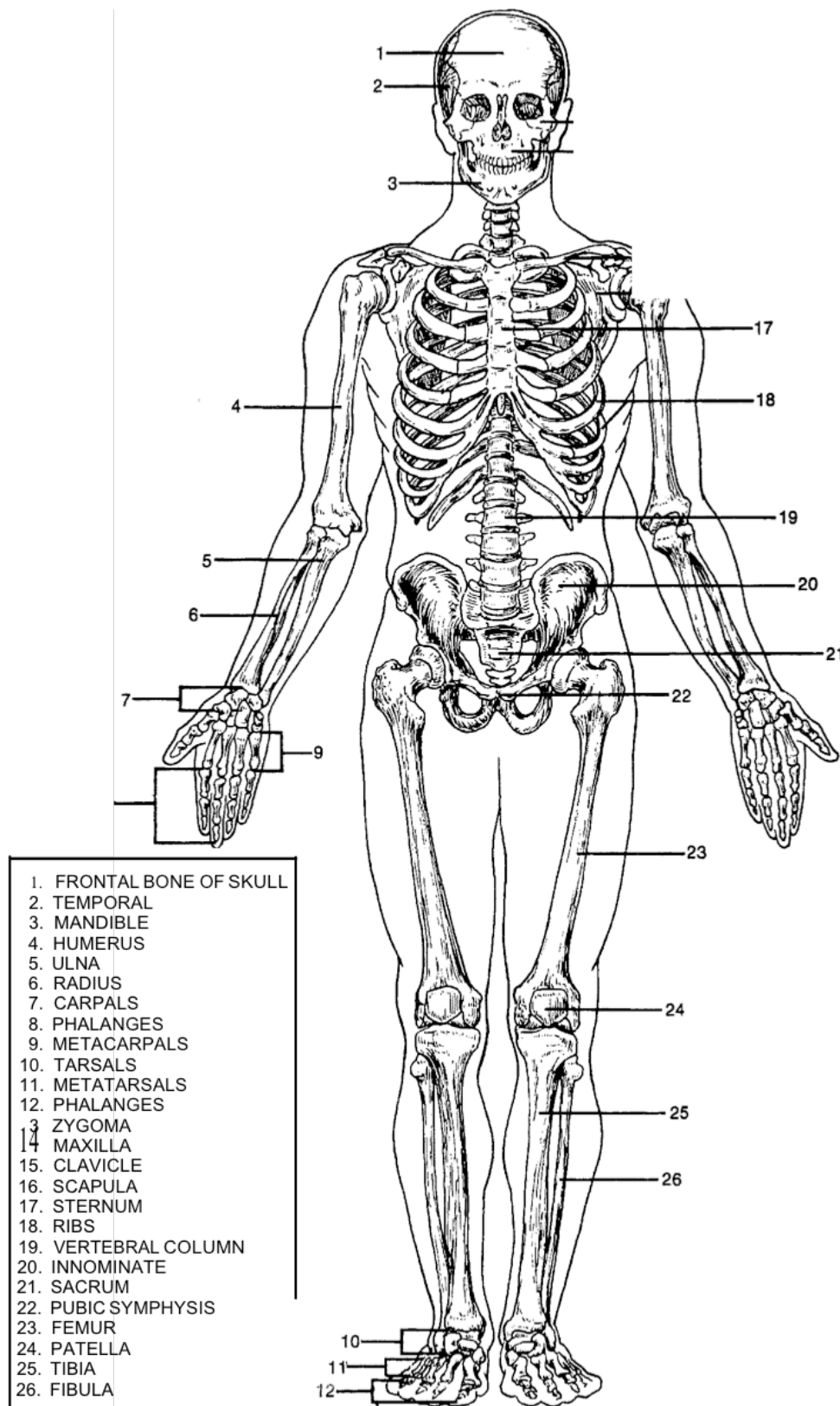
HUMAN, SKELETON, VENTRAL VIEW

Locomotion

Mammals exhibit many adaptations for terrestrial and arboreal (trees) locomotion. Examine the skeletons of the dog, cat, bat, armadillo, and limbs of the pronghorn, paying attention to foot position. Know the difference between plantigrade, digitigrade, and unguligrade (see pages 569-573,and figure 21-12 on page 571). Know how the relative lengths, fusion, or reduction of bones in limbs and feet, and how the presence/absence and size of clavicle offer different advantages for different types of locomotion.

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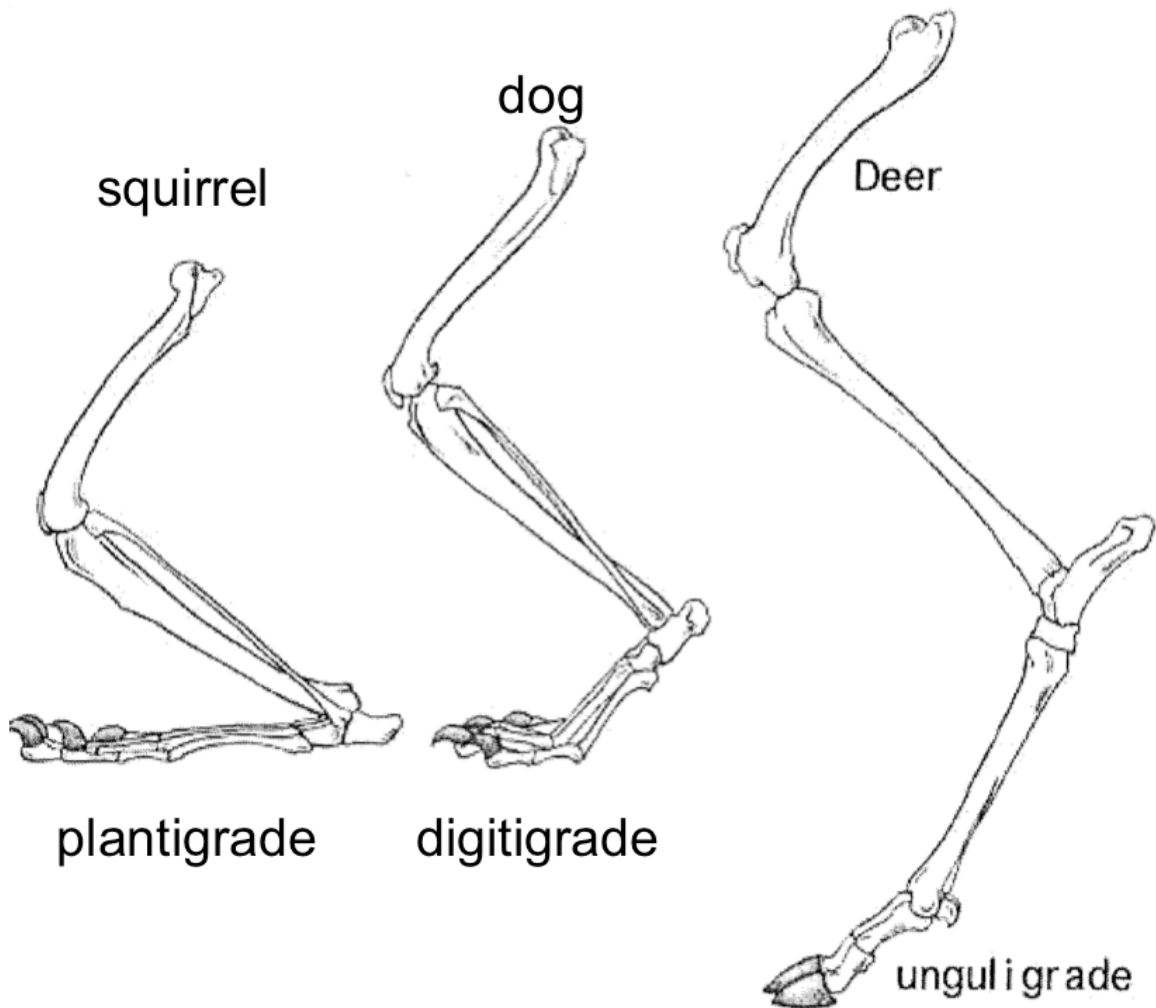
Define plantigrade, digitigrade, and unguligrade with respect to foot posture in mammals.

**Which of the mammals in lab are plantigrade, which are digitigrade, and which are unguligrade?**

Which of the mammals in lab have a clavicle? Now, compare the structure of the clavicle of a cat, opossum, and pronghorn. To what do you attribute these differences?

The next two pages focus on locomotion of vertebrates. Visit lab stations with the respective vertebrates needed to address the terminology and answer the questions.

Aquatic Locomotion

Define **anguilliform, carangiform** and **ostraciiform** with respect to fish. See page 141-143 in your text.

What forces does a fish compensate for and how does it do it?
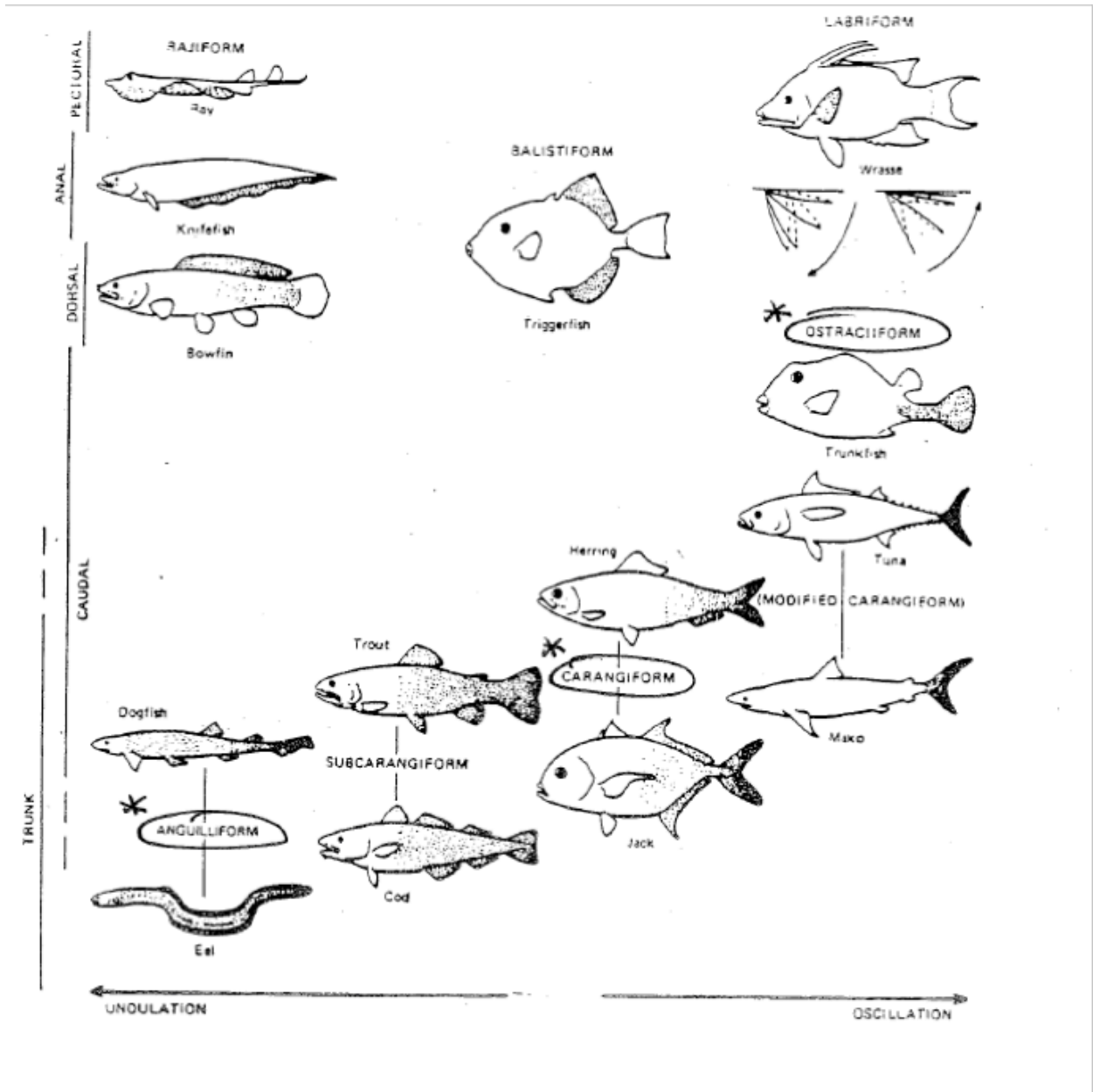
Terrestrial Locomotion

Define **saltatorial** and **cursorial** and be able to identify which mammals displayed in lab are associated with each.

What are some skeletal adaptations that make each of these locomotion types possible? Is there any association with foot posture type (e.g. plantigrade, etc.) with the type of locomotion that they may specialize in?

Aerial Locomotion

What forces does an aerial vertebrate compensate for and how does it do it?

Compare the wing shape of a Barn Swallow, Pheasant and a Red-tailed Hawk. **For each bird, how does the wing shape reflect the type of habitat it occupies and/or the way that it forages**? See pages 453-454 and Figure 17-14 in your text.
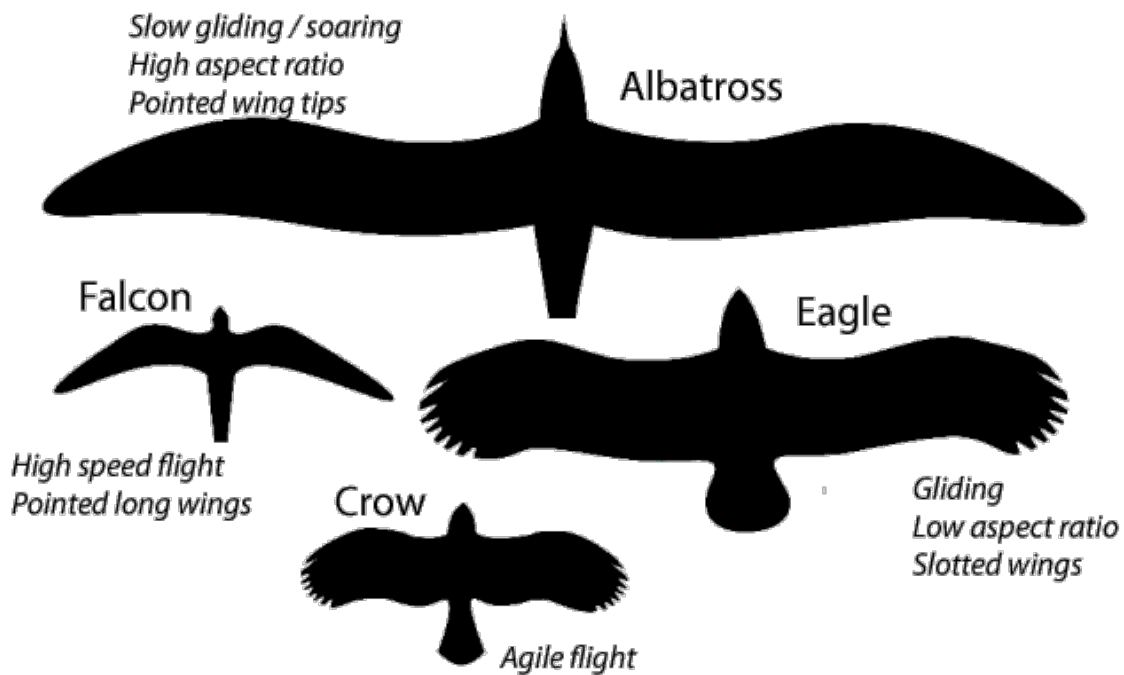

Image borrowed from Wikipedia, bird flight

Lab 2 and 3: Skeletal and Locomotion Comparative Questions

1. In which vertebrates did you observe cervical vertebrae? In which vertebrates did you observe mod- ification of the first cervical vertebra into an atlas? In which vertebrates did you observe modification of the first cervical vertebra into an atlas and modification of the second cervical vertebra into an axis? Explain these differences.

2. Compare and contrast the ribs of a salamander, frog, turtle, bird, and mammal. For example, are ribs always present, are all ribs of the same size, are all ribs attached to a sternum, and are there any modifi- cations of the ribs?

3. How does the position and attachment (to the vertebral column) of the pectoral and pelvic girdles of the perch and *Necturus* compare?

4. Compare and contrast the structure of the forelimb, the pectoral girdle, and the hindlimbs of the bird and the bat.
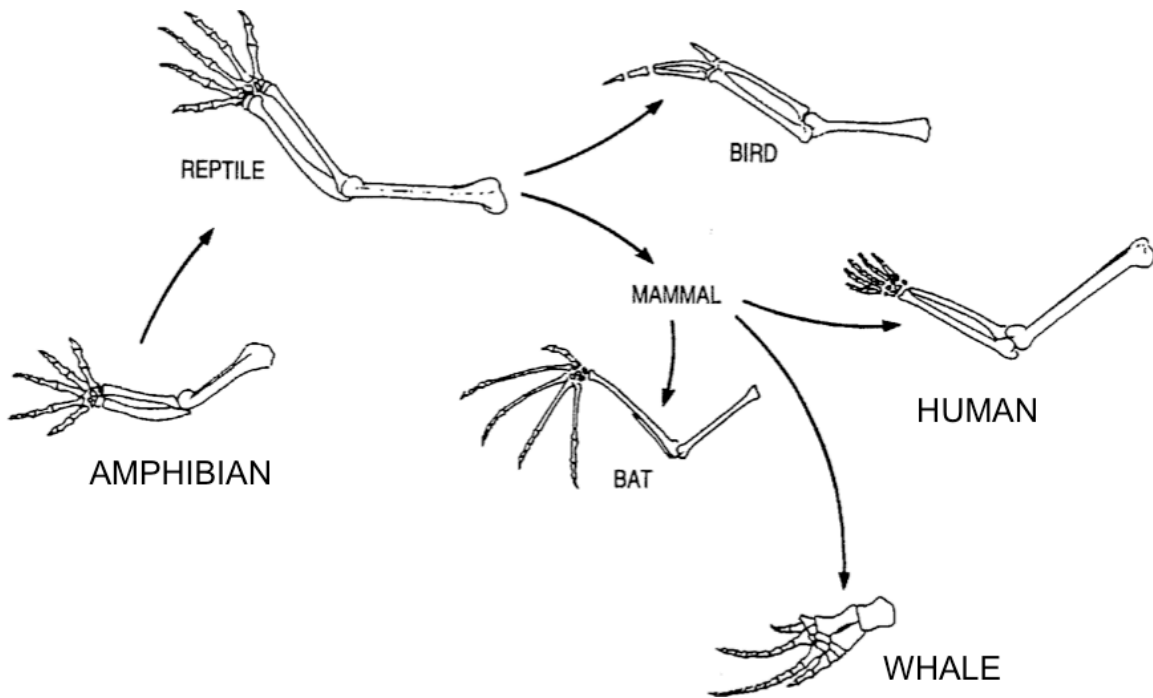
5. Explain how the lower mandible in mammals is unique, and what does this have to do with the mammalian ear?

6. What are the skeletal modifications for breathing air? Compare the secondary palate of amphibians, reptiles, and mammals.

7. What is the difference between the **axial skeleton** and the **appendicular skeleton**? Contrast the axial and appendicular skeleton of a fish and a tetrapod. See pages 173-177 in your text.