

Laboratory 1 Worksheet: The Skull

Objective: Learn about the mammalian skull, and be able to define and/or identify on a specimen all underlined terms.

Use a skull of a coyote (*Canis latrans*) or other canid and identify the following bones and other features. Other canid skulls available include red fox (*Vulpes vulpes*), gray wolf (*Canis lupus*), and domestic dog (*Canis familiaris*). Canids have a fairly "primitive" skull large enough to identify different bones. Drawings and pictures of a coyote skull from different aspects are shown in Figs. 3-6. Associated with each drawing is a photograph of a specimen in the UMD mammal collection. For comparative purposes other skulls are also shown in the figures to illustrate differences among groups or features that are missing from the coyote skull. After identifying features on a canid skull, you should be able to find the same bones or features on skulls of other mammals.

Main features of mammal skulls are the zygomatic arches (the bars on both sides of the skull) under which the jaw muscles reach from the lower jaw to the back of the head, a secondary palate that separates the mouth from the nasal passages, and a mandible (lower jaw) consisting of a single dentary bone on the left and right sides.

Cranium

The cranium is divided into two regions: braincase and rostrum. The braincase, more developed in mammals than in other vertebrates, contains the brain. The rostrum corresponds to the snout or muzzle.

Dorsal aspect of the cranium.—Bones seen from a dorsal aspect on a coyote skull are shown in Fig. 3. The nasal bones are paired bones forming a "roof" over the nasal passages. The paired premaxillary bones form the lower margin of the nasal openings (nares) and the anteriormost part of the bony palate at the anterior upper jaw. The upper incisor teeth are rooted in the premaxillary bones, and you can find the palatal foramen on the maxillary bones

Maxillary bones are paired bones that make up much of the rostrum and the bony palate, bearing all upper teeth except the incisors. Maxillary bones also form the anterior base of the zygomatic arch, and you can find the infraorbital foramen on the maxillary bones.

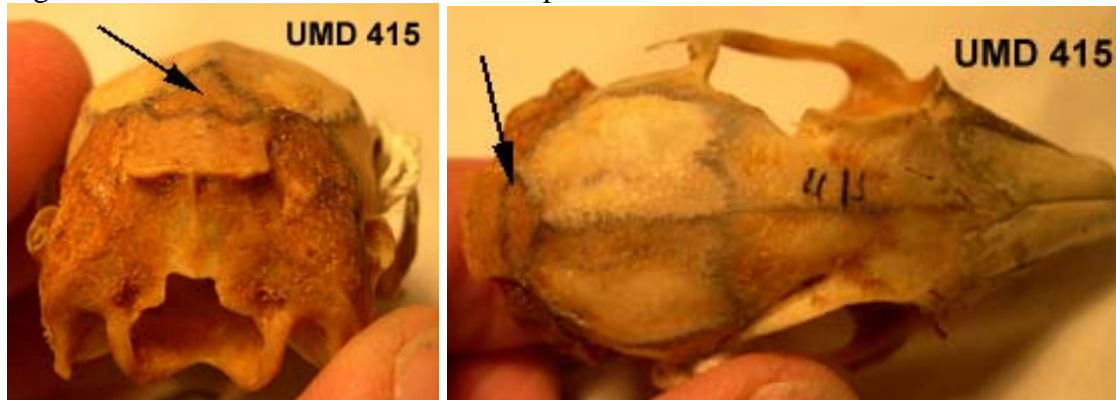
Frontal bones are paired bones just posterior to the maxillary bones. Frontal bones are the anteriormost bones that form the roof (dorsal part) of the braincase. The postorbital process is a lateral projection from each frontal bone which marks the posterior border of the orbit, or eye socket. The postorbital process may join with the zygomatic arch to form a postorbital bar as in the goat (*Capra hircus*) (Fig. 1) and the horse (*Equus caballus*) skulls present in the lab.

Figure 1. Postorbital bar present on a goat (*Capra hircus*) skull is indicated with a black arrow. Compare to lack of postorbital bar on coyote skull in Fig. 3.



The parietal bones are located posterior to the frontals and form much of the roof of the braincase. The interparietal bone is an unpaired bone located between the parietals at the posterior end of the braincase in a few mammals—it can be seen on the cottontail rabbit (*Sylvilagus floridanus*) (Fig. 2) but not on the snowshoe hare (*Lepus americanus*).

Figure 2. Cottontail rabbit skull with interparietal bone visible.



Squamosal bones are lateral and ventral to their corresponding parietal bone and form major portions of the lateral walls of the braincase and the posterior root of the zygomatic arch.

Figure 3. Dorsal view of coyote (*Canis latrans*) cranium (after DeBlase and Martin, 1981 on top drawing) and photograph of gray wolf (*Canis lupus*) in UMD collection.

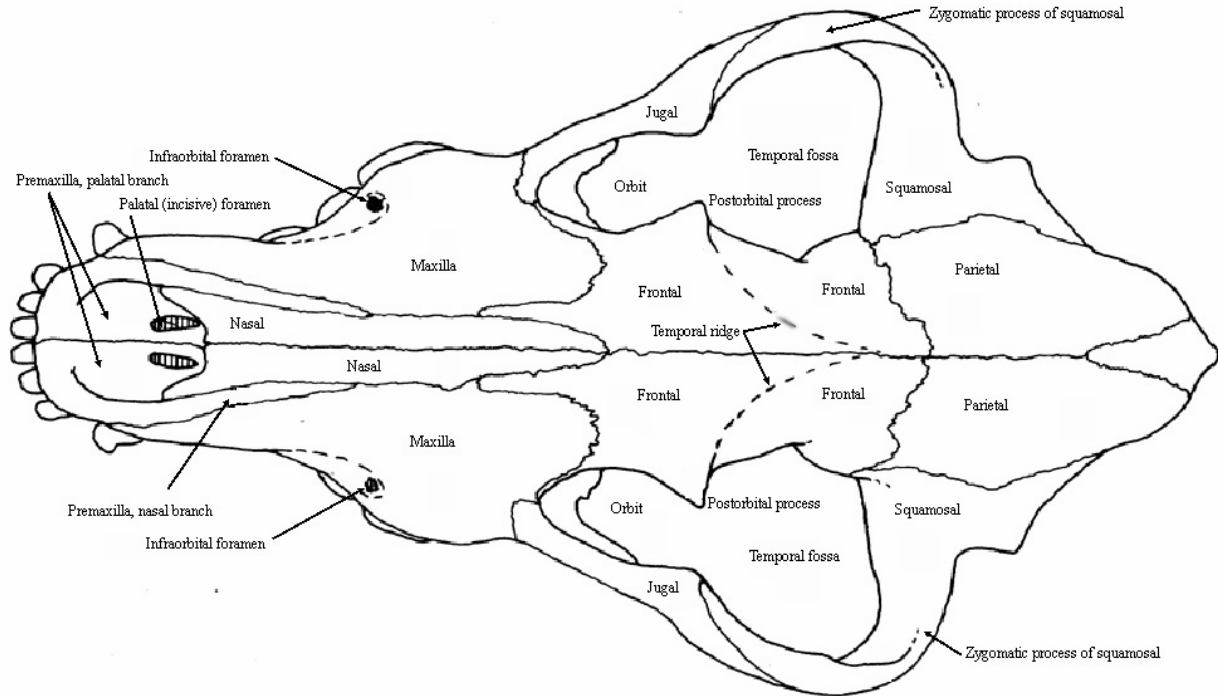


Figure 5. Lateral view of coyote (*Canis latrans*) cranium (after DeBlase and Martin, 1981) and photograph of gray wolf (*Canis lupus*) in the UMD collection.

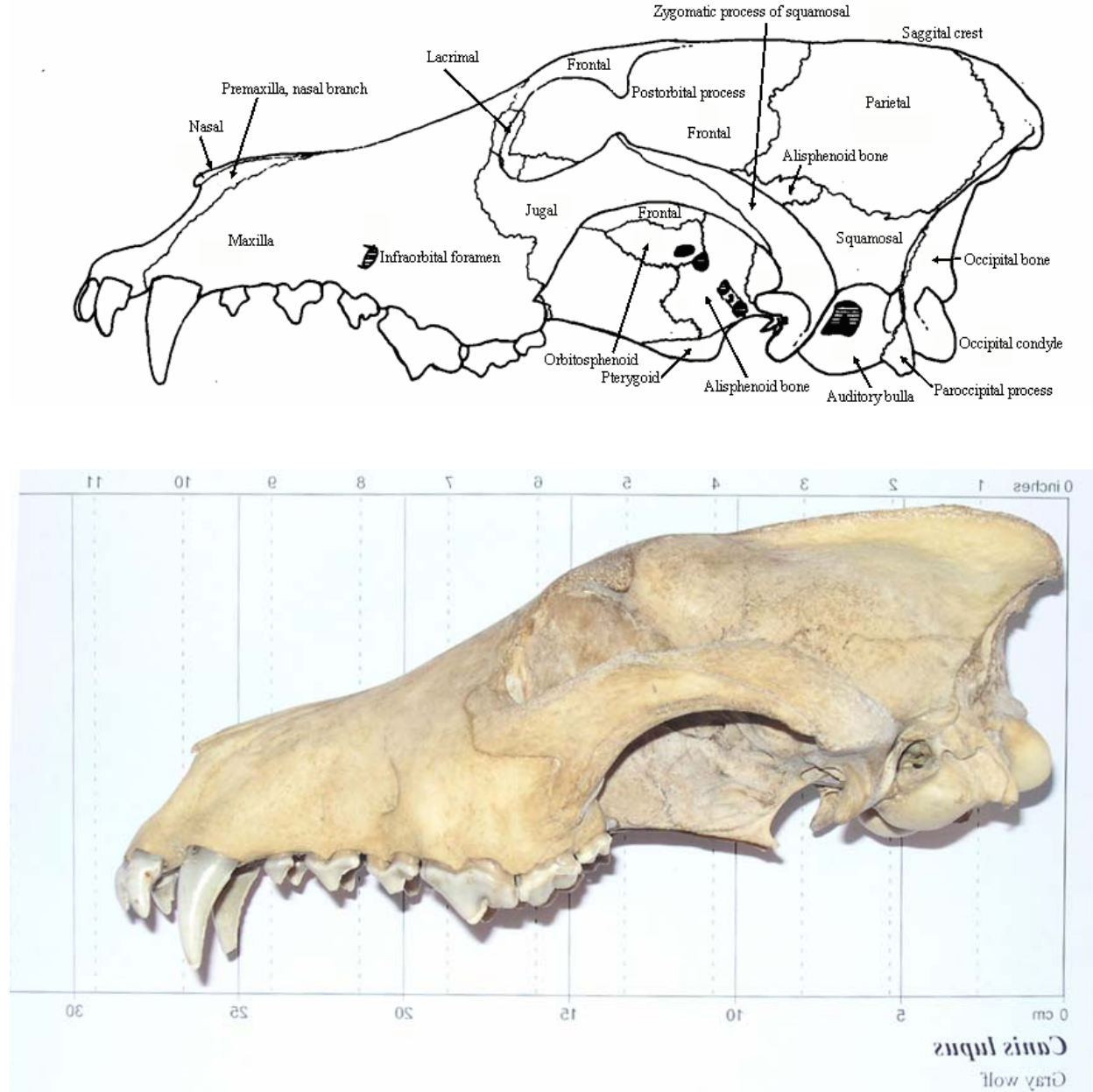
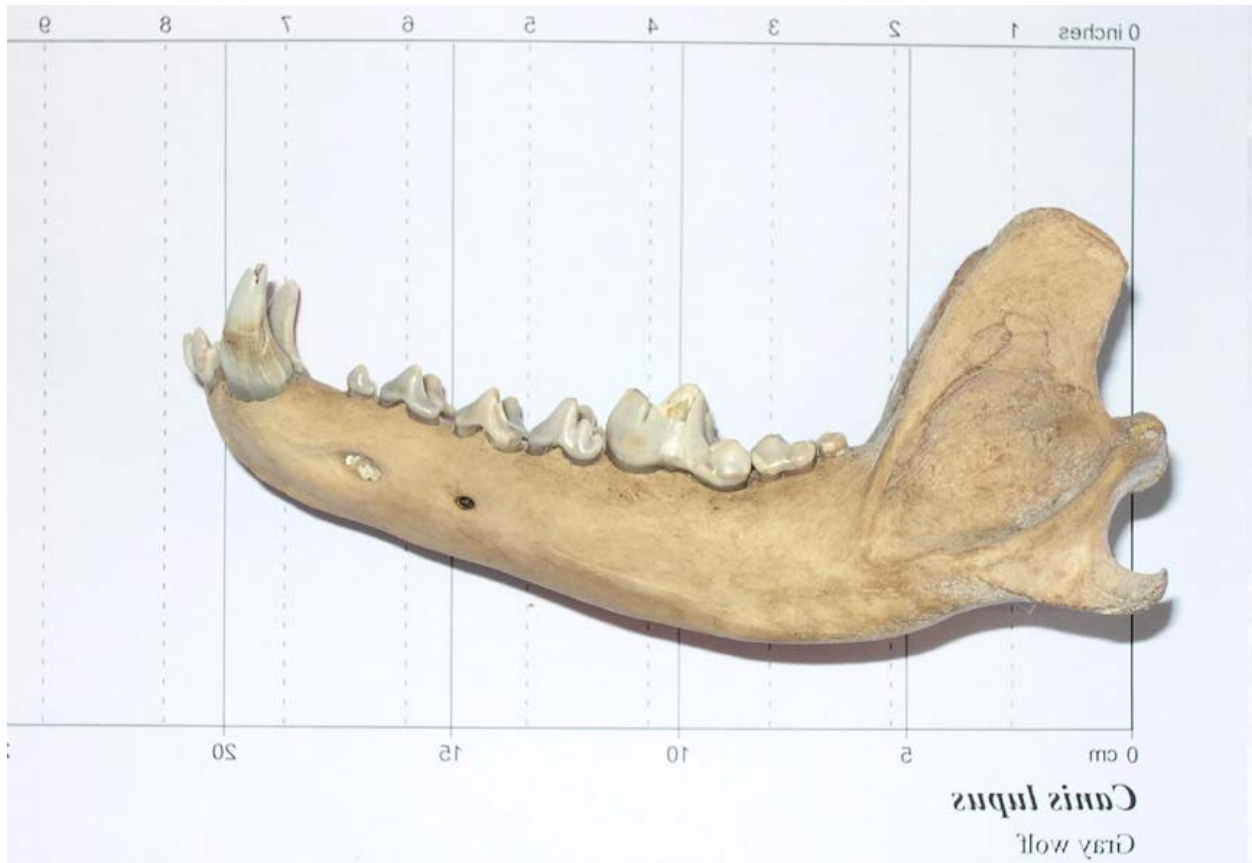
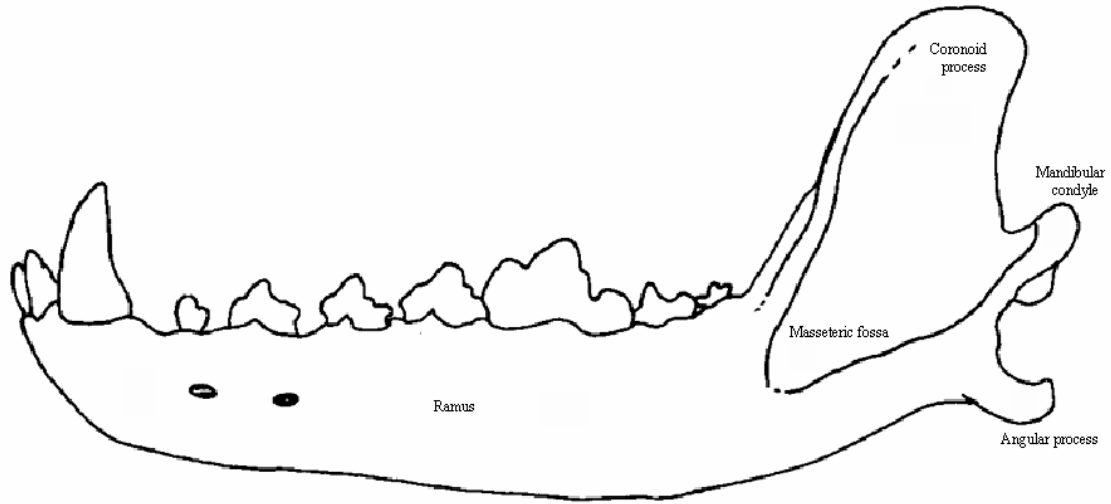
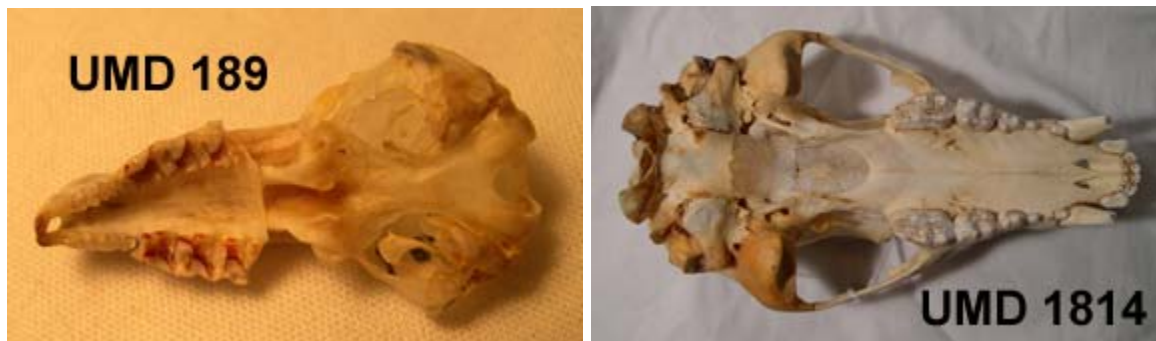


Figure 6. Lateral view of coyote (*Canis latrans*) mandible (after DeBlase and Martin, 1981) and photograph of gray wolf (*Canis lupus*) in the UMD collection.



Zygomatic arches form the lateral and ventral borders of the orbits and the temporal fossae. The zygomatic arch is what we term a cheekbone, on the sides of the cranium in most mammals (are they on sides of cranium in primates?). Zygomatic arches are sometimes incomplete (Fig. 7). The jugal bones form the central portion of the zygomatic arch. Jugal bones are located between the zygomatic processes of the maxillary (anterior) and the squamosal (posterior). The temporal fossae (singular, fossa) are spaces bounded laterally by the zygomatic arch that are posterior to the orbit, or eye socket.

Figure 7. Comparison of incomplete zygomatic arches of an insectivore (short-tailed shrew, *Blarina brevicauda*) on the left and complete zygomatic arches of a black bear (*Ursus americanus*) on the right. Photos not to same scale.



The sagittal crest is a ridge extending along the dorsal midline of the braincase (Fig. 8). The sagittal crest rises posteriorly, is especially prominent in animals with large jaw muscles, and often is a sexually dimorphic feature that is larger in adult males. In many species the crest becomes more prominent with age.

Figure 8. Dorsal and lateral view of fisher (*Martes pennanti*) skull showing sagittal crest development.



Ventral aspect of the cranium. The occipital bone is the large bone forming the posterior part of the ventral portion of the braincase. It is formed by the fusion of several bones: two lateral exoccipitals, a ventral basioccipital, and a dorsal supraoccipital. Sutures between these bones may fuse, making it impossible to distinguish the components of the occipital in older individuals. We had a fawn skull which clearly showed the different occipital bones that was broken last year.

Irregular margins of the bones of the skull that are "stitched" together along their margins in immovable, fibrous joints are sutures (Fig. 9). Sutures tend to ossify completely and disappear with age, becoming what are called synostoses ("together bone").

Figure 9. Sutures in skull of an elk (*Cervus elaphus*) contrasted with a bobcat (*Lynx rufus*) skull with no sutures apparent. Also note the fisher skull in Fig. 8, it has no apparent sutures either.

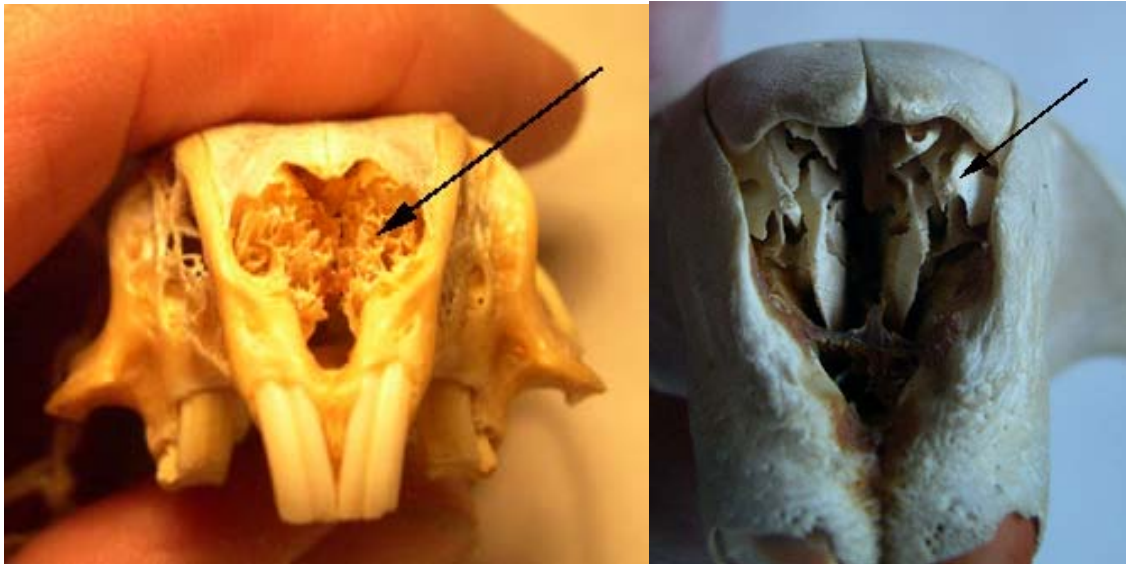


The foramen magnum is the large opening in the occipital bone through which the spinal cord and the vertebral arteries pass. Occipital condyles project from the occipital bone on either side of the foramen magnum and articulate with the first cervical vertebra, the atlas. The auditory bullae are swollen capsules on each side of the anteriormost part of the occipital. They protect the middle-ear bones and facilitate efficient transmission of sound to the inner ear. The paroccipital processes are projections of the occipital extending laterally just posterior to the auditory bullae.

The palatines are a pair of bones forming the posterior part of the secondary palate. They are located between the cheekteeth and posterior to the ventral parts of the maxillaries. The palatines surround the posterior openings of the nasal passages and ventrally reach up to contact the frontals.

The internal nares are the posterior openings of the nasal passages, apparent at the posterior end of the bony palate. The vomer forms parts of the walls separating the two sides of the nasal passages. It is located anterior to the pterygoid and between the palatines and reaches deep into the nasal passages. In some skulls you will see thin, scroll-like turbinal bones which held the olfactory epithelium in the living animal (Fig. 10).

Figure 10. Turbinal bones in a cottontail rabbit (*Sylvilagus floridanus*) skull and in a beaver (*Castor canadensis*) skull.



Mandible.--The mammalian mandible is a simple structure composed of only two bones: the left and right dentary bones (Fig. 6). In species of most mammalian orders dentaries are fused anteriorly at the mandibular symphysis. The horizontal ramus is the tooth-bearing portion of the dentary. The coronoid process (also called the ascending or vertical ramus) is the posterior, vertical part of the dentary. It fits into the temporal fossa of the cranium and provides attachment sites for jaw muscles. The masseteric fossa is the shallow depression at the base of the coronoid process. The masseteric fossa may be more conspicuous in mammals other than canids and may penetrate the dentary to form a masseteric canal. The mandibular condyle articulates with the mandibular fossa of the cranium. It is the pivot around which the mandible moves. The angular process protrudes ventrally below the mandibular condyle and provides additional attachment sites for the jaw muscles.

After finding the bones on the canid skull, you should be able to identify and name homologous structures of skulls of other mammalian groups. The following specimens are available in the lab today, other species will be available in the next labs.

Order	Family	Species	Common name
Didelphimorphia	Didelphidae	<i>Didelphis virginiana</i>	Opposum
Insectivora	Soricidae	<i>Blarina brevicauda</i>	Short-tailed shrew
Carnivora	Canidae	<i>Canis latrans</i>	Coyote
Carnivora	Canidae	<i>Canis lupus</i>	Gray wolf
Carnivora	Canidae	<i>Canis familiaris</i>	Dog
Carnivora	Canidae	<i>Vulpes vulpes</i>	Red fox
Carnivora	Felidae	<i>Lynx rufus</i>	Bobcat
Carnivora	Mustelidae	<i>Martes pennanti</i>	Fisher
Carnivora	Ursidae	<i>Ursus americanus</i>	Black bear
Cetacea	Delphinidae		Dolphin
Perissodactyla	Equidae	<i>Equus caballus</i>	Horse
Artiodactyla	Suidae	<i>Sus scrofa</i>	Pig
Artiodactyla	Cervidae	<i>Cervus elaphus</i>	Elk
Artiodactyla	Cervidae	<i>Odocoileus virginianus</i>	White-tailed deer
Artiodactyla	Bovidae	<i>Bos taurus</i>	Cow
Artiodactyla	Bovidae	<i>Capra hircus</i>	Goat
Rodentia	Muridae	<i>Ondatra zibethicus</i>	Muskrat
Rodentia	Muridae	<i>Rattus norvegicus</i>	Rat
Rodentia	Castoridae	<i>Castor canadensis</i>	Beaver
Rodentia	Erethizontidae	<i>Erethizon dorsatum</i>	Porcupine
Lagomorpha	Leporidae	<i>Sylvilagus floridanus</i>	Eastern cottontail

Numbers to use for the skull images

For this lab I recommend that you do at least two of the image pages with the bones underlined in the text identified. The images available are from a squirrel, a rat, and a raccoon. Other species are available on request.

Either place the number of the bone (below) or the name with or without an arrow (which may be more useful from a learning perspective and from a laboratory practical exam perspective). Alternatively, use a word processor as was done on Figs. 3-6.

You may want to pencil in the boundaries between bones if they are not clear on the printed sheet.

1. alisphenoid bone
2. alisphenoid canal
3. auditory bulla (tympanic bone)
4. basioccipital
5. basisphenoid
6. external auditory meatus
7. foramen magnum
8. frontal
9. infraorbital foramen
10. jugal
11. lacrimal
12. mandibular fossa
13. maxilla
14. nasal
15. occipital bone
16. occipital condyle
17. orbit
18. orbitosphenoid
19. palatal (= incisive) foramen
20. palatine
21. parietal
22. paroccipital process
23. postorbital process (of frontal)
24. premaxilla, palatal branch
25. premaxilla, nasal branch
26. presphenoid
27. pterygoid
28. sagittal crest
29. squamosal
30. temporal fossa
31. temporal ridge
32. vomer
33. zygomatic process of squamosal
34. zygomatic process of maxilla