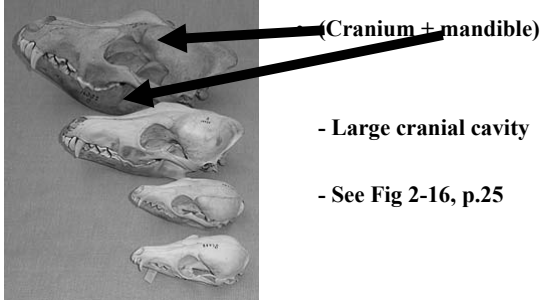


Mammal Characteristics  
**Skull**



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Mammal Characteristics  
**Skull**



- (Cranium + mandible)
- Greater brain mass
- Jaw articulation
- Surface area for muscle attachment
  - Jaw strength
  - Facial expression

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Mammal Characteristics  
**Skull**



1) **Cranium** (bones, foramina, & orbit): also includes upper teeth

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Atlas Axis  
 Cervical vertebrae Lumbar vertebrae Sacral vertebrae  
 Thoracic vertebrae  
 Scapula Ribs Pelvis Ilium  
 Sternum Pubis Femur Ischium  
 Humerus Olecranon Patella Tibia Calcaneus  
 Radius Ulna Carpals Tarsals Metatarsals  
 Metacarpals Phalanges  
 Phalanges  
 Dog wolf (Canis lupus)

- **Cranium** articulates with **atlas** of cervical vertebrae; atlas articulates with **axis** cervical vertebra
- Atlas articulation allows up-down movement of skull
- Axis articulation allows side-side and circular movement of skull

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### Mammal Characteristics Skull - Cranium

Parietal Frontal Nasal  
 Squamosal Jugal Maxillary Premaxillary  
 Infraorbital foramen

- **premaxillary** - anterior portion; origin for upper incisor
- **nasal** - anterodorsal surface following premaxillary
- **maxillary** - behind premaxillary; bears all upper teeth except incisors
- **infraorbital foramen** - opening in maxillary; passage for blood vessels & cranial nerve

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Alisphenoid canal Foramen rotundum Squamosal Jugal  
 Foramen ovale Eustachian tube Medial lacerate foramen  
 Posterior lacerate foramen Anterior condylar foramen  
 Occipital condyle Basioccipital Paroccipital process Mastoid  
 Auditory bulla Zygomatic arch Pterygoid Presphenoid  
 Palatine Palsone Maxillary Incisive foramen  
 Vomer Posterior palatine foramen  
 African hunting dog (Lycan pictus)

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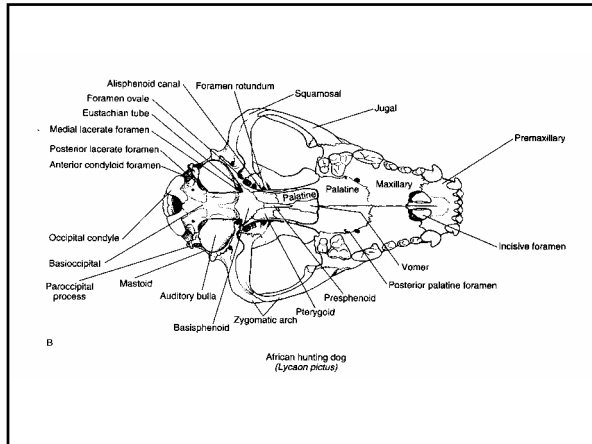
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### Mammal Characteristics Skull - Cranium

- **frontal orbit** - eye socket
- **lacrimal** - anterior portion of orbit; opening for lacrimal (tear) duct
- **frontal** - posterior to nasal, anterior to parietal
- **parietal** - posterior to frontal, dorsal to squamosal
- **sagittal crest** - bony ridge; dorsal surface of cranium

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### Mammal Characteristics Skull - Cranium

- **foramen magnum** - large opening in occiput for spinal cord

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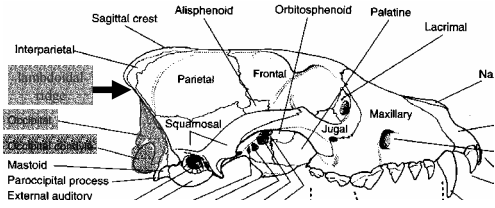
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## Mammal Characteristics

### Skull - Cranium



- **Occiput (occipital)** - posterior part of cranium; surrounds foramen magnum
- **Occipital condyle** - articulation surface, cranium to atlas
- **lambdoidal ridge** - bony ridge located where parietal & occiput meet

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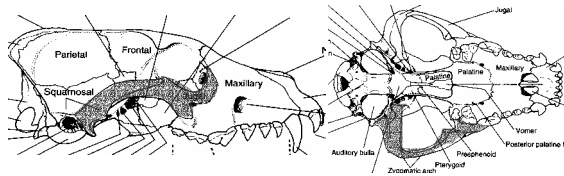
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## Mammal Characteristics

### Skull - Cranium



- **zygomatic arch** - arched bone protecting orbit; consists of maxillary, jugal, & squamosal bones; attachment for masseter muscles (close jaw)

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## Mammal Characteristics

### Skull - Cranium



- **zygomatic arch** - arched bone protecting orbit; consists of maxillary, jugal, & squamosal bones; attachment for masseter muscles (close jaw)

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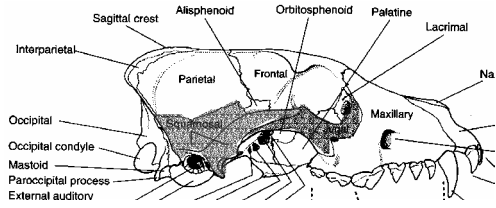
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## Mammal Characteristics

### Skull - Cranium



- **zygomatic arch** - arched bone protecting orbit; consists of maxillary, jugal, & squamosal bones; attachment for masseter muscles (close jaw)
- **jugal** - midbone of zygomatic arch
- **squamosal** - posterolateral surface

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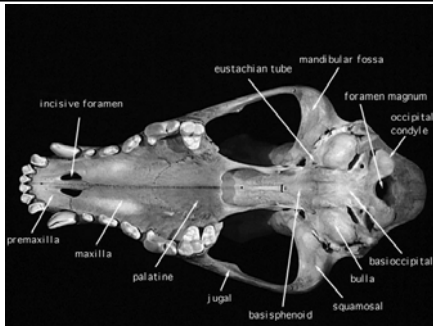
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- **incisive foramen** - upper palate; contains olfactory organ for "mouth smelling"
- Maxilla and palatine

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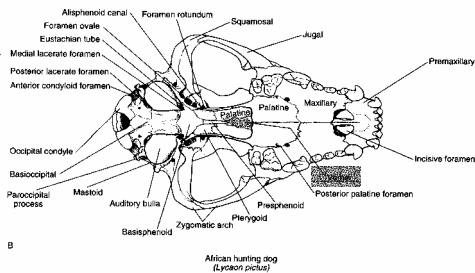
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- **vomer** – unpaired bone; forms septum of nasal passage, i.e., partitioning of nasal area

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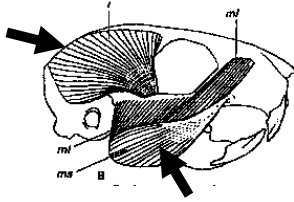
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## Mammal Characteristics Skull - Cranium



- **temporal muscles (temporalis)**: close jaw; originate on squamosals & parietals; sagittal crest allows greater area for attachment = greater strength; Carnivora
- **masseter muscles**: close jaw; attachment towards front end = zygomatic arch; allows greater gnawing force; Rodentia

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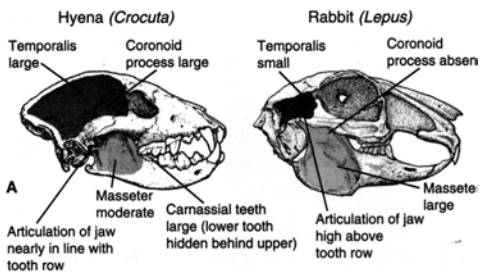
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Comparing temporal and masseter muscles in different Orders

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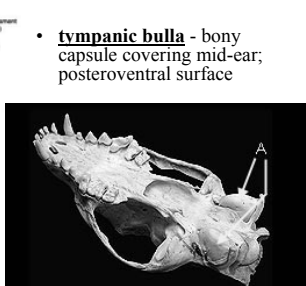
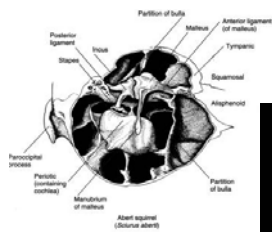
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## Mammal Characteristics Skull - Cranium



- **tympanic bulla** - bony capsule covering mid-ear; posteroventral surface

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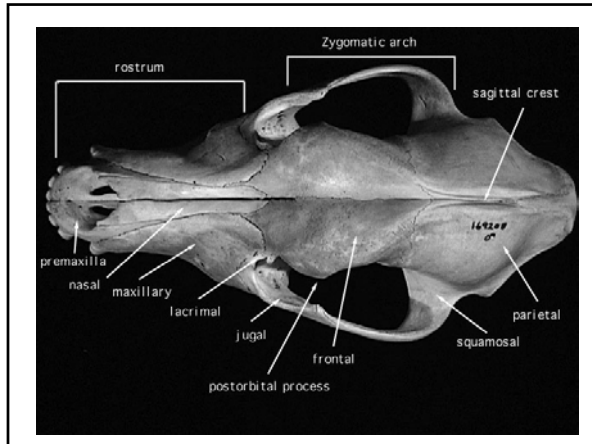
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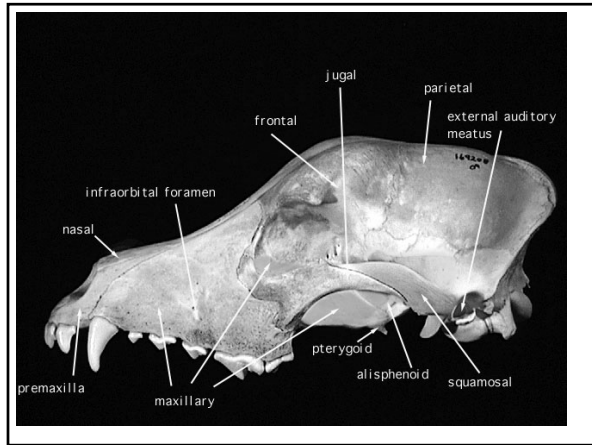
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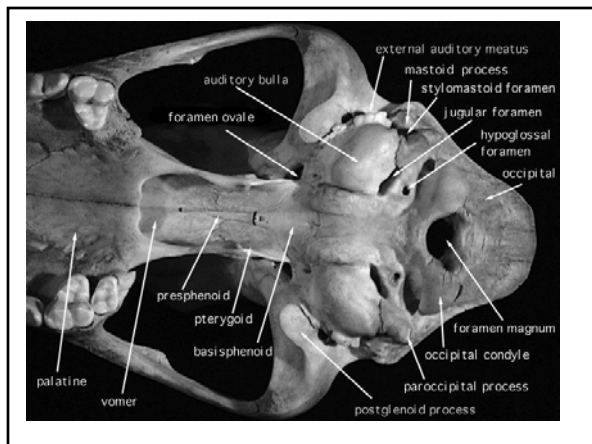
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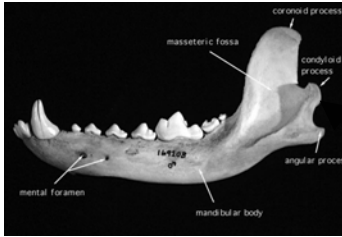


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## Mammal Characteristics Skull - Mandible



2) **Mandible** (dentary, processes, foramina & lower sets of teeth)

• **dentary** - half of lower jaw (includes several processes & foramina)

• **condyloid process** - posterior bony projection; supports **articular condyle** (articulation point for mandible & squamosal of cranium)

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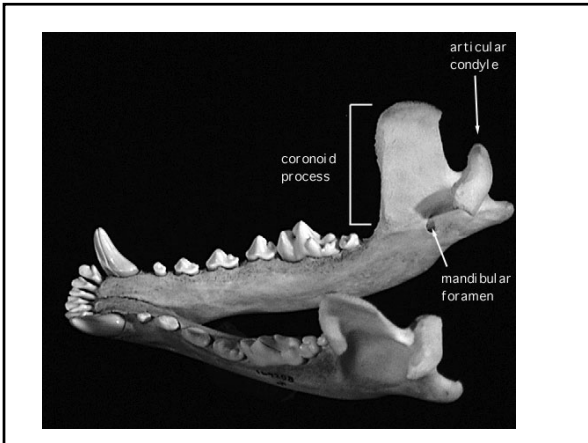
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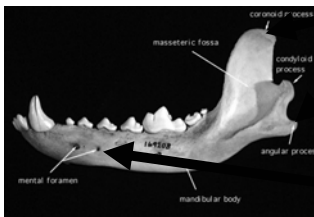
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## Mammal Characteristics Skull



• **coronoid process** - bony projection; anterodorsal to condyloid process

• **angular process** - bony projection; ventral to condyloid process; attachment for jaw opening muscles

• **mental foramina** - anterior openings for blood vessels, nerves, muscles

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## Mammal Characteristics Teeth



### Teeth

- Major advancement of mammals = specialized dentition relative to specialized & diverse diets (contrast with fish & herps)
- Close relationship between dentition, foraging strategies, and evolution; phylogenetic relationships & fossil teeth

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## Mammal Characteristics Teeth



- Use of teeth in displays of aggression, communication

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## Mammal Characteristics Teeth



- Use of teeth in social display

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# Mammal Characteristics

## Teeth

### Kinds of Teeth

#### A) Functional Variants

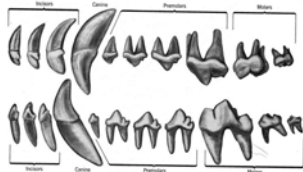


FIGURE 4-7  
HETEROdont MAMMALIAN DENTITION illustrated by the teeth of the dog.

1) **heterodont**: first seen in ancestor of mammals (i.e., mammal-like reptiles); teeth vary in form & function

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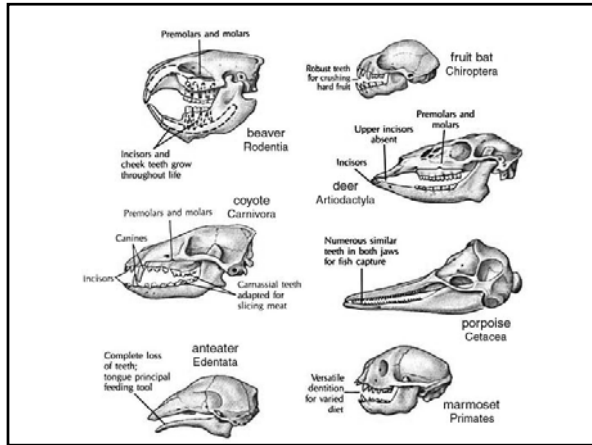
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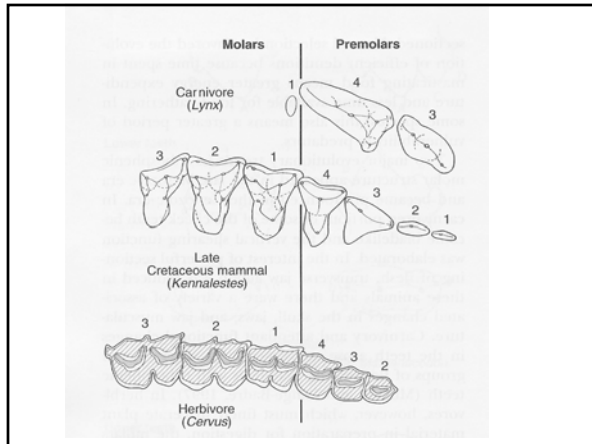
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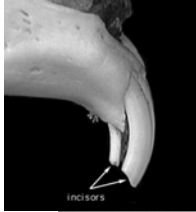
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## Mammal Characteristics

### Teeth



#### Kinds of Teeth

##### A) Functional Variants

###### 1) heterodont:

– **incisors** – single-rooted nipping teeth; non-rooted in rodents and lagomorphs

– **canines** – single-rooted; defense, grabbing, stabbing; absent in rodents

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## Mammal Characteristics

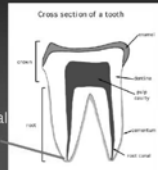
### Teeth

#### Rooted vs. rootless teeth

● Rooted - When tooth is mature, root canal closes

● Rootless - canal remains open

Root canal



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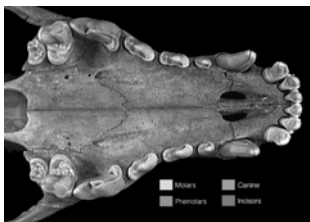
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## Mammal Characteristics

### Teeth



#### Kinds of Teeth

##### A) Functional Variants

###### 1) heterodont:

– **premolars** - cheek teeth with grinding surface

– **molars** - grinding

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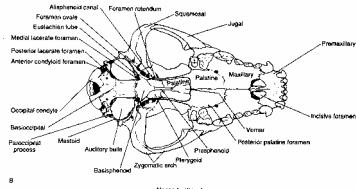
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## Mammal Characteristics Teeth



- incisors = rooted in premaxillary & dentary bones
- canines, premolars, molars = rooted in maxillary & dentary

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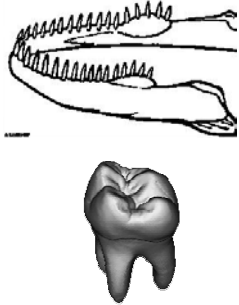
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## Mammal Characteristics Teeth



- 2) **homodont**: teeth are same in form & function  
e.g., dolphins
- 3) **brachyodont**: short-crowned; growth stops when tooth fully grown

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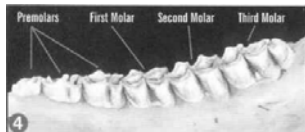
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## Mammal Characteristics Teeth



- 4) **hypsodont**: high-crowned; found in herbivores; adaptation to excessive tooth wear from abrasive materials
- 5) **ever-growing (hypsodont)**: tooth growth continuous; adaptation to abrasive materials/tooth wear

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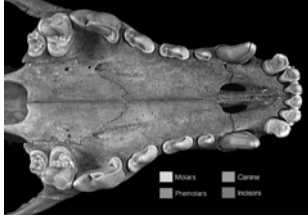
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## Mammal Characteristics Teeth



### Dental Formula (df)

- refers to number of teeth of each type in one side of upper jaw and matching dentary (i.e., 1/2 of lower jaw)
- incisors (**i**), canines (**c**), premolars (**p**), molars (**m**)

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## Mammal Characteristics Teeth

- total number of teeth is 2X dental formula (df)
- total number of teeth for primitive placentals = 44  
df = 3/3, 1/1, 4/4, 3/3
- human df = 2/2, 1/1, 2/2, 3/3

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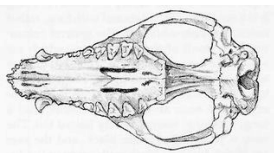
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## Mammal Characteristics Teeth



- marsupials differ in total number teeth => 44
- Also, generally premolars 3/3 & 4/4 molars
- e.g., *Didelphis virginiana*  
df = 5/4, 1/1, 3/3, 4/4

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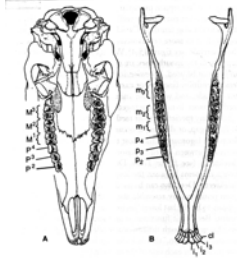
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## Mammal Characteristics Teeth



- **diastema**: space or gap between incisors or canines & premolars; prominent in rodents & lagomorphs

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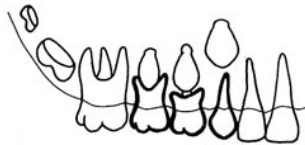
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## Mammal Characteristics Teeth



- Tooth Development (**Diphyodont** = 2 sets of teeth)
  - 1) **deciduous teeth** ("milk teeth"): develop early; consist of incisors, canines, premolars, but no molars

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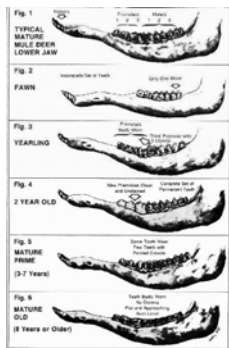
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## Mammal Characteristics Teeth



- 2) **permanent teeth**: replace deciduous teeth with maturity; consist of incisors, canines, premolars, & molars
- tooth eruption patterns useful for aging individuals, if extensive literature is available, e.g., white-tailed deer

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## Mammal Characteristics

### Teeth



- **Tooth Structure**
  - Calcifications appear as teeth arranged in a row along each ridge of jaw

- **theodont:** teeth lodged in a socket (alveolus) vs.

**Acrodont** (rootless) or

**Pleurodont** (rootless, attached to lingual side of jaw)

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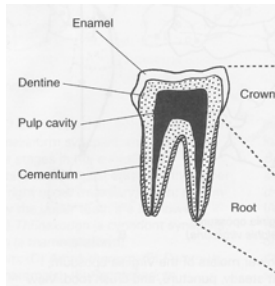
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## Mammal Characteristics

### Teeth



#### Components of tooth structure:

- 1) **enamel:** developed from the epidermis; = hard part of tooth; located on free surfaces of tooth; none on root

- develops by formation of an enamel matrix cap; this becomes calcified

- consists of hydroxyapatite (calcium, phosphate, hydroxide compound)

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## Mammal Characteristics

### Teeth



#### Components of tooth structure:

- 1) **enamel**

- enamel partly missing on lingual surface (nearest tongue) of rodent incisors, and tusks of boar & elephant

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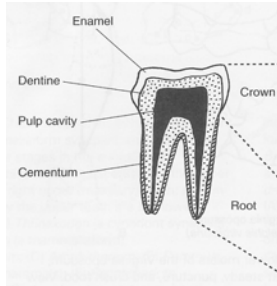
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## Mammal Characteristics Teeth



2) **dentine**: developed from mesodermal tissue

- calcified predentine
- most of crown & root
- root dentine covered by cementum

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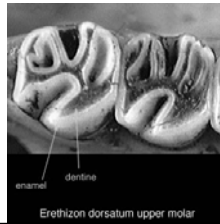
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## Mammal Characteristics Teeth



2) **dentine**: developed from mesodermal tissue




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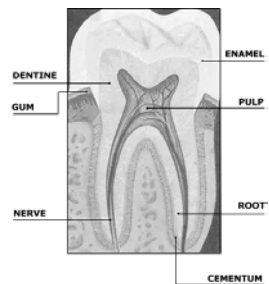
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## Mammal Characteristics Teeth



3) **cementum**: developed from mesodermal tissue;

- hard material covering roots of all mammal teeth; fasten tooth in socket
- crown cementum found in cheek teeth adapted to perform extensive chewing, e.g., rabbits, deer,....

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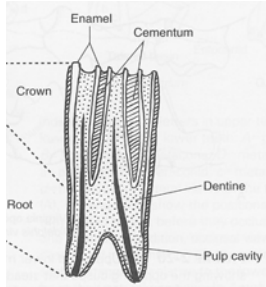
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## Mammal Characteristics Skull



### 3) **cementum:**

- grazing presents wear problem, thus high crowned teeth with entire tooth covered with cementum

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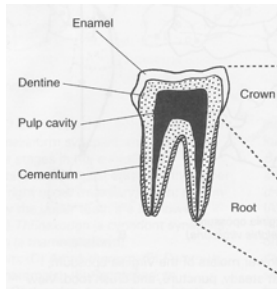
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## Mammal Characteristics Teeth



### 4) **pulp:** developed from mesodermal tissue;

- soft interior of tooth
- nerves & blood vessels enter pulp from openings in root bases
- openings in base of root may close partially with age

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## Mammal Characteristics Teeth



### 4) **pulp:** developed from mesodermal tissue;

- in other mammals (rodents, elephants, lagomorphs) openings never fully close & crown continues to grow (**persistent pulps**)

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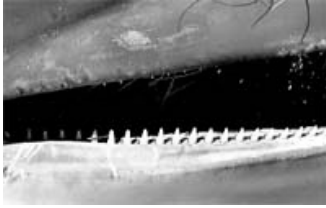
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## Mammal Characteristics

### Teeth



- Molar Structure & Function
- Ancestral molar = reptilian haplodont molar
- **haplodont**: single cusp (conical shape)

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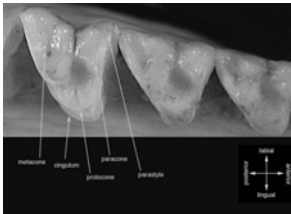
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## Mammal Characteristics

### Teeth



- **occlusal surface**: refers to chewing or shearing surface of teeth
- **cusp**: sharp or rounded projection of crown
- **tribosphenic**: basic primitive molar; triangular
  - basic 3-cusp pattern of occlusal surface
  - found in fossil teeth & primitive mammals (opossum)

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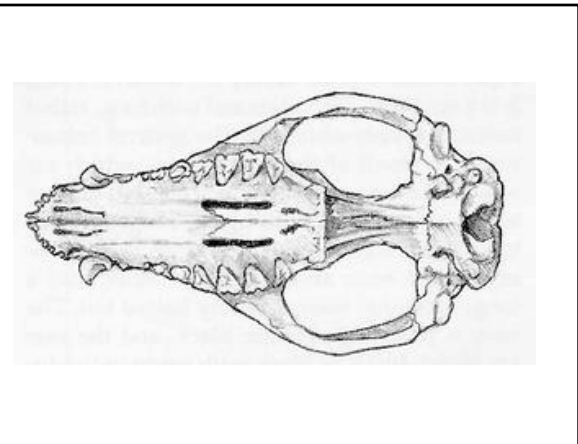
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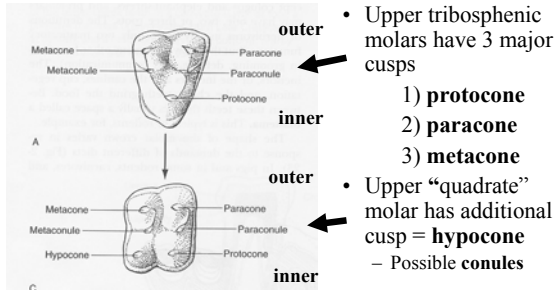
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## Mammal Characteristics

### Teeth



- Upper tribosphenic molars have 3 major cusps

- 1) **protocone**
- 2) **paracone**
- 3) **metacone**

- Upper "quadrate" molar has additional cusp = **hypocone**
  - Possible **conules**

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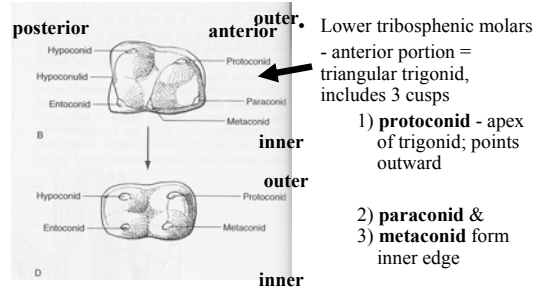
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## Mammal Characteristics

### Teeth



- Lower tribosphenic molars - anterior portion = triangular trigonid, includes 3 cusps

- 1) **protoconid** - apex of trigonid; points outward

- 2) **paraconid & metaconid** form inner edge

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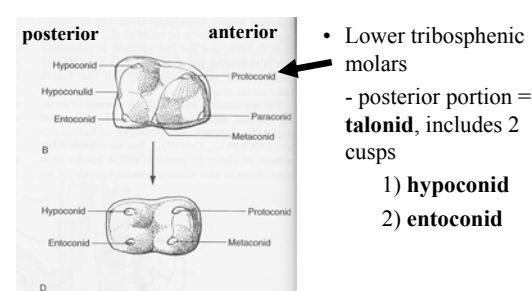
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## Mammal Characteristics

### Teeth



- Lower tribosphenic molars - posterior portion = **taloid**, includes 2 cusps

- 1) **hypoconid**
- 2) **entoconid**

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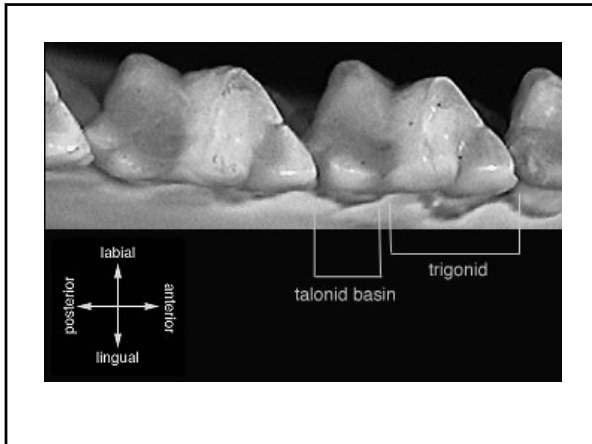
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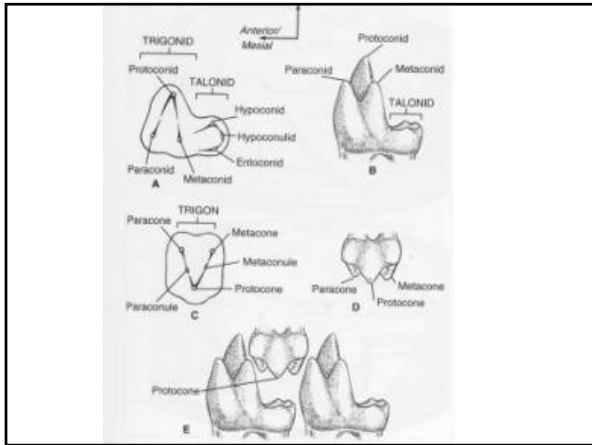
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### Mammal Characteristics Teeth

Diagram B (top) shows a tooth cross-section with labels: posterior (left), anterior (right), outer (top), inner (bottom), Hypoconid, Entoconid, Protoconid, Paraconid, and Metaconid.

Diagram D (bottom) shows a tooth cross-section with labels: posterior (left), anterior (right), outer (top), inner (bottom), Hypoconid, Entoconid, Protoconid, and Metaconid. An arrow points to the inner side.

- Lower "quadrate" molars
- anterior portion = 2 cusps
  - 1) protoconid
  - 2) metaconid
- posterior portion = 2 cusps
  - 1) hypoconid
  - 2) entoconid

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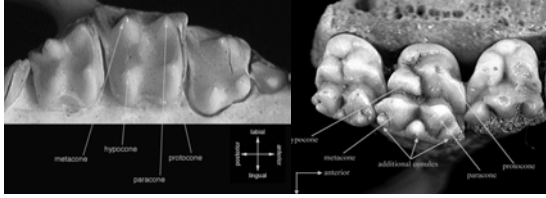
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## Mammal Characteristics Teeth



**Quadrate molars:** upper teeth with 4 main cusps (protocone, paracone, metacone, hypocone), e.g., hedgehog

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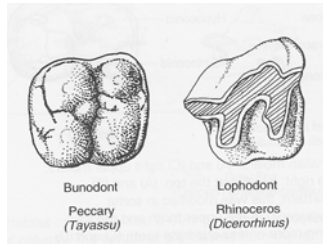
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## Mammal Characteristics Teeth



### Types of Molars

- 1) **bunodont:** rounded, separate cusps for crushing/grinding food  
- pigs, rodents, primates, carnivores
- 2) **lophodont:** cusps form ridges (lophs)  
- herbivores

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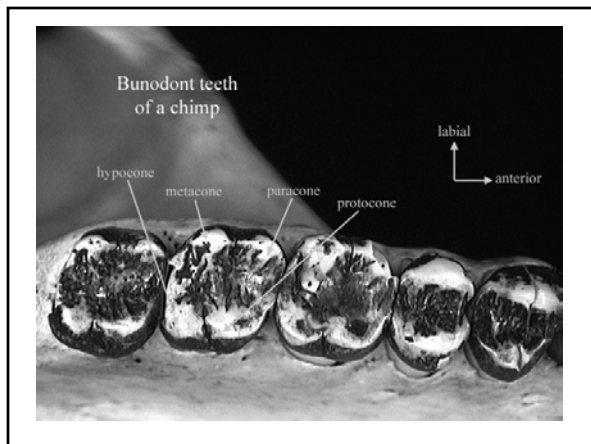
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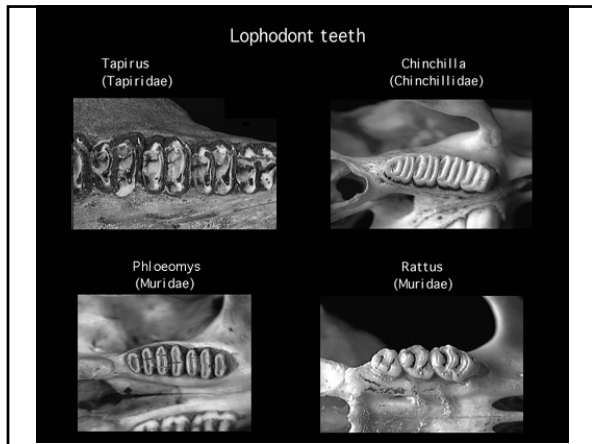
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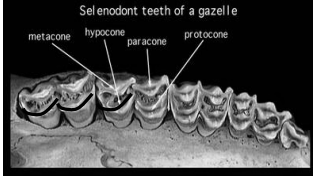
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**Mammal Characteristics  
Teeth**

Types of Molars

Selenodont teeth of a gazelle



3) **selenodont**: cusps form triangular crescents  
- herbivores



Selenodont  
Pronghorn  
(Antilocapra)

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**Mammal Characteristics  
Teeth**

Types of Molars



4) **sectorial**: blade-like cutting edges, e.g. carnassials  
- carnivores

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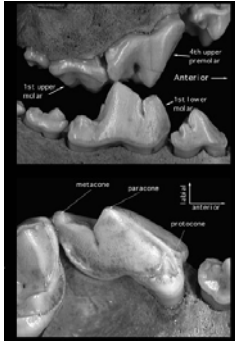
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## Mammal Characteristics

### Teeth



#### Carnivores

- **carnassials**: main shearing teeth of terrestrial carnivores (fissipeds)

- p4 / & m1 = upper 4th premolar & lower 1st molar

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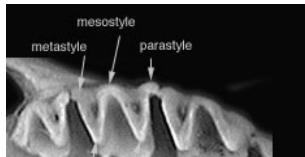
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## Mammal Characteristics

### Teeth



#### Insectivores

- 5) **dilambdodont** molars: shrews & moles; - W-shaped

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## Mammal Characteristics

### Teeth

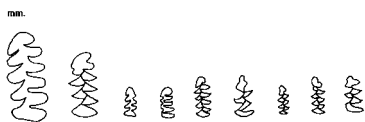


Fig. 29.—Drawings (to scale) of occlusal surface of first lower left molar of nine genera of microtines (anterior up, lingual right). Left to right: *Onychia*, *Neofiber*, *Clethrionomys*, *Phocaenomys*, *Dicrostonyx*, *Lemmus*, *Lemmiscus*, *Microtus*, and *Synaptomys*.

#### Types of Molars

- 6) **microtine**: zig-zag prisms with loops

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## Mammal Characteristics

### Teeth

- Diet & Molar Structure - A Summary

#### Herbivory

- lophodont
- selenodont
- equine (hypsodont)
- microtine

#### Omnivory

- bunodont

#### Insectivory

- tribosphenic
- dilamodont

#### Carnivory

- sectorial

#### Piscivory

- homodont

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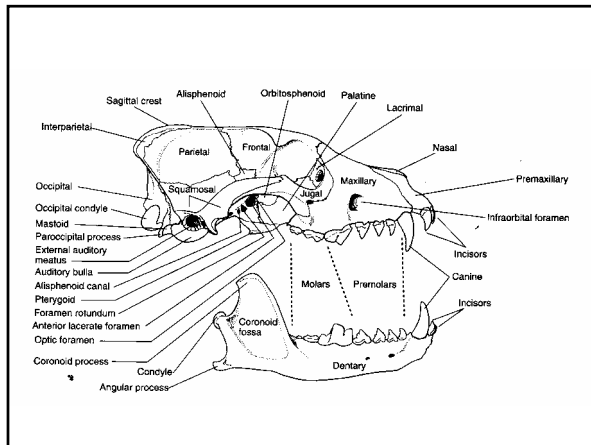
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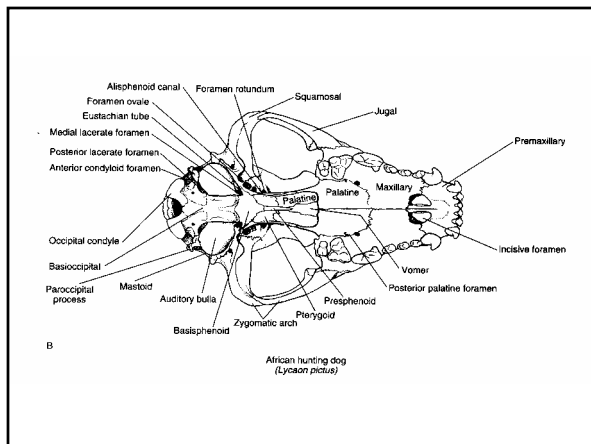
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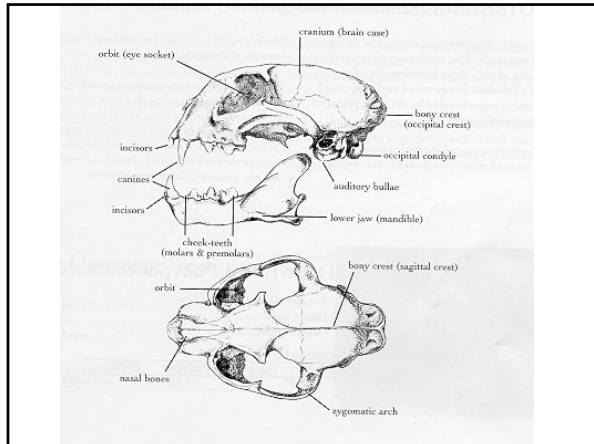
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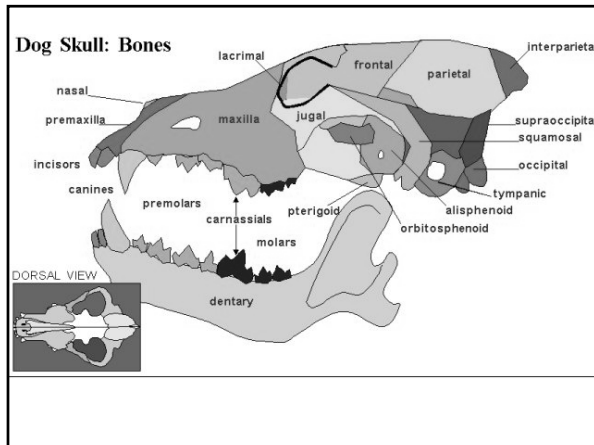
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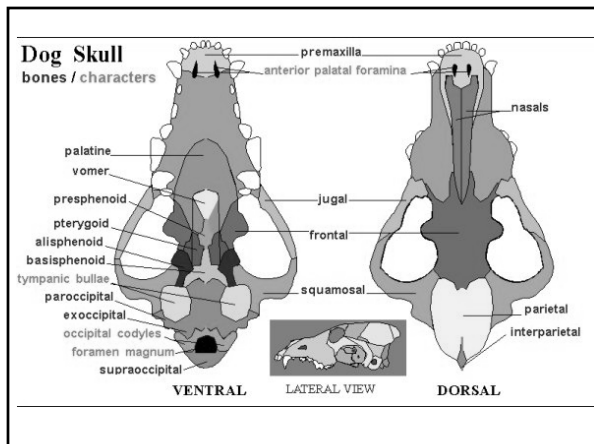
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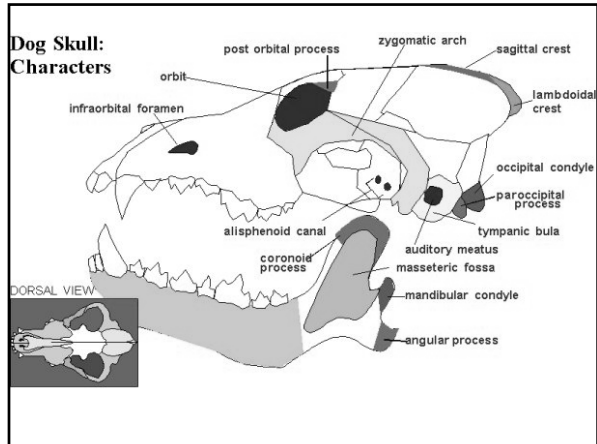
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