

ANSWER QUESTIONS 1-4 WITH REFERENCE TO THE PHYLOGENY DRAWN BELOW

(1) (6 pts) Provide the names of the node groups A, B and C

- A. *Reptilia*
- B. *Therapsida*
- C. *Mammalia*

(2) (4 pts) Give the stem group names for the lineages indicated by the arrows labeled D and E.

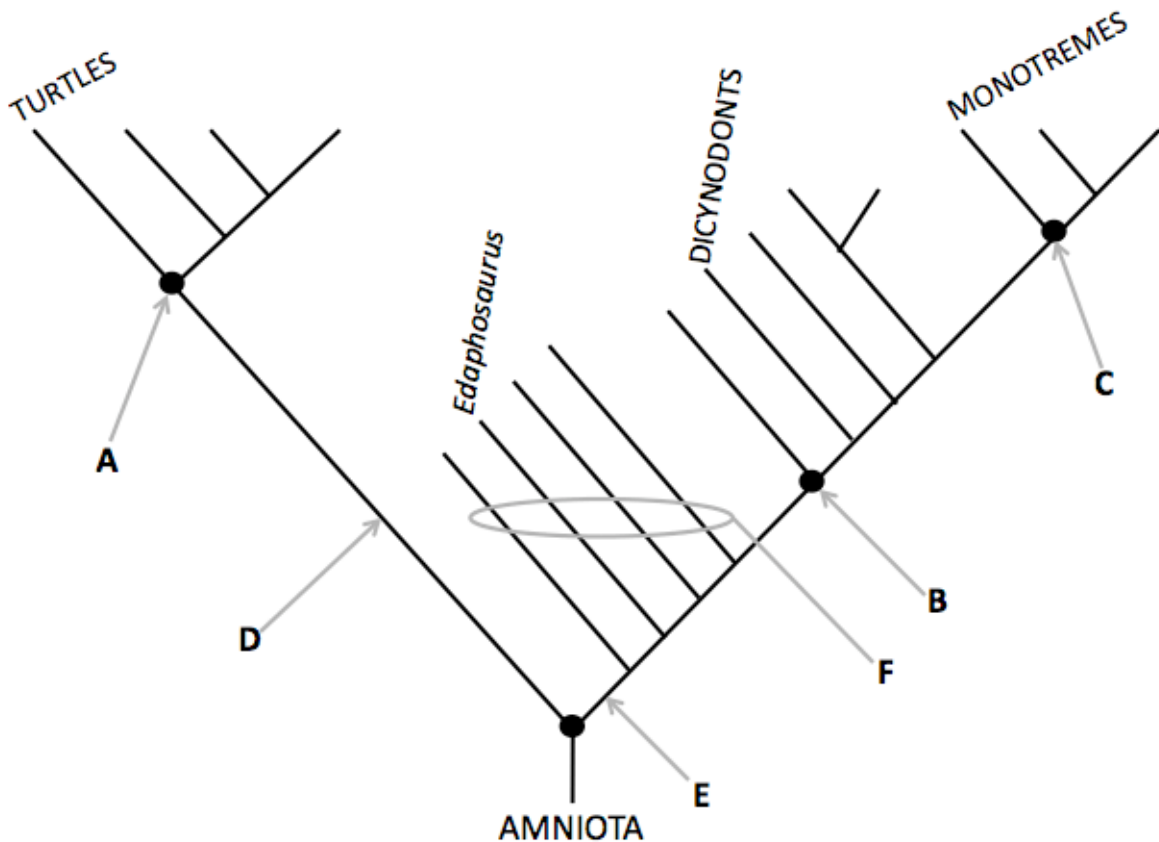
- D. *Sauropsida*
- E. *Synapsida*

(3) (2 pts) What is the informal name given to the group of lineages circled and labeled F?

- F. *Pelycosaur*s

(4) (8 pts) Answer the following questions based on what the common ancestor of the two main amniote lineages would have been like (the black dot just above the name "AMNIOTA").

- | | |
|--|--------------------------------|
| a) Did it masticate its food? | <i>No</i> |
| b) Did it have hair? | <i>No</i> |
| c) What kind of posture/limb position did it have? | <i>Sprawled, limbs to side</i> |
| d) Was it ectothermic or endothermic? | <i>ectothermic</i> |
| e) Did it have a masseter muscle? | <i>No</i> |
| f) Did it have ribs on its neck vertebrae? | <i>Yes</i> |
| g) Did it have a secondary palate? | <i>No</i> |
| h) Did it lay eggs or give birth to live young? | <i>Eggs</i> |



(5) (3 pts) Give the crown group definition of “Mammalia.”

The common ancestor of all the LIVING mammals and ALL of its descendants (extinct or alive)

(6) (8 pts) Place a **T (True)** or an **F (False)** next to the following statements.

F Small animals heat up and cool down more slowly than large animals.

T Enlargement of the coronoid process is associated with changes in the action of the temporalis muscle related to the evolution of mastication

T Living reptiles and mammals extract the same amount of energy per unit of food.

F A secondary palate evolved in response to selection for breathing efficiency to support high activity levels.

F Sagittal (ventral) limb position is correlated with lateral undulation during locomotion.

T Living reptiles can afford slow gut passage rates because they are ectothermic.

T The area of the sail in early ‘sail-back’ synapsids is correlated with body weight, not length

F Character-based definitions (e.g., animals with only one bone—the dentary—in the lower jaw) of Mammalia are bogus (i.e., without merit)

(7) (2 pts) What is the significance of villi and microvilli in mammalian guts?

Increase the surface area of the small intestine in order to increase the rate of absorption of food molecules, which in turn, helps to increase the rate of food passage through the gut. This is related to endothermy and the need for endotherms like mammals to constantly supply the cells with food in order to keep the metabolic rate high and generating heat.

(8) (7.5 pts) Name the 5 regions of the mammalian vertebral column and very briefly describe a key feature of each.

CERVICAL - neck, no rib attachments to interfere with bending

THORACIC - thorax/chest, ribs attached

LUMBAR - lower back, no ribs, but transverse processes (homologous with ribs)

SACRAL - sacrum, fused vertebrae for attachment of pelvic girdle

CAUDAL - tail

(9) (4 pts) What is the significance of **buttocks** in the evolution of synapsids?

Buttocks reflect the evolution of a new locomotory system in mammals in which the force for hind limb propulsion comes from muscles that run from the pelvic girdle to the femur (upper limb bone) (e.g., the gluteus muscles) RATHER than the caudofemoralis, which in reptiles and ancestral synapsids runs along the base of the tail and inserts onto the femur. In the latter situation, the tail base is broad and muscular and blends into the lower trunk. In mammals, the posterior end of the body ends abruptly and there are two, muscular buttocks with a slender tail protruding more dorsally.

10) (28 pts/4 pts each) **Choose 7 of the following 9 words** and write a brief explanation of what it is and/or why it is significant. *A few sentences to a paragraph for each should be plenty.*

heterodonty

cellular respiration

masseter

Edaphosaurus

secondary palate

dinocephalian

mastication

inertial homeothermy

dicyodont

NOTE: THE FOLLOWING ARE 'PERFECT' OR MOST COMPLETE ANSWERS – A GOOD ENOUGH ANSWER FROM YOU MIGHT NOT BE QUITE SO COMPLETE...

Heterodonty - having different, specialized teeth along the tooth row, rather than the same kind of tooth all over (related to evolution of mastication)

Cellular Respiration - process whereby individual cells break-down food molecules, releasing their chemical energy, which is stored within the bonds of ATP molecules. The process of energy conversion is slightly wasteful and releases lost energy as heat. The sum-total of all cellular respiration is 'metabolism'. The faster the cells respire, the more waste heat that is produced. If enough waste heat is produced, the animal can use it to warm its body metabolically (endothermy)

Masseter - New jaw-closing muscle (jaw adductor) that evolves in early cynodonts. It has its origin on the zygomatic arch (cheek bone). It pulls the lower jaw not only upward, but also forward and outward (laterally). As such, it evolves as part of the masticatory system.

*Edaphosaurus - a 'pelycosaur', i.e., an early synapsid, notable for being herbivorous, having a relatively small head and having a 'sail-back' like the carnivorous *Dimetrodon*.*

Secondary Palate - evolves in early cynodonts, initially as partial outgrowths of maxillas and palatines. The extra 'shelf' creates an 'I-beam' kind of structure that makes the snout more rigid to resist bending during

predation and mastication. Eventually becomes complete across the entire palate (and is filled in and extended by the soft palate) so that a new airway is created separate from the mouth - leads air directly to glottis (opening of trachea) so that late cynodonts, including mammals, can breathe and eat at the same time (part of requirement for endothermy).

Dinocephalian - *A non-cynodont therapsid group, includes weird, bulldog-log Moschops, with a thick skull and massive shoulders. It is thought that it might have used head-butting in male-male combat.*

Mastication - *A form of chewing unique to mammals (and possibly earlier cynodonts). It requires heterodonty, occlusion of the upper and lower teeth one side at a time and medio-lateral and/or antero-posterior jaw movement to grind food. The functional result of mastication is reduction of food into a slurry of very fine particles mixed with saliva. It helps to 'pre-digest' food so that passage rate through the gut is increased. Supports high energy needs of mammals owing to endothermy.*

Inertial Homeothermy - *A large animal has relatively little surface area relative to its volume (mass) as compared to a small animal. Therefore, it does not have much area to radiate (lose) whatever heat its body contains (either from metabolism, or from environmental heat). Therefore, once it warms up (which might take awhile), it does not cool down rapidly. Since it can neither warm-up nor cool-down quickly, it tends to stay about the same temperature, with only small fluctuations, i.e., it is a homeotherm (maintains same body temp) by inertia.*

Dicynodont - *Member of a non-cynodont therapsid group notable because some early species independently evolved tooth occlusion, suggesting that they were efficient herbivores. It is speculated that large numbers of efficient herbivores (and fewer carnivorous predators) might represent the first time a 'pyramidal' trophic system/ecology evolved (during Late Permian). Late dicynodonts were unusual in losing all of their teeth except for large, tusk-like canines that they presumably used to root in the ground, digging up roots and such.*