Name ANSWER KEY **EEB 3273/Schwenk/Fall 2010**

LECTURE EXAM 1 (100 pts)

(1) (11 pts) Below are a series of fill-in-the-blanks questions about 'connective tissues' (1 pt. each).

a. The 3 components of all connective tissues are: **living cells**, **matrix**, **fibers**

b. The cells associated with bone tissue are called **osteocytes** .

c. Tendons are primarily composed of **collagen** fibers.

d. The **nuchal (or yellow)** ligament found in many large mammals such as horses and bison, is an example of an 'elastic ligament' because instead of the usual fiber type it contains mostly **elastin** fibers.

e. An example of a 'fibrocartilage' is the **intervertebral disc** .

f. Bone is both stiffer and stronger than cartilage because in addition to the usual stuff, it deposits inorganic **calcium** and **phosphate** molecules within its **matrix** , which form into a crystalline arrangement known as 'hydroxy appatite'.

(2) (8 pts) Match the concept/term to the person with whom they are associated. ***You can use the same name/letter more than once***.

A = Aristotle
D = Charles Darwin
G = Stephen J. Gould
O = Richard Owen

O Homology

D Natural selection

D Gradualism

O Analogy

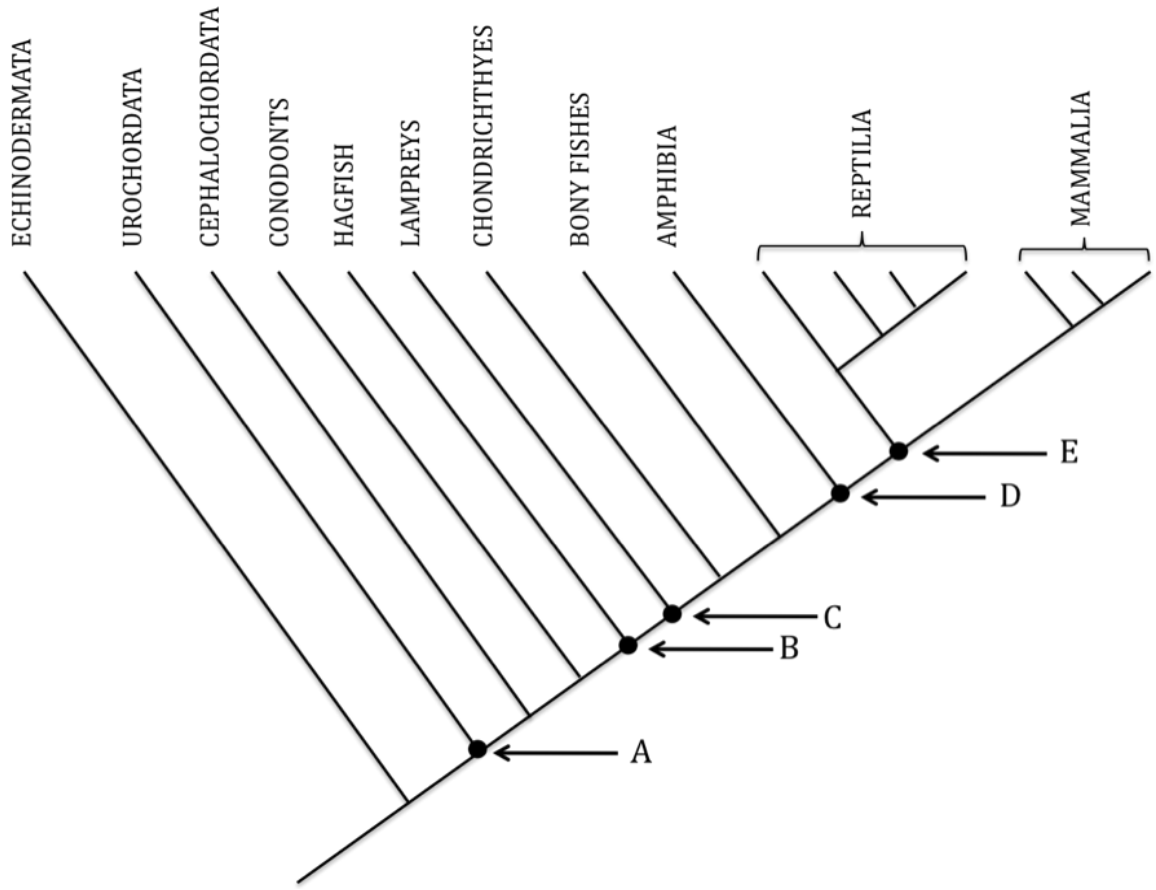
G Punctuated equilibrium

A *Scala Naturae*

O Archetype

D Tree metaphor for the evolution of life

(3) (5 pts) On the phylogeny below, give the name of each group/clade that starts at the node indicated with a letter (i.e., the group includes everything on the clade from the labeled point up). Choose from the list of names given below the phylogeny.



Sauropsida	Tetrapoda	Chordata	Craniata	Amniota
Osteichthyes	Lepidosauria	Diapsida	Anapsida	Vertebrata

A. **CHORDATA**

B. **CRANIATA**

C. **VERTEBRATA**

D. **TETRAPODA**

E. **AMNIOTA**

(4) (10 pts) True or False (**T** or **F**)

T The term 'phenotype' includes not only the form or anatomy/morphology of an organism, but its behavior and function, as well.

F The periosteum is composed primarily of elastin fibers.

T Bone is stronger than cartilage, but cartilage is more flexible.

T 'Special creation' implies that species have changed very little (or not at all) through time.

F According to the 'gradualism' model of phenotypic evolution, most phenotypic change occurs during cladogenesis.

T Within a clade, a homologous character that is variable is said to have different 'character states'.

T A classification that names the group 'Reptilia', but leaves birds out of this group, is based on the notion of evolutionary 'grades' rather than 'clades'.

T The term 'primitive' can only be applied to characters, not to whole organisms or groups of organisms.

F Two characters that look very similar because of evolutionary convergence are probably homologous.

F The 'blastopore' of a gastrula (early embryo) is where the mouth will form.

(5) (18 pts) For each bone or cartilage in the left column, name the embryonic/ancestral cartilage it developed in or from (center column) and give the visceral arch number to which each belongs (right column).

STRUCTURE	NAME OF CARTILAGE	VISCERAL ARCH NUMBER (1-7)
articular bone in a lizard	**mandibular/Meckel's**	**1**
columella in a bird	**hyomandibula**	**2**
hyomandibula in a bony fish	**hyomandibula**	**2**
incus bone in a human	**palatoquadrate**	**1**
quadrate bone in an amphibian	**palatoquadrate**	**1**
hyomandibula cartilage in a shark	**hyomandibula**	**2**
stapes in a mammal	**hyomandibula**	**2**
ceratohyal bone in a bony fish	**ceratohyal**	**2**
gill/branchial cartilage in a shark	**branchial/epibranchial/ceratobranchial**	**3-7**

(6) (48 pts, 6 pts each) *Compare and contrast* the following pairs of words. The words have some sort of *relationship*—it might be ***anatomical*** (e.g., they are physically connected), ***functional*** (e.g., they both perform the same function in different animals, or they both work together in a single animal to perform a particular function), ***evolutionary*** (e.g., they are homologues) ***or otherwise***. In your answer **YOU MUST SHOW THAT YOU UNDERSTAND EACH TERM AND ESPECIALLY HOW THEY ARE RELATED TO ONE ANOTHER.**

CHOOSE ONLY 8 OF THE FOLLOWING 13 WORD COMPARISONS (LEAVE 5 BLANK)

(a) gastrula—mesoderm

- gastrula is the embryonic stage resulting from gastrulation
- during gastrulation, 3 of 4 embryonic tissues, or 'germ layers', are formed
- there is an outer layer = ectoderm, an inner (mostly yolk) layer = endoderm, and a middle layer mesoderm
- mesoderm first forms directly above the endoderm as an intermediate layer between endo- and ectoderm

(b) anagenesis—cladogenesis

- both of these represent patterns of evolution and new species formation
- in anagenesis, one population evolves phenotypically through time, but remains a single species
- if enough phenotypic change occurs, the descendant species becomes a new species compared to the original, ancestral species (although there is still only a single species that has changed through time)
- in contrast, during cladogenesis one species splits into *two* daughter (descendant) species
- according to the theory of 'punctuated equilibrium', most phenotypic evolution would occur during cladogenesis, with very little anagenetic evolution in between

(c) dorsal hollow nerve cord—neurulation

- neurulation is the embryonic process during which the dorsal nerve cord is formed
- this is then the neurula stage
- the nerve cord forms when the ectoderm on the dorsal side of the embryo thickens and the sides roll up to form a hollow tube
- the neural crest cells (4th embryonic tissue type) form at this time alongside the nerve cord

(d) somite—hypomere

- following neurulation, the mesoderm forms into two major components, the somites and the hypomere
- the somites are segmented blocks of mesoderm that lie dorsally in the embryo alongside the nerve cord and notochord
- the somites form most of the skeleton and body musculature
- the hypomere grows downward on each side of the embryo – it is continous and remains unsegmented
- the hypomere later splits into two layers, becoming hollow. The cavity in between becomes the body cavity or coelom
- the inner (splanchnic) layer is associated with the gut tube and forms the smooth muscle of the gut and viscera
- the outer (somatic) layer becomes part of the body wall

(e) endochondral—dermal

- both are types of bone formation or ossification
- endochondral ossification occurs within a cartilage. The cartilage is invaded by osteocytes that convert the existing cartilage into bone, i.e., the bone is always preceded by a cartilage 'model' of exactly the same size and shape
- most of the skeleton is made of endochondral bone
- in contrast, dermal bone forms directly within the dermis of the skin. Sometimes it sinks down deeper
- dermal bone is primarily found in the skull where it often 'ensheaths' or covers over cartilages and fuses with endochondral bones
- dermal bone evolved first in ancestral fish in which it served as head and body armor

(f) epidermal placode—neurocranium

- epidermal placodes form as 3 thickenings of the ectoderm on each side of the developing skull
- they sink down and form 'capsules' that will house the main sensory organs of the head – nasal capsule, optic capsule and otic capsule
- these 3 sensory capsules fuse with the neurocranium and together they form the chondrocranium

(g) notochord—cartilage

- the notochord forms the principal skeletal element of the body in basal chordates and develops in vertebrate embryos
- as vertebrates develop, they replace the notochord with cartilaginous vertebrae, which usually ossify
- in most vertebrates (except some fishes), the notochord is completely obliterated by the developing vertebrate, except for small pockets that remain within the center of each intervertebral disc (= nucleus pulposus)

(h) amphioxus—ammocoetes

- although amphioxus is a cephalochordate (basal chordate) and ammocoetes is a larval lamprey (a vertebrate), these animals are useful to study because they represent a combination of features that probably resembles the ancestral vertebrates
-these features include the basic chordate characters: notochord, dorsal hollow nerve chord and pharyngeal (gill) slits supported by a pharyngeal skeleton
- in addition, the ammocoetes exhibits an eye, small brain and other organs, and a reduced number of visceral arches/gill slits

(i) analogy—homoplasy

- both of these refer to patterns of character evolution that are revealed by character analysis
- analogy occurs when two or more characters independently evolve similar functions; the characters may or may not look alike (e.g., lungs and gills are analogous, they develop from different – non-homologous – characters, and they don't look alike, but both function in gas exchange/respiration)
- in contrast, homoplasy refers to characters that have independently evolved phenotypic similarity owing to convergence or parallelism.
- as such, the characters are non-homologous, but appear phenotypically similar (they may or may not have similar functions)

(j) gills—visceral arches

- gills are respiratory (gas exchange) structures that evolved on the visceral arches
- in ancestral, jawless fishes, the visceral arches supported the pharynx for filter feeding
- gills evolved later for respiration, along with muscles that could move the visceral arches to create a pump
- the first arch later evolved into jaws (gnathostomes) and the second arch evolved into a jaw support/suspension structure
- the gills were restricted to the remaining 5 arches (3-7)

(k) atomization—character

- atomization is the process that leads to the identification of characters
- in atomization, an entire, whole organism is broken down into parts or bits ('traits') that are called 'characters'
- identification of characters is based on the observation (or supposition) that they represent parts of the organism that are relatively independent of other parts in terms of their development and evolution (i.e., they can evolve and develop independtly)
- characters are then compared among different organisms/species to determine how the organisms are related and how the phenotype evolves

(l) chondrocranium—dermatocranium

- along with the splanchnocranium, these are both components of the embryonic vertebrate skull
- the chondrocranium forms a cartilaginous container for the brain (neurocranium) and major sensory organs (sensory capsules)
- in most vertebrates, the elements of the chondrocranium later ossify
- the dermatocranium represents the part of the skull formed directly from dermal bone
- the dermal bone forms a roof over the braincase, forms most of the facial skeleton and covers over various cartilages, largely fusing with the ossified chondrocranium to form a coherent, solid skull

(m) somitic mesoderm— splanchnic mesoderm

- these are both embryonic, mesodermal tissues
- the somatic mesoderm is mesoderm of the segmented somite that ultimately forms most of the skeleton and body musculature (as well as other things)
- in contrast, the splanchnic mesoderm derives from the unsegmented hypomere, specifically the inner layer of the hypomere after it splits into two layers with the coelom in between
- the splanchnic mesoderm is associated with the gut tube and forms the smooth muscles of the gut and viscera