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Notes:

1. Use Scantron form to mark your answers for questions 1-20.
2. This is a closed-book, closed-note test.
3. Make sure you write your name on the Scantron form and ALL pages of the test.
4. Turn in the Scantron form and your test.
5. You may turn in a SASE if you wish your grade mailed to you, or email me with your social security number, and I'll email you back your grade - do this about the 20th of March.
6. The blanks in front of each multiple-choice question are for you to mark your answers before transferring them to the scantron sheet, if you wish. The key will eventually be posted on Bryant's web site.
7. Mark the **one best** answer to each multiple-choice question on your Scantron.

- a** 01. [Ch. 14.2] The classification of organisms by similarity of appearance constitutes:
a. phenetics b. cladistics c. evolutionary taxonomy d. divergence e. phenetic phylogenetics
- e** 02. [Ch. 14.6] Which of the following avoids some of the extraordinary properties of cladism (such as putting humans in the lungfish clade), but suffers from some of the ambiguity of phenetics, even though it excludes convergence but doesn't exclude differential divergence?
a. phylomeiotics b. pheneticism c. phyletic gradualism d. punctuated equilibrium
e. evolutionary classification/taxonomy
- c** 03. [Ch. 15.1] Field identification of species is usually accomplished by: a. cladistic analysis
b. phenetic analysis c. a few reliable external characteristics d. using the biological species concept e. determining which individuals fit into which niches
- a** 04. [Ch. 15.2] A set of organisms sufficiently similar to one another is one way of stating which of the following species concepts? a. phenetic b. ecological c. recognition d. cladistic e. none of the preceding
- b** 05. [Ch. 15.5] A set of organisms adapted to a particular niche is one way of stating which of the following species concepts? a. phenetic b. ecological c. recognition d. cladistic e. none of the preceding
- d** 06. [Ch. 16.7] A factor which establishes strong positive assortative mating among genotypes within a species range would predispose the species for which of the following types of speciation? a. allopatric b. parapatric c. orthopatric d. sympatric e. none of the preceding
- e** 07. [Ch 16.9] The enhancement of reproductive isolation by natural selection is called:
a. character displacement b. allopolyploidy c. clinal interbreeding d. postzygotic isolation
e. reinforcement
- c** 08. [Ch. 18.2] Based on the similarity of bird and mammal species, and due to vicariance events, the world can be divided into how many main faunal regions? (These are the Nearctic, etc.) a. 2
b. 4 c. 6 d. 8 e. 10

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21. (3) List below 2 prezygotic and one postzygotic isolating mechanism:

a. pre #1: *geographical isolation*

b. pre #2: *temporal isolation*

c. post: *hybrid sterility*

22. (4) What distinguishes females from males?

Females are the sex that produces fewer, larger gametes; males are the sex that produces more, but smaller, gametes.

23. (4) Define the terms plesiomorphy, apomorphy, symplesiomorphy, and synapomorphy. Tell which is of use in cladistic classification.

Plesiomorphy is the acnestral state of a character; an apomorphy is the derived state of a character. A symplesiomorphy is a shared ancestral character state; a synapomorphy is a shared derived character state. Synapomorphies are used in cladistic classification.

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24. (4) List 4 species concepts, with short definitions for each.

biological: “a group of actually or potentially interbreeding organisms, reproductively isolated from other such groups”

ecological: a group of organisms sharing the same niche

phenetic: a group of organisms sufficiently similar to one another and sufficiently different from other such groups

recognition: organisms with a shared mate recognition system

25. (5) Tell in simpler words is meant by “Ontogeny Recapitulates Phylogeny”, and tell what kind of macroevolutionary change actually produces recapitulation.

Ontogeny is the embryological development of an organism; phylogeny is the evolutionary history of an organism. Recapitulation is repetition. So the phrase means that the embryological development of an organism repeats or reflects the evolutionary history of an organism. Only terminal addition will produce recapitulation.

26. (5) Briefly explain the “Red Queen” hypothesis of Leigh Van Valen.

Species are all evolving as fast as they can to meet the challenges of not only the physical environment, but of predators and parasites. However, the predators and parasites are also evolving as fast as they can, so, although some species fail to meet the challenges posed by the evolution of their predators and parasites, generally the relative advantages of the species don't change.

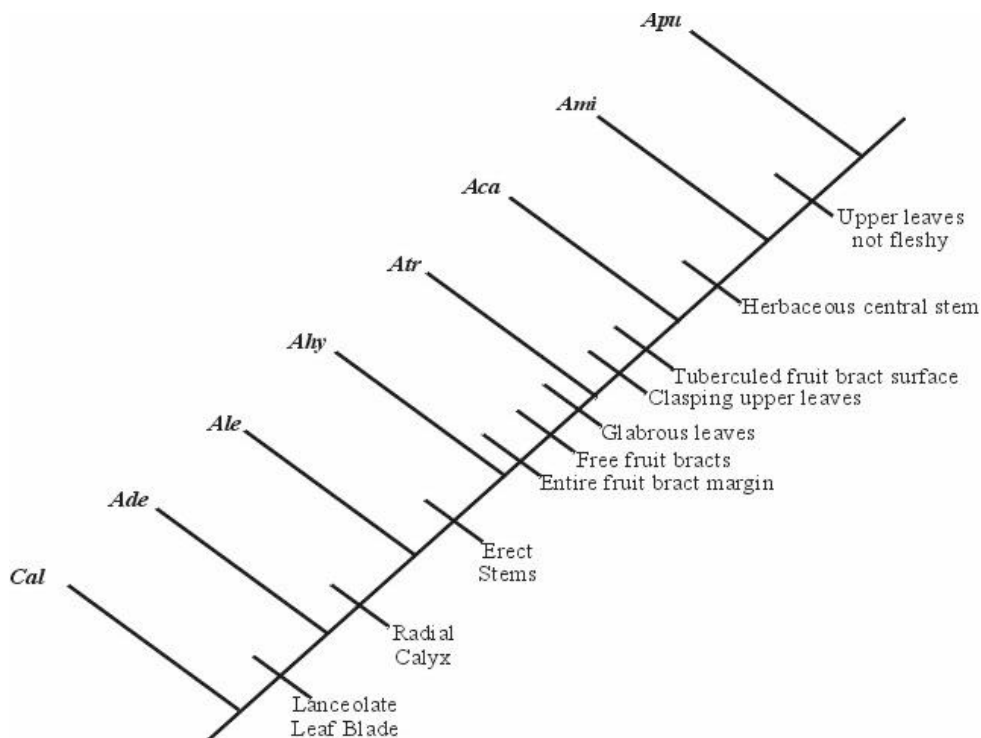
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27. (15 points) Construct a cladogram as done in class for the 7 species of *Atriplex* (saltbush) shown below, using *Chenopodium album* as the outgroup. Between each branch of your cladogram, write in the **COMPLETE new character STATE(S)** (such as "leaves glabrous", "fruit bract surface tuberculed", or whatever) that evolved.

MAKE SURE YOU WRITE THE FULL NAME (OR 3-LETTER ABBREVIATION) OF THE SPECIES ON EACH BRANCH OF THE CLADOGRAM, AND THAT YOU WRITE OUT IN FULL THE COMPLETE NEW (NEW!!!, that is, apomorphic [not the plesiomorphic ones!]) CHARACTER STATE(S).

Species	Leaves	fruit bract surface	leaf blade	stems	fruit bracts	central stem	calyx	upper stems	upper leaves	fruit bract margin
<i>A. hymenelytra</i>	scaly	ribbed	lanceolate	erect	fused	woody	radial	fleshy	petioled	cut
<i>A. pusilla</i>	glabrous	tuberculed	lanceolate	erect	free	herbaceous	radial	not fleshy	clasping	entire
<i>A. triangularis</i>	glabrous	ribbed	lanceolate	erect	free	woody	radial	fleshy	petioled	entire
<i>A. lentiformis</i>	scaly	ribbed	lanceolate	prostrate	fused	woody	radial	fleshy	petioled	cut
<i>A. depressa</i>	scaly	ribbed	lanceolate	prostrate	fused	woody	bilateral	fleshy	petioled	cut
<i>A. minuscula</i>	glabrous	tuberculed	lanceolate	erect	free	herbaceous	radial	fleshy	clasping	entire
<i>A. canescens</i>	glabrous	tuberculed	lanceolate	erect	free	woody	radial	fleshy	clasping	entire
<i>Chenopodium album</i>	scaly	ribbed	elliptic	prostrate	fused	woody	bilateral	fleshy	petioled	cut



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8. (20 points) Explain evolution. Write between 300 and 500 words, as legibly as possible. Use the back of this page if necessary. PLEASE WRITE LEGIBLY!! (Yes, I know it is difficult, you've seen me try.)

Evolution is genetic change in a lineage, which is a group of organisms and their ancestors and/or descendants through time. The study of evolution includes the study of evidence for evolution, population genetics, adaptation and natural selection, classification, and the rates and modes of evolutionary change. The evidence for evolution includes the fossil record, which shows ever more dissimilar fossils as rocks get older; laboratory experiments which can produce new species; artificial selection experiments which produce new kinds (dogs, cats, pigeons, and flowers, for instance); evolution on a small scale in nature (such as the peppered moth and insects evolving resistance to insecticides); the imperfectness of adaptation; and homologous similarities among organisms.

Population genetics is the branch of genetics which studies the ways in which genetic changes may occur in lineages. Such changes have been seen in extensive laboratory experiments, and the mathematical theory is well-developed. Five major forces can cause evolutionary genetic change: selection, migration, mutation, non-random mating and genetic drift. Of these, selection, which is a difference in reproduction among individuals, is the most generally important. Selection is also the only force that can produce an adaptation, which is a feature of an organism that allows it to reproduce better than if it lacked the feature.

Organisms may be classified in many ways, but the cladistic method is the most generally used today. This method involves classification by shared derived traits, and defines a species as the organisms in a lineage between branching points of that lineage. Other methods of classification define species differently.

Fossils are traces of past life. Single-celled organisms arose at least 3.8 billion years ago, and large multi-cellular organisms arose in quantity 600 million years ago. Since then, there has been a general increase in the size and complexity of organisms on the planet. Evolution may proceed gradually with unnoticeable gradations from species to species (phyletic gradualism), or species may remain practically unchanged until a new species arises in a geologically short period of time (punctuated equilibrium). It is currently unresolved whether either phyletic gradualism or punctuated equilibrium is the case for most of evolutionary change. As far as the evidence goes, changes which result in new kingdoms, phyla or other large groupings are no different in kind than those which result in new species — macroevolution is brought about by the same processes as microevolution.

Species may go extinct due to competition, shifts in climate or other factors, and the majority of species that have lived on the planet are extinct. However, species do not "age"; that is, they appear to have a constant probability of extinction which does not increase with the length of time the species has existed. On occasion, many species go extinct simultaneously, which is called a mass extinction. The best studied of these, between the Mesozoic and Cenozoic, was caused by a meteorite that fell on the Yucatan Peninsula in Mexico, 65 million years ago. Probably not all mass extinctions were caused by meteorites.