GVZ 2023 Test 1 Study Guide

Topics to know:

Sources of information; History of vertebrate systematics; Species concepts; Species discovery;

Species description; Speciation; Allopatry, sympatry; Vicariance, dispersal; Ring species; Phylogenetic tree structure, terminology; Character evolution concepts, terminology; Homology; Phylogenetic taxonomy, including techniques, terminology, and contrast with the Linnaean system; Reconstructing phylogeny, including problems and techniques; Parsimony analysis; Close relatives of vertebrates; Vertebrate/chordate traits; Reconstructing ancestral states; Lamprey, hagfish; Gnathostome traits.

Be able to…

--understand new (i.e., not from lecture) examples of terms of character evolution (homology,

homoplasy, etc.). [Example: Are lungs in humans and lizards homologous or homoplastic or

both? Explain/support your answer]

--judge whether two or more phylogenetic trees present the same or conflicting relationships

--know basic biology of chordates, cyclostomes, tunicates, hemichordates, cephalochordates.

--given some evolutionary scenario, describe whether aspects of speciation like allopatry,

vicariance, etc., apply. [Example: During a hurricane, a group of 8 individuals of Uta

stansburiana in Baja California floats across the Gulf of California to Isla Angel de la Guarda.

Over thousands of years, these 8 individuals interbreed and produce offspring and the

population prospers in this new environment. Is this a case of speciation by vicariance? Explain

your answer.]

--construct a phylogenetic definition for a taxon name, given some real or hypothetical

phylogenetic scenario. [Example: Give a node-based definition for the taxon name amphibia,

which includes all extant amphibians.]

--perform a parsimony analysis, including distinguishing between the optimality among

candidate trees with four taxa or candidate trees with five taxa.

Practice questions:

1 How have the goals of systematics (i.e., the conceptual basis) changed over time from

Aristotle to the present day? Put another way, what were/are classifications intended to

reflect?

2 Draw the most realistic estimate of phylogenetic relationships for humans, lampreys, hagfish,

snakes, acorn worms, tunicates.

3 What does John Wiens see as the main problem with most speciation research? What is his

solution? How does he describe the process of speciation?

4 Describe the steps involved with describing a new species—i.e., the components of a good

species description.

5 True or false: an individual of a species cannot interbreed with an individual of a different

species and produce viable offspring. Explain your answer.

6 What is ‘vicariance?’ Contrast this term with ‘dispersal.’ What do these terms have to do with

speciation, if anything? Give an example of each of these terms using vertebrates (a contrived

example is OK for now if you can't think of a real one).

7 Define the terms "holotype" and "paratype" and give examples of each.

8 Assume you decide to name a new species of frog of the genus Craugastor after legendary

UNM biologist and soul singer James Brown. What do you name this species?

9 How are new species discovered?

10 Give vertebrate examples of the following terms: synapomorphy, plesiomorphy, homology,

homoplasy, reversal. Be sure to identify the taxa involved (i.e., make it clear why your example

reflects the term you are describing).

[Note—your best road to understanding these terms is to think of new examples, rather than to

memorize examples from class. For example, try to think of a synapomorphy of humans and

other apes relative to other mammals, or of turtles relative to other clades. Try to imagine

examples of each of these terms from molecules and behavior as well as morphology, e.g., is

presence of a cell nucleus in most cells of the body homologous between dinosaurs and bats?].

11 There are three main clades of mammals: the monotremes (e.g.: platypus), the placentals

(e.g.: house cat), and the marsupials (e.g.: kangaroo). Suggest potential node- and branchbased

definitions for the taxon names for this group (Mammalia is the standard node-based

name for this group, Synapsida is the standard branch-based name).

12 Describe the contributions of the following figures to systematics: Aristotle, Linnaeus, Kevin

de Queiroz, Ernst Mayr, Charles Darwin.

13 Describe Kevin de Queiroz' view of "species." How does de Queiroz view the myriad species

'concepts' (e.g. BSC, cohesion SC, PSC) relative to his own view (you may need to reread his

1998 paper)?

14 Compare and contrast the Linnaean system of taxonomy with the system of Phylogenetic

Taxonomy.

15 How might the character state "presence of fins" be interpreted as a homology, or a

homoplasy, or a synapomorphy, or a plesiomorphy, or a convergence, or a reversal?

16 Contrast parsimony, likelihood, and distance methods for reconstructing phylogeny.

17 For the following data matrix of states for DNA characters 1-5 for the taxa human, cookie

cutter shark, stingray, and great white shark...

Draw the most parsimonious tree, using human as your outgroup.

What is the length in steps (# of changes) of the most parsimonious tree?

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| taxa | 1 | 2 | 3 | 4 | 5 |
| Cookie cutter shark | C | A | A | A | C |
| Great white shark | C | G | A | T | A |
| Stingray | A | A | T | A | C |
| Human | A | C | T | T | T |

18 What different types of data are used to reconstruct phylogeny? What are desirable

properties of data used to reconstruct phylogeny?

19 How many different potential sets of phylogenetic relationships (i.e., phylogenetic trees)

exist for 4 species? For 1000 species?

20 Summarize Tom Nichols' arguments in his article, *The Death of Expertise*.

21 How is the information on Wikipedia different from the information in academic journals

like Evolution or Nature?

22 Compare and contrast the following terms: Taxonomy, Systematics, Classification,

Nomenclature.

23 Most phylogenetic trees are presented with dichotomous splits. How would you interpret a

tree that is presented with a trichotomous split?

24 Twenty-seven of 36 lamprey species live exclusively in fresh water (the other 9 migrate

between fresh and salt water). What is the most likely state for the ancestor of all lampreys?

A) fresh water

B) salt water

C) can't tell from this information.

Explain your answer.

25 Discuss the ideas of species concept and species criterion with reference to the species

definitions we discussed in lecture.

26 Compare the perceptions of lampreys in the Great Lakes versus in the northwestern United

States.