

# Biology 180 Exam 3

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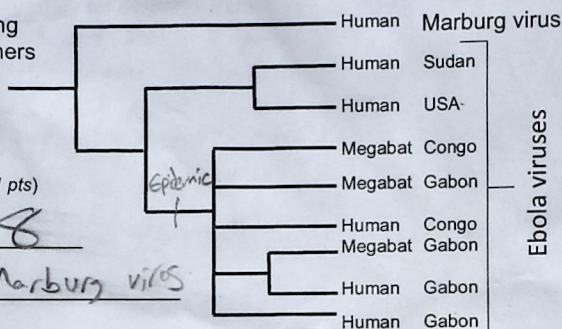
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1. In 2001-2005, an Ebola virus outbreak occurred in people living near the border of Congo and Gabon. During the event, researchers captured over 1000 mice, bats, birds, and lizards in the affected area. The phylogeny at the right shows the relationships among viruses isolated from these animals and from infected humans; the labels indicate the host species, their location, and the named viral group. According to this tree: (11 pts)



a. How many phylogenetic species of Ebola virus are there? 8

b. What is the closest living relative of the Ebola virus group? Marburg virus

c. Which virus started the 2001-2005 epidemic in Congo and Gabon?

Mark the tree with a vertical bar labeled EPIDEMIC.

d. Of the animals sampled in the study, which is most likely to act as a "natural reservoir" (meaning, non-human host) for Ebola virus? Bat

- Explain your logic, in 2 sentences or less.

According to the phylogenetic tree, there are 3 different species of ebola residing in bats, while none of the other animals sampled had a species of ebola. Therefore, they most likely can act as a natural reservoir.

- Ebola can only be transmitted through blood or other body fluids. Generate a hypothesis to explain how the virus could be transmitted from this non-human animal to humans.

Animals that contain the virus could have bitten humans and put saliva into their blood stream. Animals that contain the virus could have urinated and it got into humans' food, which would transmit virus.

2. In a steep canyon in Israel, there is a hot, dry, south-facing slope covered with grass and a cooler, wetter, north-facing slope covered with forest. Spiny mice live on both slopes. In experiments in which female spiny mice from each slope are given a choice of males from the wet versus dry slope, females strongly prefer males from their own slope. Individuals from each slope also show habitat preferences. Some researchers claim that the populations on the two slopes are in the process of becoming different species. In two sentences or less in each case, explain the: (7 pts)

- Mechanism of genetic isolation

Because they only mate with one from their slope, but they live in same geographic area, this is sympatric speciation. The mice prefer to only mate with mice living on the same slope, so they are isolated. No gene flow.

- Mechanism of genetic divergence

Because the two different slope mice mate mostly with their own slope mice, there is a lack of gene flow between the hot and wet slope mice. Because there is no gene flow, allele frequencies are not homogenized between the two, and therefore they are independently evolving and are 2 different populations. They will have different natural selection due to different environments, and different drift and mutation.

3. Vertebrate jaws are hypothesized to have evolved through modification of paired, rod-like, skeletal elements called gill-supports that are located close to the mouth in jawless fishes. Based on how we analyzed the evolution of the limb in class, explain how the gill-supports hypothesis could be supported by a) genetic data and b) data from the fossil record. (6 pts)

a) Genes involved in gill-support formation and in jaw formation:

The genes are the same for both, which supports the fact that the traits are from homologs, because the genes are the same. If they were different, it would be homoplasy. Same gene combinations passed on from common ancestor.

b) Structures found in the earliest fossils of jawed fishes:

In fossil record, we see that there are similarities in the structure of human -vertebrate jaws and early jaw fishes. These similarities are due to the common ancestor and homologous traits passed on. Because of these, there are some residual similarities between the two groups.



4. Seagrasses are flowering plants that live submerged in the ocean. Traditionally, researchers assumed that seagrasses rely solely on water currents to move pollen from one individual to the next. (14 pts)

a) Recently, researchers observed that tiny invertebrates carry pollen on their bodies and visit both male and female seagrass flowers. What would be the fitness advantages of pollination by an animal versus water currents?

Pollination means that the male gametophyte is enclosed in a small shell as pollen. This means that the sperm is protected, and that it does not require water to get around; in dry environments the pollen will still be able to go, because wind and such can take them.

b) How could you set up an experiment to test the hypothesis that tiny marine invertebrates facilitate seagrass pollination?

Treatment group #1: Seagrass with presence of tiny marine invertebrates  
Treatment group #2: Seagrass without presence of tiny marine invertebrates

Key conditions to control (other than the difference in conditions between treatment groups): list two and explain why they are important.

- Control sunlight. Sunlight will affect the growth and therefore the pollination of the seagrass. If it is not controlled for, differences in pollination could be due to unequal sunlight received by both treatment groups.
- Control location. Some areas might be better for pollination just because of geographic factors. The location must be randomized between treatment groups to ensure that difference in pollination is not due to location of growth.

Outcome variable:

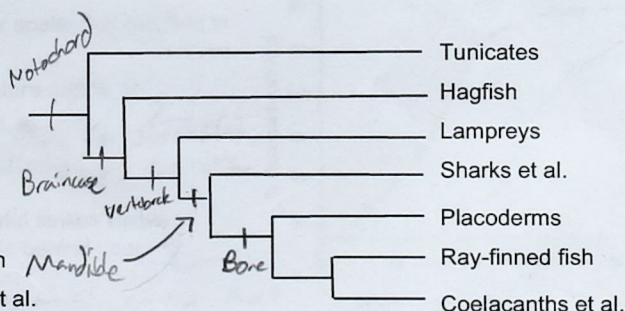
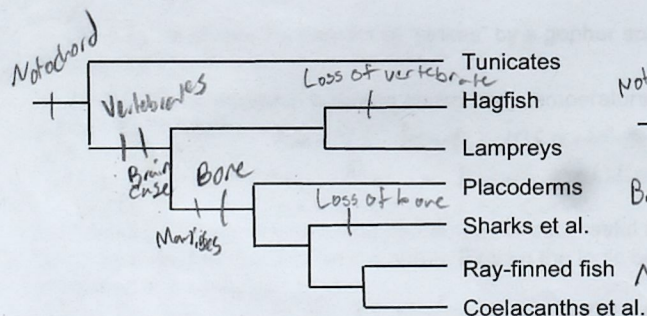
Pollination is related to amount of seeds produced by plant. To measure pollination, therefore, measure # of seeds produced.

5. Although they differ, both of the trees below estimate the phylogeny of chordates. (11 pts)

a. Using the data in the table to the right, map and label the origin (and loss, if required) of the following 4 traits ON BOTH TREES. (Note: "et al." means "and others.")

- Bone
- Vertebrae
- Braincase
- Mandibles

	Noto-chord	Bone	Vertebrae	Brain-case	Man-dibles
Tunicates	1	0	0	0	0
Hagfish	1	0	0	1	0
Lampreys	1	0	1	1	0
Placoderms	1	1	1	1	1
Sharks et al.	1	0	1	1	1
Ray-finned fish	1	1	1	1	1
Coelacanths et al.	1	1	1	1	1



b. If the tree on the left turns out to be correct, state what you consider the most surprising or interesting result in terms of the evolution of these 4 traits. Explain your reasoning in two sentences or less.

The most surprising result is that multiple traits were passed on to descendant species multiple times. Vertebrae and brain case homologues were passed on at the same time, while bone and mandibles were also passed on (homologues) at the same time.



6. If present trends in climate change and human population growth and resource use continue, researchers predict that over 60% of the species on Earth will go extinct over the next 200 years. Assume that this prediction proves correct. Also note that currently, the species that are declining most rapidly are those with large space requirements. (4 pts)

a. How is this event similar to mass extinctions that have occurred in the past?

In mass extinction events, 60% of the species dies within the span of 1 million years. This event is similar because large amounts of species are dying - 60% is a lot. 2

b. How is this event different from mass extinctions that have occurred in the past?

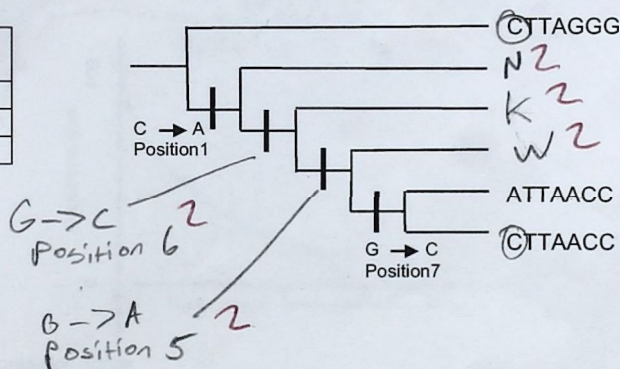
Usually, in the other mass extinctions, the time period was much greater than 200 years to lose 60%. Some were even almost in 1 million years. Therefore, this is happening much faster. 2

7. The table and the tree provide the sequence data that were used to estimate a phylogenetic tree. (12 pts)

a. Using these data, place species K, W, and N on the tree. (At each empty tip, write K or N or W). Add a label—similar to the 2 shown—at each of the two unlabeled vertical lines to indicate which base change occurred at which position.

b. On the 3 sequences given on the tree, circle two bases that are similar due to homoplasy.

Species name	1	2	3	4	5	6	7
K	A	T	T	A	G	C	G
W	A	T	T	A	A	C	G
N	A	T	T	A	G	G	G



8. This figure shows the percent of "strikes" by a gopher snake that resulted in the capture of a mouse. (10 pts)

a. What is the relationship between snake body temperature and % of successful strikes?

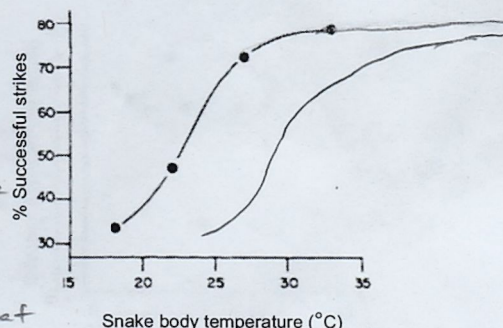
As snake body temp increases, % successful strikes increases. Not a linear relationship, because it is an S curve. Logistic curve. 2

b. Predict what will happen to the percentage of successful strikes above 35°C, by extending the line on the graph. Explain the logic behind your prediction in 2 sentences or less.

This is not linear. It is a logistic curve, which means that the slope approaches 0 at the top. Therefore, because of the curve, the % successful strikes will stay the same or even decrease slightly, based on how much heat the snake can tolerate. 2

c. This species of snake lives the U.S. Add a line to the figure showing your prediction for the data from a closely related species of snake found only in tropical rain forests, where average daily temperatures are 30°C. Explain the logic behind your prediction in two sentences or less.

I shifted the curve to the right. This snake lives in a different environment, where the average temperature is higher than it is in the U.S. This means that it is also adapted to this environment more, which means it should function better at higher temperatures, hence, the shift right. However, it is still a logistic curve. 3





After 1 year there are 100

9. A population of aphids doubles every year. Initially, there were 50 aphids. Recall that  $N_t = N_0 \lambda^t$ . Show your work. (16 pts)

a) What is  $\lambda$ ? 2 2 100 50 2  $\lambda = 2$

b) How many aphids would there be after 15 years? Show your work.

1638400 2  $N_t = 50(2^{15}) = 1638400$

c) Is this exponential or logistic growth? Explain your logic in two sentences or less.

This is exponential growth. The growth is density independent and rapidly increases in size. The constant  $\lambda$  of 2 means the population size doubles each year, so this is exponential.

d) The habitat of the aphids is suddenly degraded; now  $\lambda = 0.4$ . What is  $r$ ? Show your work.

-0.9163

$r = \ln \lambda = \ln(0.4)$

$r = -0.9163$

e) If there were 400 aphids in the habitat prior to degradation, how many will there be after three years? Show your work.

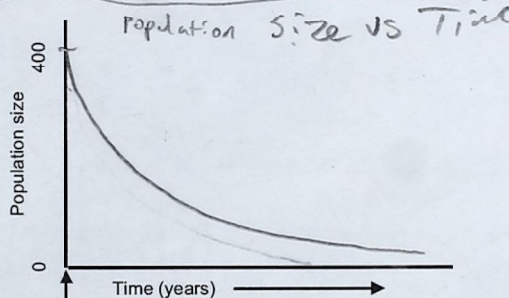
25.6 25 individuals

$N_t = N_0 \lambda^t$

$N_t = 400(0.4)^3$

$N_t = 25.6$   
 $N_t = 25$

f) Assume the growth rate does not change after the habitat degraded. Graph how population size will change over time (a rough sketch showing the general shape is fine).



Habitat degradation occurs

10. These data show the average number of young song sparrows (birds) produced on a small island each year for 11 years. (9 pts)

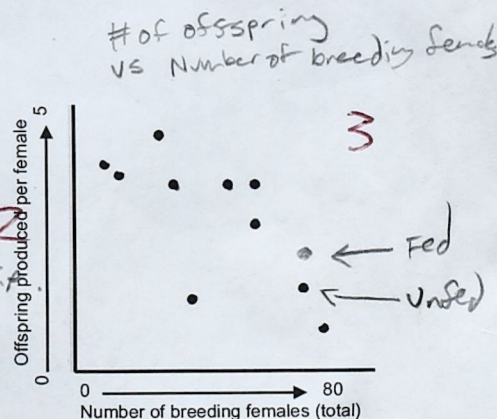
a) What is the relationship between number of breeding females and number of offspring produced per female?

As number of breeding females increases, # of offspring per female decreased. Negative linear relationship.

b) The data suggest that population growth is (circle one):

density-dependent

density-independent



c) One year, researchers fed some parents but not others. They counted the number of offspring produced by fed versus unfed parents.

- Label a point on the graph as "unfed" (pick any one—doesn't matter).
- Place a new a point on the figure predicting the effect of providing extra food on the number of offspring produced per female. Label this point "fed". In one sentence or less, explain why you placed the data point where you did.

Creating offspring requires huge amounts of resources and energy from the mother. If they are able to have more resources, they will be able to produce more offspring.

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