

Study Guide for Exam 4

(Exam 4 will be 3:30-5:30 Tuesday, May 7, 2019)

Thursday, April 18: Population genetics

- What is the difference between observed and expected heterozygosity?
- Does genetic drift result in evolution?
- What is the main factor determining how much of an influence drift will have in a population?
- What are two different processes that both lead to a reduction in the number of heterozygotes (i.e. heterozygosity) in a population?
- Which of these accomplishes the reduction in heterozygosity via fixation of alleles?
- What is the Wahlund effect?
- What does Wright's F_{st} measure?
- What is the minimum/maximum possible value for F_{st} (and what is true about a group of populations when F_{st} is at its minimum/maximum)?
- Which two assumptions of Hardy-Weinberg equilibrium cannot possibly be true in any human population?
- What is a coalescent event?
- What is effective population size, and how is it different from the census size of a population?
- Does the amount of time back to the coalescent event for two randomly selected gene copies depend on the effective population size? If so, how?
- Would you agree with someone who claimed that mitochondrial DNA proves that there was just one female human alive around 125,000 years ago that is the female ancestor of all humans alive today? What issues would you raise with this claim?

Tuesday, April 23: Population genetics (cont.)

- Provide examples of reasons why the effective population size is often smaller than the census size.
- What is a documented example of an organism that has gone through a genetic bottleneck?
- How does a genetic bottleneck differ from founder effect?
- What does polydactyly in the Pennsylvania Amish community have to do with genetic drift?

- At what point does selection become stronger than drift? Answer in terms of selection coefficient (S) and effective population size (N_e).
- Which of the following generates an adaptive landscape with two peaks and an unstable equilibrium between the peaks? Dominance, overdominance, or underdominance.
- Why do hybrids between the sunflowers *Helianthus annua* and *H. argophyllus* represent a case of underdominance?
- Does migration intensify or reduce the effects of drift?
- Is it possible to have continuous directional selection and yet no evolutionary change? Name an example of this that was discussed in lecture?

Thursday, April 25: Allopatric speciation, reproductive isolating barriers

- What was one important thing about microbial (bacterial) evolution that you learned from the video associated with the Baym et al. 2016 study (links to both the paper and the YouTube video are provided at <https://uconneeb.github.io/evolution/literature-cited/>)
- What characterizes most species pairs that are allopatric?
- What characterizes most species pairs that are sympatric?
- What are species according to Mayr's biological species concept (BSC)?
- What are the two main types of reproductive isolating barriers (RIBs) and how do they differ?
- What are some examples of prezygotic isolating barriers?
- What are two examples of postmating isolating barriers?
- What are two examples of actual events that caused formerly contiguous populations to become allopatric, leading to allopatric speciation?
- What is the main difference between Batesian and Müllerian mimicry?

Tuesday, April 30: Peripatric, parapatric, and sympatric speciation

- What is reinforcement in the context of speciation?
- How is peripatric speciation similar to allopatric speciation?
- How does peripatric speciation differ from allopatric speciation?
- Does selection play a direct role in the evolution of reproductive isolating barriers in allopatric speciation? Why or why not?
- Secondary contact is when populations that diverged in allopatry expand their ranges to become sympatric in some areas. Which is the most common evolutionary

result of reinforcement upon secondary contact: prezygotic or postzygotic isolating barriers?

- Under what environmental conditions do you expect to see parapatric speciation?
- If two species are known to be each other's closest relative (from DNA evidence) yet are found living in the same physical locality (sympatric), can you say that they evolved by sympatric speciation? Why or why not?
- What is the difference between autopolyploid and allopolyploid speciation?
- Why is chromosome doubling so important for allopolyploid speciation? Why don't the diploid hybrids become new species?

Tapeworms

The litobothriidean tapeworms from the pelagic thresher shark are an example of what type of speciation (allopatric, parapatric, peripatric, or sympatric)?

Can we confidently say that *L. aenigmaticum* (the odd looking species) and *L. nickoli* (the normal looking species) are reproductively isolated?

Which species concepts can we confidently apply to the thresher shark tapeworms?

What types of isolating barriers are thought to maintain the species boundaries between the thresher shark tapeworms?

Lacewings

- Why are the lacewings with unique songs considered different species even though they are sympatric and morphologically similar?
- What species concept is being used in this case?
- What type of isolating barrier separates the lacewing species with different songs?

Thursday, May 2: relatedness, kin selection, and altruism

- What is Hamilton's rule?
- Be sure you understand how to calculate relatedness using the handout (which is available on the same Exam Review web page as this document)
- What is the relationship between the concepts of direct fitness, indirect fitness, and inclusive fitness?
- What is the benefit of altruism in subordinate male turkeys as calculated in the study described in Box 12C? How was this value calculated?
- What is the cost of altruism for subordinate male turkeys in that same study?
- Why did the queen tree bumblebee actively prevent her daughter worker from laying eggs in the video shown in class (<https://www.thedodo.com/in-the-wild/queen-bee-fights-rebelling-colony-worker>)?

- How is kin selection related to the evolution of multicellularity? Is it significant that multicellular organisms begin life as a single cell (zygote or spore)?

About the exam

Because this exam covers only 5 lectures, I will shoot for devoting about 20% of the exam to each lecture. Because there are only so many questions I can think of about each lecture, expect each question to be worth at least 3, maybe 4 points! That does not mean that you will automatically get partial credit: not all questions can be half right.

I will add more information when the exam has been written, so download this study guide again on Monday to see if this section has grown.