The Final Exam Study Questions for bs182h fall - 2016

I reserve the option to revise and fine-tune the questions below late in the semester to address new issues, perspectives and facts that come up late in the semester. At the final exam I will choose one of these questions for you to answer.

You must construct your answer on a clean sheet of paper from information in your brain. I want the best answer you can write in approximately one page.

(something you wouldn’t be embarrassed to have posted on the www for all the world to see).

I want you to demonstrate that you understand the facts – what we do and do NOT know;
that you understand what are the open issues and questions,
and that you can use relevant examples to make your explanation more effective.

Your answer should be much more broad and deep than our typical 2 pt, 5 min quiz.

You can prepare however you like.
I suggest you discuss your ideas with classmates
and at least outline your answers to all the questions.

If you want to write out detailed answers and memorize them, that’s OK too,
but I do not want to see those practice answers at the final exam.

1. Understand and be able to use examples to explain what is evolution by natural selection (ENS)? What are the fundamental, necessary and sufficient conditions for ENS? Use examples to illustrate stabilizing, directional and disruptive selection. What is heritability? How was it traditionally estimated from phenotypic similarities between relatives? What are genotype-environment (GxE) interactions and why do these create problems for estimating heritability? Use an example to illustrate and explain why high heritability does not imply that environmental interventions are useless.

2. Understand and be able to use examples to explain what is the Hardy-Weinberg equilibrium? How is it used as a null model? Describe five processes that can put a population’s gene frequency out of H-W equilibrium. Use the example of either local adaptation to altitude among Tibetans or the persistence of milk digestion into adulthood in northern European herders, to illustrate the origin of locally-adapted genetic differences among different ancestral lineages of modern humans. What is the distinction between ancestral lineage and racial identity and why does that distinction make conventional racial categories a poor guide to genotype and personalized medicine?

3. What is life? Your answer should include (a) the properties listed in the text, readings and lecture and (b) a careful analysis of the criteria for detecting life on Mars. (c) Explain the strengths & weakness of each of the criteria and specify what level of biological organization these criteria can be applied to. Apply these properties & criteria to I) real viruses II) computer viruses, III) human fetuses, and IV) the earth.

4. What is a species? Explain the fundamental role of gene flow (or lack thereof) in the process of speciation and why the potentially gradual, continuous nature of the process of speciation makes it difficult to clearly define when two seemingly isolated populations are or are not well-defined species. Compare and contrast “the biological species concept” vs “the phylogenetic species concept.” Which concept underpins the US Endangered Species Act? Why is it so difficult to decide what “species” should be protected under the definitions of the endangered species act? Do you think wolves and dogs are different species? Justify your answer in terms of the various species concepts.
5. Explain the principle of negative feedback (-FB) regulation. Use examples from lecture and text to illustrate how this works in the realms of (a) endocrine regulation of blood glucose, (b) the -FB regulatory mechanism that leads from exogenous testosterone use to testicular atrophy, (c) the patellar reflex for posture maintenance, and (d) population regulation via density dependent demographics.

6. Briefly describe the Nonspecific Defense Mechanisms that a human would put up against bacteria that enter the body on a splinter. Describe and explain the processes that (1) generate the near infinite diversity of antibody structure that results in molecular recognition of near infinite varieties of antigen epitopes, and (2) and then eliminates the mutant lineages that recognize self-epitopes. Be able to describe and explain the roles of B cells, CD4 Helper T cells and CD8 Cytotoxic (killer) T cells in adaptive immunity. What are memory cells and how do they allow vaccination to be effective? What is the primary target of the HIV virus and why does that result in “immune deficiency”?

7. Describe and explain the roles of sperm entry position, maternal yolk cytoplasmic determinants, sonic hedgehog and the HOX clusters in organizing the switching on and off of genes that regulate vertebrate tissue differentiation and development. Briefly describe how this differentiation relates to the progressive loss of “potency” in stem cells. How does disregulation of these processes relate to cancer?

8. Explain how eye-tracking studies illustrate the distinction between sensations and perceptions. Describe the Necker cube illusion-phenomenon and explain how it illustrates the mind testing alternative hypotheses for consistency of the perception with the sensory data. Describe the placebo effect and explain how it relates to cortical activity (ACC), limbic dopamine cells, impulsivity and variation in the magnitude of the placebo effect.

9. What are the component demographic processes that combine to determine population growth rate? What kinds of ecological processes influence these demographic processes? What is exponential (or geometric) population growth and what conditions should lead to this kind of growth? What is the logistic model and what additional ecological and demographic processes does it incorporate?

10. What is the Lotka-Volterra competition model and what additional ecological and demographic processes does it incorporate? Use examples to help explain competitive exclusion. What, in general, tends to lead to coexistence rather than competitive exclusion in competitive interactions? Explain how predators or parasites can increase biodiversity. Illustrate with examples from lecture and/or the text.