Exam 1 Study Guide

Why is evolution difficult to understand?

- Understanding evolution pushes the limit of human intuition
- Requires a statistical understanding of change
- The randomness problem
- The grand timescale over which evolution occurs

What is a "Hot hand?" What is the "Gambler's fallacy?"

- The gambler's fallacy is the false idea that if something happens more frequently than normal during a given period, it will happen less frequently in the future

Who is Karl Popper, and what did he do?

- Kar Popper is a Critical Rationalist philosopher and professor
  - All theories can and should be rationally criticized, and subjected to tests by which they can be falsified
  - Theories are either falsifiable, and therefore empirical, or non-falsifiable, and thus, nonempirical
  - Science is the process of developing and rationally criticizing (testing) empirical (falsifiable) theories (hypotheses)

What is the difference between a good hypothesis and a bad hypothesis?

- A good empirical hypothesis
  - Makes specific predictions
  - Is fecund or generates a large number of falsifiable predictions
  - Those predictions must be testable.

What is falsifiability? Testability?

- Falsifiability: Is there a clear way for the statement to be false?
- Testability: Is there a way that I can actually try to falsify that statement?

What are naturalistic causes? What are some other kinds of causes?

- Naturalistic causes: causes which derive from the workings of the natural world
- Supernatural causes: causes which derive from beyond the workings of nature

What did Thomas Kuhn say? Why was it important?

- Science mostly operates as "normal" science.
  - Theories are well accepted
  - Experiments and modeling is used to refine theory
- Occasionally normal science is interrupted by "revolutionary science"
  - Experiments and observations deeply challenge accepted theories
  - The field will be in flux often with intense debates

  - This is a period of deep concept changes, or paradigm shifts.
- Paradigm shifts are not just scientific revolutions
  - The logical conclusion is that scientists act as humans in a political setting, not as Popperian automatons.

What are "essential" and "accidental" differences?

Who were some of Darwin's main influences? Why?

Who was Russel Wallace? What did he do?

- A remarkably adept naturalist
- Traveled extensively in Indonesia and the Malay Achipelago
- Made extensive collections, most of which he needed to sell to survive.
- He was beset with numerous disasters, probably do to the fact he was running a low-budget operation!
- On one trip his ship burned taking with it all his collections. He saved only part of his diary and a few sketches. He ended up spending ten days at sea awaiting rescue

What are some good definitions of "evolution"

- Descent with modification
- Lasting change in the mean phenotype of a population that transcends the life of an individual
- Change in gene frequency
- Evolution is a change in a population due to individuals entering and leaving a population

Evidence for evolution? What evidence? What does it look like? Got any examples?

- Artificial Selection
- Changes in natural populations
  - measured increase in whale size 1800s - 2000s
- Geological Evidence
  - Fossils show past environmental changes
- Existing patterns in organisms
- Vestigial organs
- Extinction
- Homology

What might development tell us about evolution?

- Embryos of distinct animals within the same class are often strikingly similar
- Certain organs in the individual which when mature become widely different and serve for different purposes, are exactly alike in the embryo

What is "Homology?"

- Homology: the existence of shared ancestry between a pair of structures, or genes, in different taxa.
  - Human, Dog, Bird, While share similar forelimbs indicating a common ancestor

Why did Darwin wait to publish The Origin of Species?

- Darwin waited to publish *The Origin of Species*, because he knew how upsetting to the status quo the theory of evolution was. If he published before he had gained enough legitimacy as a scientist, his theory could have been discredited by those that saw him as a lesser scientist.

Explain the difference between the Lamarckian and Darwinian models of evolution

- Lamarck identified the important idea that species change, but got the mechanism wrong.
- Lamarck believed that species could pass down physical characteristics developed over their lifetime
- Darwin believed in descent with undirected modification
  - poor mutations are rooted out of the gene pool through natural selection