

Biology 6 – Week by week review

Week 1: Variation and natural selection

Natural selection – four tenets of NS

Terms to know associated with natural selection: fitness, adaptation, heritable

Genotypes and phenotypes

Variation –

Classification: discrete (qualitative) versus continuous (quantitative)

Sources of variation (genes, environment)

Importance of variation to natural selection

Week 2: Diversity of life

Phylogeny (= evolutionary tree)

Scala Natura (scale of life)

Questions in biology (mechanical, functional, historical)

Explanations in biology (proximate, ultimate understanding)

Themes in *The Origin*

(1) All organisms are connected together via a series of common ancestors. Organisms descend and are modified (change) from these ancestors.

(2) Natural selection is an important mechanism that gives rise to diversity of life

What is the evidence for common ancestry & descent with modification?

How do biologists depict evolutionary change?

Nuts & bolts of reading/interpreting evolutionary trees

How are evolutionary trees useful?

Week 3: What is sex & how does it happen?

Decoupling and defining sex & reproduction

Asexual reproduction (e.g., fragmentation, budding, specialized structures, parthenogenesis, binary fission)

Prokaryotic (Bacteria/Archaea) and eukaryotic cells and organisms

Prokaryotic sex (gene exchange in Bacteria & Archaea)

Conjugation / Transformation / Transduction

Meiotic sex = meiosis and fertilization

How meiosis generates diversity: Crossing over (recombination) / Independent assortment

Diploid/haploid

Week 3: Why two sexes?

Contrast Ridley & Low readings.

- (1) Conflict between organelle and nuclear genomes
- (2) Disruptive selection on gamete size

Gamete size: isogamy and anisogamy

Mating types versus eggs and sperm

Defining male and female

Week 4: Sex determination

General concepts re: central dogma of molecular biology (transcription, translation, genetic code)

Terms to be familiar with: genomes, chromosomes, genes, alleles

Genetic sex determination (heterogametic and homogametic)

Several systems: XX/XY (mammals); ZW/ZZ (birds, many insects);

XX/XO *C. elegans*; haplodiploidy (ants, bees, wasps)

Environmental sex determination: temperature, context-dependent, parasites

Hormones: androgens and estrogens; aromatase (enzyme)

Mammalian sexual differentiation (*DAX1* and *SRY*)

Dosage compensation mechanisms

Evolution of dimorphic sex chromosomes (e.g., degeneration of Y chromosome)

Sex linked, sex influenced, and sex limited traits

Week 5: Costs & explanations for sex

Twofold (demographic) cost of sex (= cost of producing males)

Ecological costs of sex

Genetic costs of sex

Genetic explanations for maintenance of sex (ratchets and hatchets)

Ecological explanations for maintenance of sex (lotteries, tangled banks and red queens)

Molecular explanations for maintenance/evolution of sex: DNA repair

Concepts of genetic drift, mutation