

Biology 20 Evolution

Evolution:

Modern synthesis:

Individuals:

Lamarck: **Use and disuse:**

Inheritance of Acquired Traits:

Darwin:

Travelled:

Galapagos Islands:

What was the name of Darwin's book, which he published 15 years after his return?

Charles Lyell (geologist) influenced Darwin:

Uniformitarianism: geological processes are so uniform that their rates & effects must balance throughout time

Two major points in Darwin's book:

a) **Descent with modification:**

b) **Natural selection:**

Differential reproduction:

Points based on:

Fact 1: all species can increase their population exponentially

Fact 2: most populations are stable in size (except for seasonal fluctuations)

Fact 3: natural resources are limited

Inference 1:

Fact 4: individuals of populations vary

Fact 5: much of this variation is heritable

Inference 2:

Inference 3:

Examples of Natural Selection:

English peppered moth: white, peppered & black

Birch trees:

Why weren't there as many black or white ones?

Industrial revolution:

Why were the black moths better now?

What placed the selection pressure on the moths to cause this change?

Galapagos Finches:

beak depth: different food sources (adaptive to seed size)

wet years -> smaller seeds =>

dry years -> larger seeds =>

*****Environment acted on inherited variations that were already present.*****

Alfred Wallace:

Artificial selection:

Evidence for Evolution:

1. **BIOGEOGRAPHY** (p. 299, Fig 15.3 A – D)

2. **FOSSIL RECORD** (p. 260; Fig. 13.2)

Limitations:

Fossil record:

Fossil record supports evidence of chronological appearance of vertebrates:

3. **COMPARATIVE ANATOMY** (p. 262; Fig. 13.3)

Anatomical similarities:

Homology:

Vestigial structures:

4. COMPARATIVE EMBRYOLOGY

5. MOLECULAR BIOLOGY

Population Genetics:

Population:

Species:

Gene pool:

Hardy-Weinberg Theorem:

Theorem: The frequency of alleles in a population's gene pool remains constant over generations unless acted upon by agents other than sexual recombination.

5 Assumptions for Hardy-Weinberg:

If all are met, then the population is at **equilibrium** and there is **no change**

1)

2)

3)

4)

5)

Calculating Hardy-Weinberg (p.268 – 269)

Allelic Frequency

p = frequency of the dominant allele

q = frequency of the recessive allele

Genotypic Frequency

p^2 = frequency of homozygous dominant genotype (AA)

$2pq$ = frequency of heterozygous genotype (Aa)

q^2 = frequency of the homo. recessive genotype (aa)

$$p + q = 1$$

$$p^2 + 2pq + q^2 = 1$$

Polka dottedness, a recessive characteristic, is found in 16 of out of every 100 frogs in Mission Viejo Lake. Determine the frequency of alleles and the frequency of frogs that do not express polka dottedness, but could pass on this characteristic.

q = _____

Usefulness of Hardy-Weinberg:

Ex. There is approximately 0.248% of Americans affected with sickle cell anemia.
What is the approximate frequency of the sickle cell allele in the US?

What are the chances that two heterozygous individuals could mate and have offspring with the sickle cell trait?

Microevolution:

5 Causes of Microevolution:

1) Genetic drift:

a) Bottleneck effect:

Causes:

b) Founders Effect:

2) Gene Flow:

immigration:

emigration:

3) Mutations:

4) **Non-random mating:**

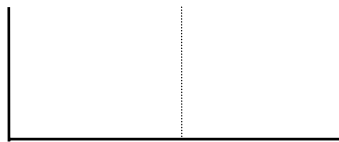
5) **Natural Selection:**

Adaptive:

Modes of Natural Selection:

Which heritable traits are favored and will be passed on via differential reproduction

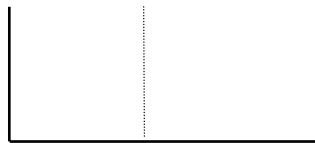
1) **Stabilizing selection:** (p. 276; Fig. 13.19)



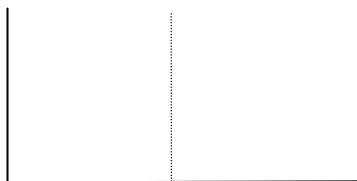
2) **Directional selection:** (p. 276; Fig. 13.19)

Occurs: a)

b)



3) **Diversifying (disruptive) selection:** (p. 276; Fig. 13.19)



Sexual selection (p. 277; Fig. 13.20):

Sexual dimorphism:

REMEMBER: Natural selection acts on the whole organism, therefore it will affect: _____

Speciation:

What's a Species?

Biological species (p.282; Fig. 14.1A&B):

Ring species (p.283, Fig. 14.1C):

What maintains species boundary?

Reproductive barriers:

2 types of reproductive barriers:

A) Pre-zygotic barriers:

1) **Habitat isolation:**

2) **Temporal Isolation:**

3) **Behavioral Isolation:**

Ex. blue-footed boobie:

Meadowlark:

4) **Mechanical Isolation:**

Ex. flowers with pollinators (H-birds, bees, bats, etc)

5) **Gametic Isolation:**

B) Post-zygotic barriers:

1) **Hybrid Inviability:**

2) **Hybrid Sterility** (p.285; Fig. 14.2C):

3) **Hybrid Breakdown:**

Mechanisms of speciation:

1) **Allopatric speciation** (p. 286; Fig. 14.3):

Barrier could be:

Ex. pupfish in Death Valley

Adaptive radiation (p. 287; Fig. 14.4B):

Ex. Galapagos Islands: Darwin's Finches
Hawaiian Islands => flora and fauna

2) **Sympatric speciation** (p. 288; Fig. 14.5A)

Polyploidy:

Importance of Polyploidy:

Less common in animals: requires reproductive isolation with geographical range

Interpretations of Speciation:

1) **Gradualism (Neo-Darwinian):**

2) **Punctuated Equilibrium:**

Macroevolution:

Geologic Time Scale (p. 296; Fig. 15.1):

Paleontologists:

Sedimentary rocks

Fossils in the different strata, chronicle the relative ages of fossils

Radioactive dating:

Radioactive isotopes:

C14: half-life: 5730 years

U238: half-life: 1.3 billion years