

Biology 30 IB Populations

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Unfinished!

Contents

Human Populations	2
Problems with Human Genes	2
Population Sampling	2
Frequency	2
Hardy Weinberg Principle	2
Hardy Weinberg Equilibrium	3
Tips	3
Conditions of No Evolution	3
(21.2) Conditions of Evolution	4
Mitochondrial DNA & Evolution	5
Speciation	5
Geographic Isolation	5
Reproductive Isolation	5

- Most species have thousands of genes
- More genes = more genetic diversity
- More alleles in said genes = more genetic variation
- Genetic diversity increases from sexual reproduction

Human Populations

Problems with Human Genes

- Few offspring
- Observations take time
- Many traits affected by environment as well as genes

Population Sampling

- Technique used to study human populations
- **Representative group** = group within population is selected, not entire population
- **Trends or Frequencies** = how often genes occur in the representative group
- **Gene pool**, aka. **genome** = all genes in a population
- **Fixed frequency** = only 1 allele for a gene, all organisms in population have gene

Frequency

- **Genotype frequency** = proportion of a population with a particular genotype (expressed as a decimal)
- **Phenotype frequency** = proportion of a population with a particular phenotype (expressed as a decimal or %)
- **Allele frequency** = rate of occurrence of a particular allele in a population with respect to a particular gene (expressed as a decimal)

Hardy Weinberg Principle

- Populations have either a...
 - tendency to remain stable
 - tendency toward variability
- **Genetic equilibrium** = if all other factors remain constant, the gene pool will have the same composition generation after generation
- Population **evolve** when **equilibrium is upset**

Hardy Weinberg Equilibrium

1.

$$p + q = 1$$

- Allele frequency
- p = frequency of dominant allele (e.g. A)
- q = frequency of recessive allele (e.g. a)

2.

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

- Genotypic frequency
- Above formula, but for all heterozygote father and heterozygote mother crosses

Tips

- $A = p$, $a = q$
- $AA = p^2$, Aa & $Aa = 2pq$, $aa = q^2$
- Work with homozygous recessive individuals first
(only one possible genotype — homozygous recessive)

Conditions of No Evolution

Conditions under which no change will occur in a gene pool are...

- Large populations = changes in gene frequencies are not the result of random chance alone
- Random mating
- No mutations
- No migration = no immigration, no emmigration, no new genes enter or leave the population
- Equal viability (no disease), fertility, and mating ability of all genotypes (no selection advantage)

(21.2) Conditions of Evolution

The population gene pool is very unstable.

Conditions under which change will occur in a gene pool are...

- **Mutation**

- Changes in the genetic makeup, either chromosome mutation or gene mutation
- Occurs during meiosis
- May be harmful in some parts and beneficial others, e.g. sickle cell anemia carriers (heterozygous) gives malaria resistance

- **Migration** (aka. Gene Flow)

- Movement of members of a species, into (immigration) or out of (emigration) a population
- **Immigration** = new genes are added to existing gene pool
- **Emigration** = genes are removed

- **Non-random Mating** (aka. Sexual Selection)

- Choice of which males will mate with which females
- Choice often made by woman, based on physical or behavioral traits of mate
- **Sexual dimorphism** = difference between male and female phenotypes (e.g. mane, antlers)

- **Small Populations**

- **(Random) Genetic Drift**

- * Disruption of genetic equilibrium in small populations
- * If a unique allele does not mate, the allele is gone forever

- **Founder Effect**

- * Few individuals of large population leave, forms new population
- * Allele frequencies will not be the same as former population

- **Bottleneck Effect**

- * Severe environmental event, drastic reduction in population size
- * Allele frequencies very different than original population

- **Natural Selection**

- * Only process that leads directly to evolution
- * Individuals with greater survival traits reproduce, passing on their favorable genes to the next generation

Mitochondrial DNA & Evolution

- **mtDNA** = Mitochondrion contain their own genetic material
- Mitochondria and chloroplast were once individual organisms, but symbiotic relationship formed with cells
- Mutations in mtDNA = Parkinson's

Speciation

- Process by which species originate
- **Species** = organisms that can...
 - interbreed
 - produce fertile offspring

Geographic Isolation

- Caused by physical obstacles/barriers
- Gene flow between main population and isolated group ceases
- Eventually, new species; become so genetically different that they can no longer interbreed, due to...
 - different adaptations
 - different gene frequencies
 - different mutations

Reproductive Isolation

- Organisms in a population can no longer mate and produce offspring
- Even if barriers are removed
- Even if fertilization occurs, genes so different that zygote doesn't develop
- Due to...
 - differences in mating habits
 - seasonal differences in mating
 - inability of sperm to fertilize eggs