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**IDX G9 BIOLOGY S STUDY GUIDE ISSUE 6**

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**17.1 Genes and Variation**

**Genotype and Phenotype in Evolution**

* 2 sets of genes, one by each parent
* Alleles: Specific forms of gene, may vary in individuals
* Particular combo of alleles it carries 🡪 genotype, if plus environmental factors  phenotype (physical, physiological, behavioral)
  + Natural selection only acts on phenotype

**Populations and Gene Pools**

* Population: Group of individuals of same species that produce offspring
  + Interbreed 🡪 common grp of genes, gene pool
* Gene pool: All genes, including all diff. alleles for each gene that are present in population
* Allele frequency: number of times an allele occurs in gene pool compared to total number of alleles in that pool for the same gene
  + Nothing to do with dominant/ recessive
* Evolution involves change in frequency of alleles in population over time
  + Changes it causes in allele frequency show up in population as whole

**Sources of Genetic Variation**

1. **Mutations**

* Any change in genetic material of cell
* Neutral mutations do not change organism’s phenotype
  + Mutations that produces changes in phenotype may/ may not affect fitness
* Makes us diff from parent
* Mutations matter in evolution only if passed from generation to generation

1. **Genetic Recombination in Sexual Reproduction**

* Crossing-over during meiosis
  + Paired chromosomes often swap lengths of DNA at random
  + Increases number of new genotypes created in each gen
* Explains why individual members of a species differ from one another

1. **Lateral Gene Transfer**

* Passing of genes from one organism to another organism that is not its offspring
  + Bacteria swap genes on plasmids like trading cards
    - Important for antibiotic resistance in bacteria
* Can increase genetic variation in any species that picks up new genes

**Single-Gene and Polygenic Traits**

* Number of phenotypes produced for trait depends on how many genes control trait

1. **Single-Gene Traits**

* Trait controlled by only one gene
* May have just two or three distinct phenotypes
* In populations, phenotypic ratios determined by allele frequency and dominant or recessive alleles
  + Blood type, pea flower color

1. **Polygenic Traits**

* Traits controlled by two or more genes
* Each gene of polygenic trait often has two or more alleles 🡪 single polygenic trait often has many possible genotypes and even more different phenotypes
* Phenotypes not clearly distinct
  + Height, skin color

**17.2 Evolution as Genetc Change in Populations**

Evolution = change of allele frequencies in a population

Fitness = survive & reproduce = successfully pass genes to the next generation

1. Natural Selection on **Single-Gene** Traits

* Selection on a particular phenotype ------>change in allele frequencies ----->evolution

1. Natural Selection on **Polygenic-Gene** Traits

* Selection on a range phenotypes ------>change in allele frequencies ----->evolution

1. **Directional selection**

* Selection on one extreme end of phenotypes
* Eg: Industrial melanism in pepperd moths

1. **Stabilizing Selection**

* Selection on common/intermediate forms of phenotypes eliminated the extreme forms
* Eg: Selection on birth weights of infants

1. **Disruptive selection**

* Selection on both extreme ends of phenotypes, eliminate the common forms------->One population divided into two distinct groups
* Eg: Less medium-sized seeds ------>birds with unusually small or large beaks would have higher fitness----->two groups: one with smaller beaks&one with larger beaks.

**Random Genetic Change——Genetic Drift**

* Random change in allele frequency
* Usually in small populations
* Individuals that carry a particular allele may leave more descendants than other individuals, just by chance
* Two types:

1. **Genetic Bottlenecks Effect**

* Due to change in the environment(disaster, disease)
* Only a small portion of the population survived
* Leading to chnage in allele frequency

1. **The Founder Effect**

* Due to migration of small subgroup of a population
* A few individuals become isolated from a larger population&estabilsh a new population
* The new population's allele frequency is different from the original populations

**Sexual Reproduction and Allele frequency**

* Meiosis and fertilization do not change allele frequency of a population
* No producing of new alleles
* Only produces many different allele combinations

**Evolution Vs. Genetic Equilibrium**

* A population is in genetic equilibrium/not evolve if allele frequency do not change

**The Hardy-Weinberg Principle**

* When population is in genetic equilibrium/no evolution
* Allele frequencies in a population remain constant from generation to generation
* Five conditions required:

1. A large population——Genetic drift has less effect on large populations than on small population
2. No mutation——No new alleles be introduced into the gene pool
3. No sexual selection——All members of the population must have an equal oppurtunity to produce offspring
4. No migration——Population does not gain or lose alleles by any movement of individuals into or out of population
5. No natural selection——No phenotype can have a selective advantage over another

* Hardy-Weinberg Equilibrium

For a population in genetic equilibrium:

p+q=1

(p+q)2=1

p2+2pq+q2=1

p=frequency of the dominant allele A

q=frequency of the recessive allele a

p2=frequency of genotype AA(homozygous dominant)

2pq=frequency of genotype Aa(heterozygous dominant)

q2=frequency of genotype aa(homozygous dominant)