

POPULATIONS AND SPECIES

POPULATION- localized group of individuals capable of interbreeding

GENE POOL- All the alleles in a population

SPECIES= = group of organisms that can interbreed with one another and produce viable fertile offspring

Different species can't produce fertile offspring

EX: Horse X donkey → mule; lion X tiger → liger

WHAT PREVENTS INTERBREEDING AND KEEPS SPECIES SEPARATE?

1) REPRODUCTIVE BARRIERS:

PREZYGOTIC BARRIERS - Impede mating or hinder fertilization

BEHAVIORAL ISOLATION

signals/behaviors used to attract mates differ

EX: visual (firefly), auditory (crickets);

pheromones; mating "dances"

"NICHE PRINCIPLE"

niche

live in same area

TEMPORAL ISOLATION

Breed during different times of day,
seasons, or different years

MECHANICAL ISOLATION

Size and shape of reproductive organs
anatomically incompatible

GAMETIC/GENETIC ISOLATION

= gametes are incompatible

Sperm can't survive in female reproductive tract

OR not recognized by egg receptors

POSTZYGOTIC BARRIERS - After mating

ZYGOTE DIES

fertilized egg doesn't develop

Offspring is **INFERTILE** (can't reproduce)

EX: Horse (64 chromosomes) X donkey (62 chromosomes)

→ mule (63 chromosomes)

EX: **POLYPLOIDY** (3n, 4n, 6n . . .)

- Can't interbreed with the parent/

- Can self-fertilize or mate with other "ploids"

2) GEOGRAPHIC BARRIERS

- Gene pool of a population is separated/split

Ex: Island, lake, mountain top, retreating water, fire separating populations of grasslands,
seed blown to new region by storm, lake drying up

- Allows change in gene pool provided that each population has selection taking place

REPRODUCTIVE/GEOGRAPHIC BARRIERS

- can lead to **SPECIATION**: formation of new species
- too many changes make interbreeding impossible

ALLOPATRIC SPECIATION "other country"

- GEOGRAPHIC barrier blocks gene flow

SYMPATRIC SPECIATION "same country"

- **REPRODUCTIVE BARRIER** within population

EX: **POLYPLOIDY**

- Can't interbreed with the parent

- Can self-fertilize or mate with other "ploids"

MACROEVOLUTION (fish → amphibians; dinosaurs → birds)

- change above species level

MICROEVOLUTION- (bacteria → different bacteria; fish → different fish)

- changes within a gene pool (species level)
- Most creationists accept evidence for microevolution

5 CAUSES OF MICROEVOLUTION

1) **GENETIC DRIFT** random changes in small gene pools **DUE TO CHANCE** NOT natural selection

EX: BOTTLENECK EFFECT- disaster drastically reduces size/genetic variation of population
survivors determined by chance (Ex: flood, overhunting)

EX: FOUNDER EFFECT- small subgroup moves to new area
"Blue skinned people" in Appalachia

2) **GENE FLOW**:

The movement of alleles into and out of a gene pool

Mixing tends to reduce differences between populations

3) **MUTATIONS** = introduce new alleles to gene pool

important source of variation for natural selection to act upon

POLYPLOIDY- (3n, 4n, 6n, 8n) not common in animals

- Common in plants (40-80% of all plant species?)
- rapid growth/abundant fruit production = hybrid vigor

EX: Strawberries, banana, potato, watermelon, pansies, chrysanthemums, wheat, kiwi, cotton, tobacco

4) **NONRANDOM MATING**- Everyone doesn't have an equal chance to "get a partner"

Inbreeding- mate more frequently with close individuals than distant ones

SEXUAL SELECTION - Favors traits with no advantage for survival
other than fact that males/females prefer them

Leads to pronounced differences between sexes = **SEXUAL DIMORPHISM**

KIN SELECTION- favors altruistic behavior that enhances reproductive success
of relatives

EX: Bird that calls to warn others is in danger of being eaten, but does it anyway.

5) **NATURAL SELECTION**

Alleles for traits that provide survival/reproductive advantage are selected for; increase in population

FITNESS- = **REPRODUCTIVE SUCCESS** measured by number of offspring
relative contribution an individual makes to the gene pool of the next generation

HETEROZYGOTE ADVANTAGE "Survival of the sickest"

Deleterious alleles are maintained in population because heterozygous condition has benefit

EX Sickle cell: aa = sickle cell disease Aa- protected against malaria

Finding more and more such links - osteoporosis/TB; cystic fibrosis/cholera

Hardy-Weinberg Theorem: = NULL HYPOTHESIS

Used to determine if population is evolving

All conditions rarely met in actual populations

No change in gene frequencies = NO evolution happening

Populations is said to be in **H-W EQUILIBRIUM**

- **LARGE** population
- **NO GENE FLOW** in or OUT
- **NO MUTATIONS**
- **NO NATURAL SELECTION**
- **RANDOM MATING**

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

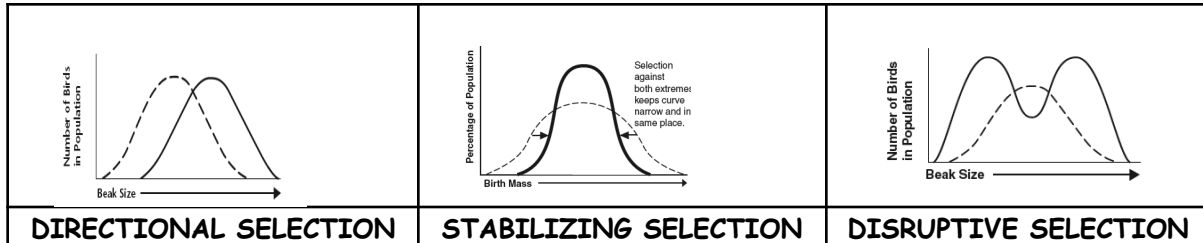
p = frequency of dominant allele

q = frequency of recessive allele

q^2 = frequency of homozygous dominant

$2pq$ = frequency of heterozygote

p^2 = frequency of homozygous recessive



DIVERGENT EVOLUTION (ADAPTIVE RADIATION)

closely related species becoming more different in response to changes in environment

EX: Darwin's finches and tortoises on Galapagos

CONVERGENT EVOLUTION

Unrelated species becoming more alike because they live in same type of environment

EX: Whales (mammals), penguins (birds), and sharks (fish) all have streamlined bodies

COEVOLUTION

Different organisms in symbiotic relationships evolve together

EX: Insects and flowers

HOW FAST DOES SPECIATION OCCUR?

No debate about whether evolution happens . . .

some debate over mechanism

GRADUALISM-

- Proposed by Darwin
- Evolution proceeds slowly at a constant rate
- Many small differences accumulate over time

PUNCTUATED EQUILIBRIUM-

- Proposed by Niles Eldredge and Stephen Jay Gould
- Species diverge in spurts of rapid speciation separated by long periods without change
- Due to rapid changes in environment

EX: **MASS EXTINCTION**

