

SYSTEMATICS & EVOLUTION

NATURAL SELECTION

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NATURAL SELECTION

- **Natural Selection: Organisms that are best adapted to an environment survive and reproduce more than others**

Mechanism of natural selection

- **Darwin's Theory of Natural Selection occurs in four steps:**
 - **Overproduction**
 - **Variation**
 - **Competition**
 - **Selection**

Overproduction

- **Each species produces more offspring that can survive**



2. Variation

- Each individual has a unique combination of inherited traits.
 - **Adaptation:** an inherited trait that increases an organism's chances of survival



Why is variation important?

- Because the environment changes.
- The more **variation within a species**, the more likely it will **survive**
 - EX: If everyone is the same, they are all vulnerable to the same environmental changes or diseases
- The more **variation of types of species** in an habitat, the more likely at least **some will survive**
 - EX: Dinosaurs replaced by mammals

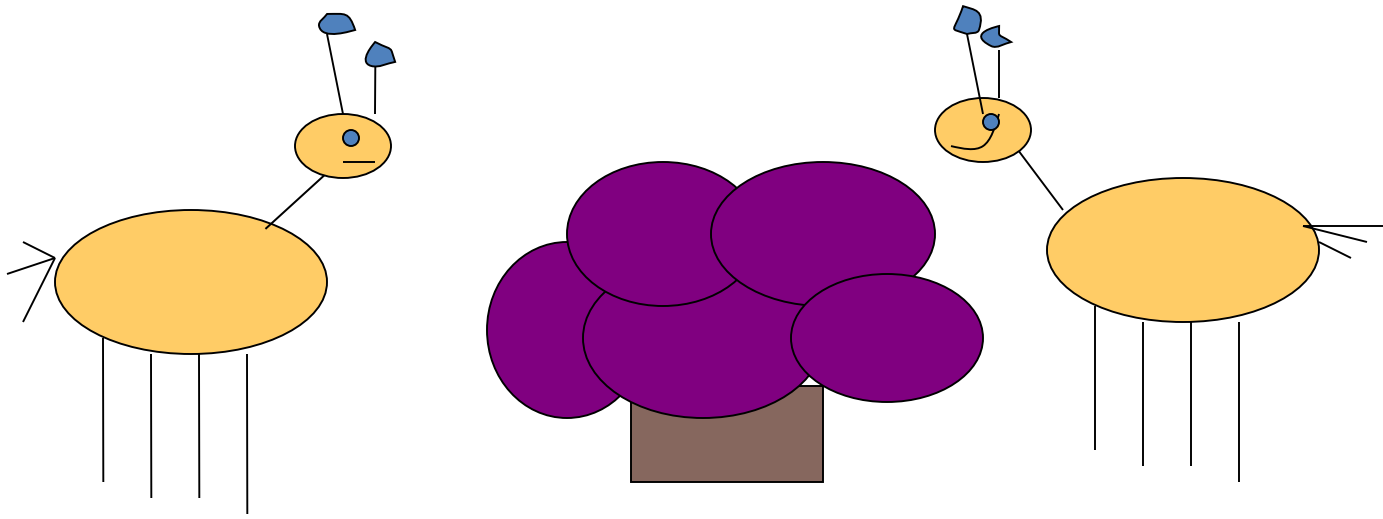
3. Competition

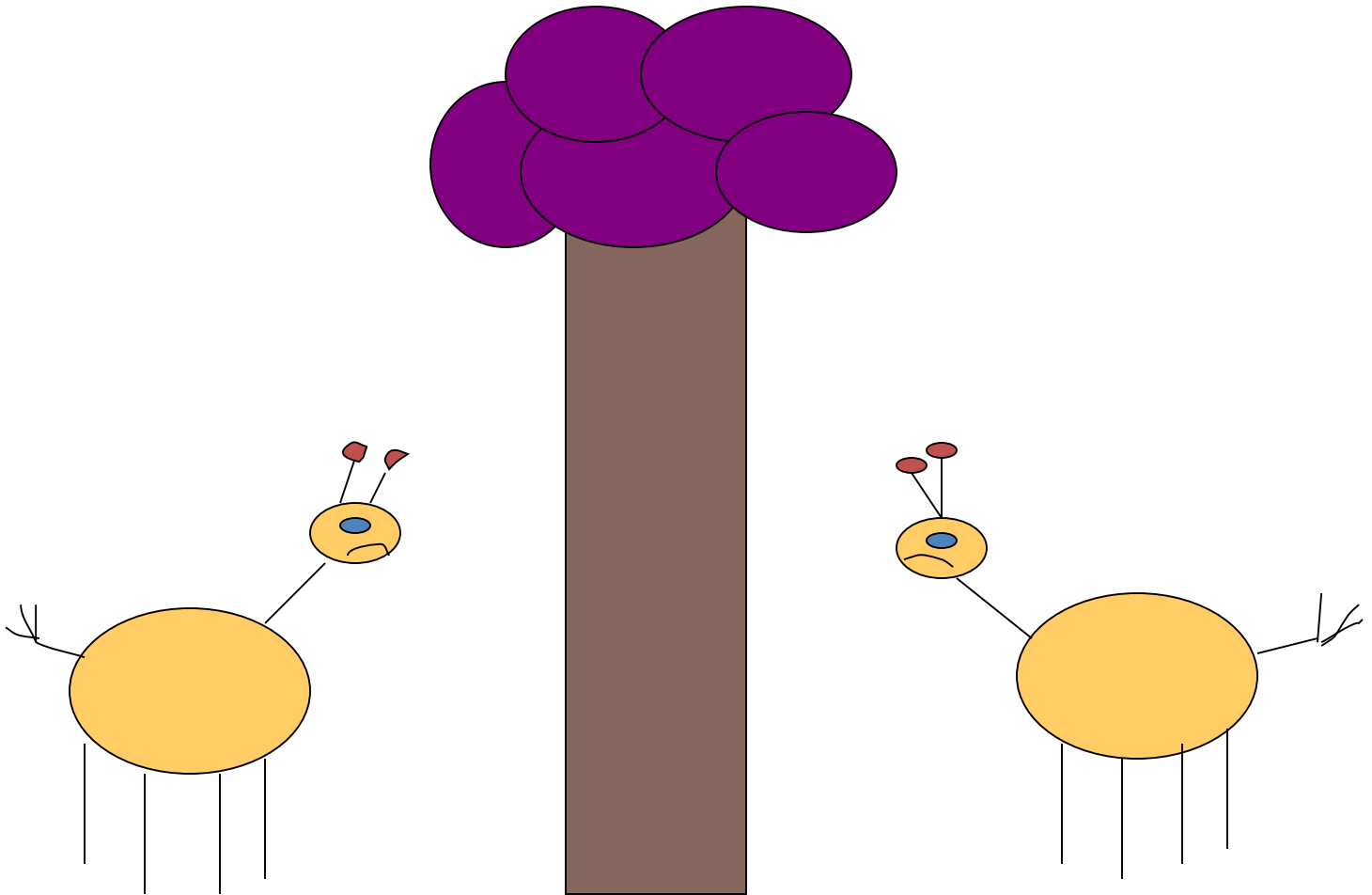
- **Individuals COMPETE for limited resources:**
 - Food, water, space, mates
- **Natural selection occurs through “Survival of the fittest”**
 - **Fitness:** the ability to survive and reproduce
- **Not all individuals survive to adulthood**

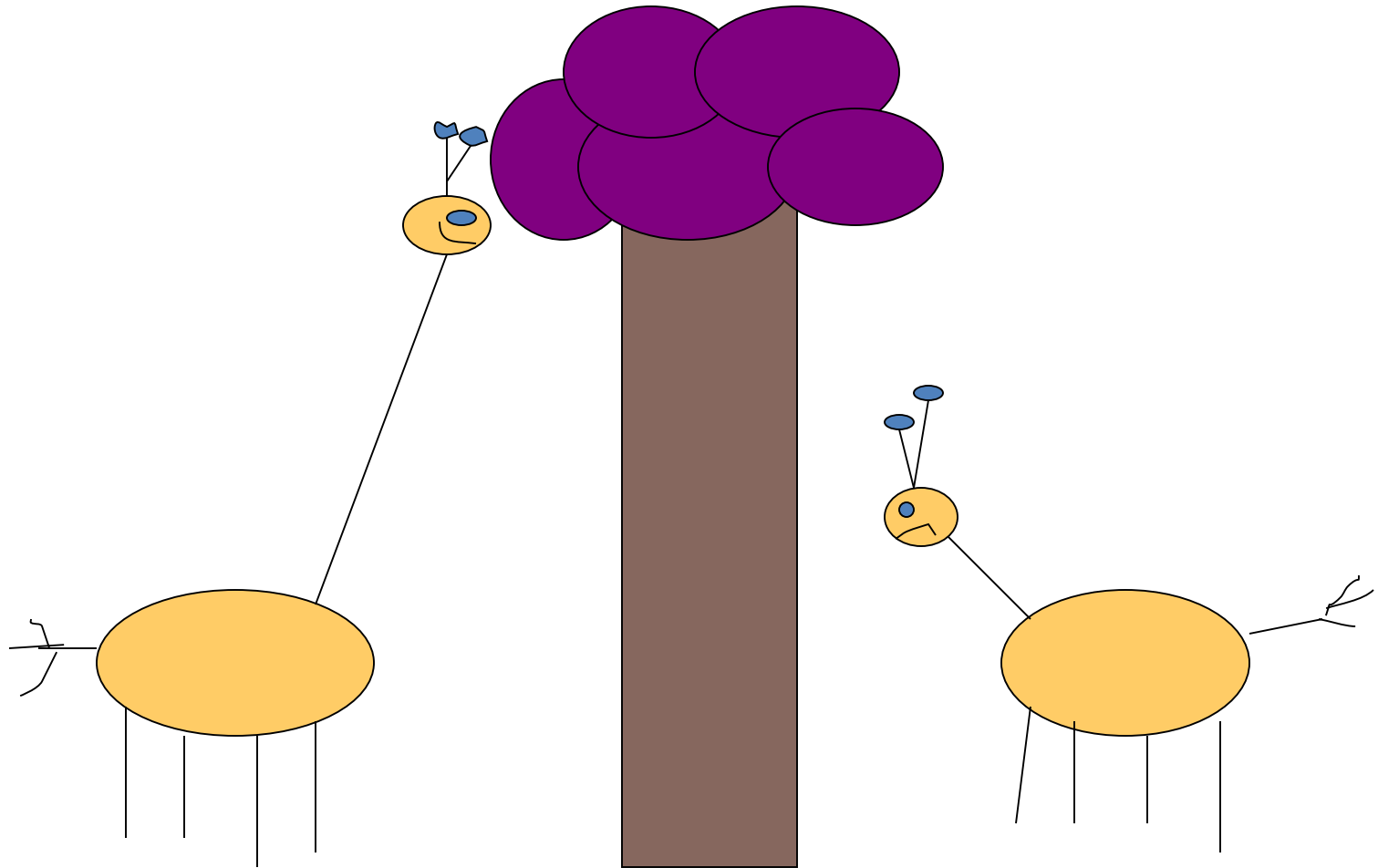
4. Selection

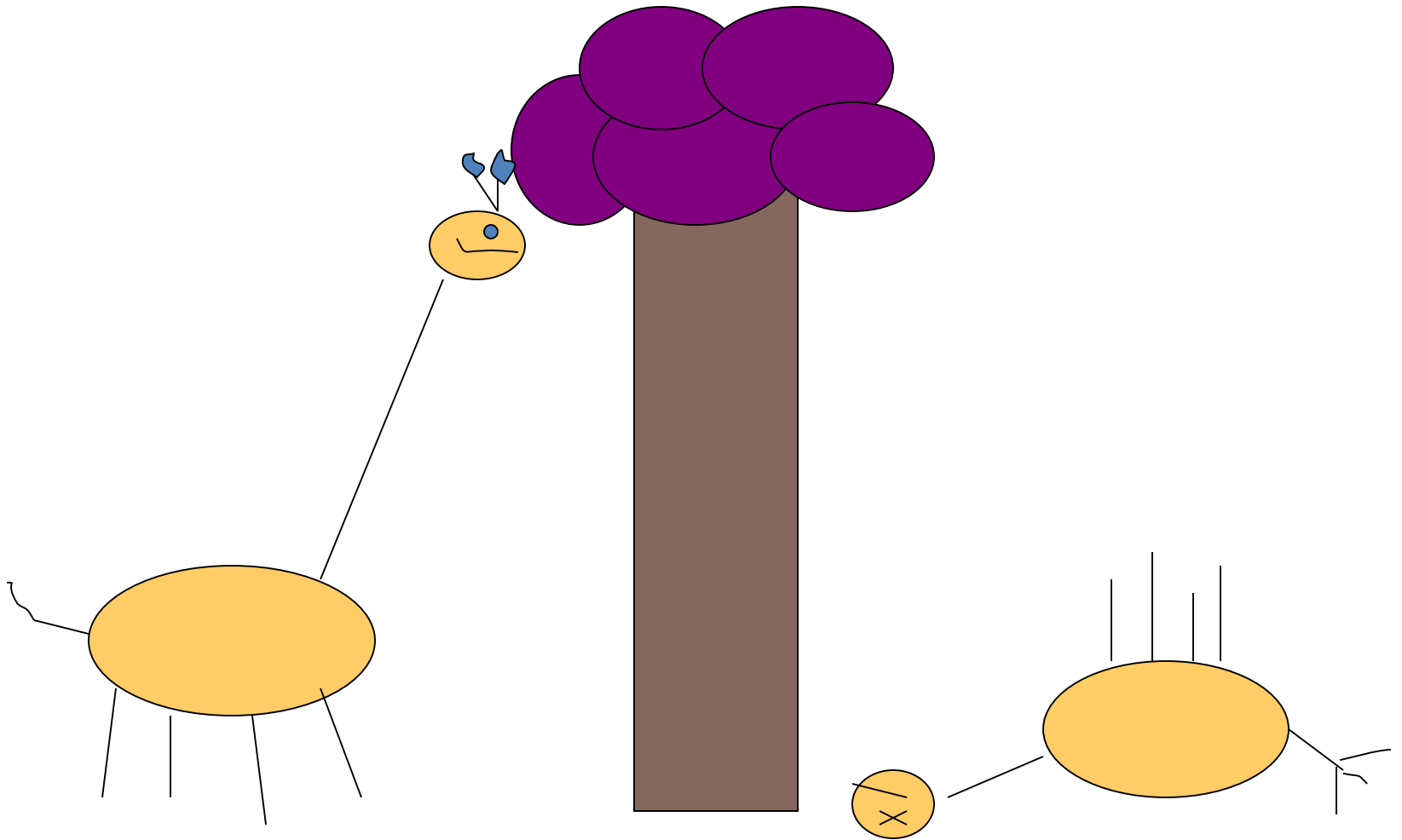
- **The individuals with the best traits / adaptations will survive and have the opportunity to pass on it's traits to offspring.**
 - Natural selection acts on the **phenotype** (physical appearance), not the **genotype** (genetic makeup)
 - Ex: When a predator finds its prey, it is due to the prey's physical characteristics, like color or slow speed, not the alleles (BB, Bb)

- **Individuals with traits that are not well suited to their environment either die or leave few offspring.**
- **Evolution occurs when good traits build up in a population over many generations and bad traits are eliminated by the death of the individuals.**









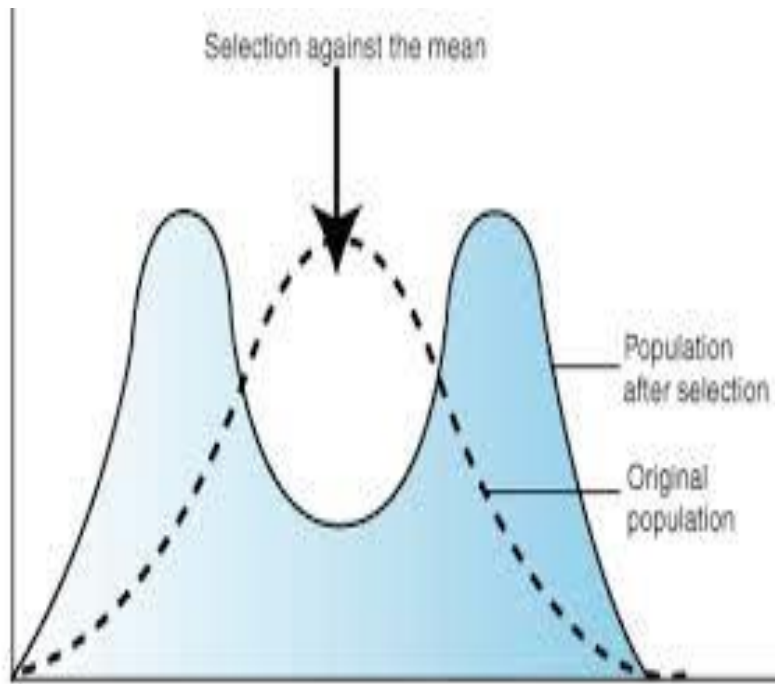
What acts as a selection pressure on a population?

- Competition for food
- Competition for a mate
- Changes in the environment
- Predators
- Parasites

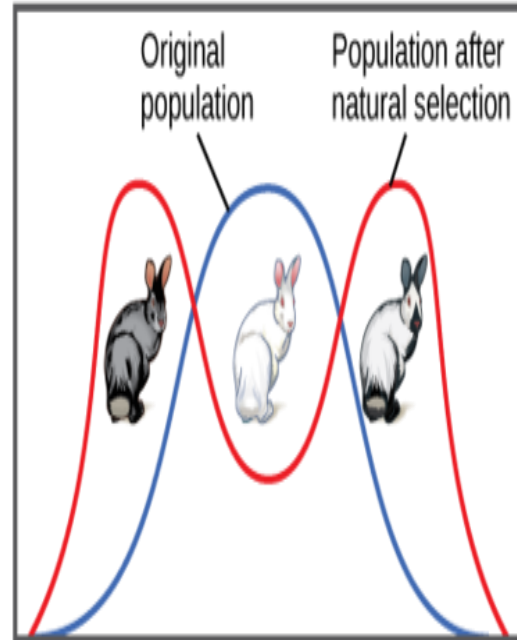
DISRUPTIVE SELECTION

- Diversifying selection
- within the species
- Occurs when two different types of resources in one area
- Results in specialization for each branched group
- May lead to formation of new species
- Disruptive selection occurs when environmental conditions favour individuals on both extremes of phenotypic range over intermediate phenotypes

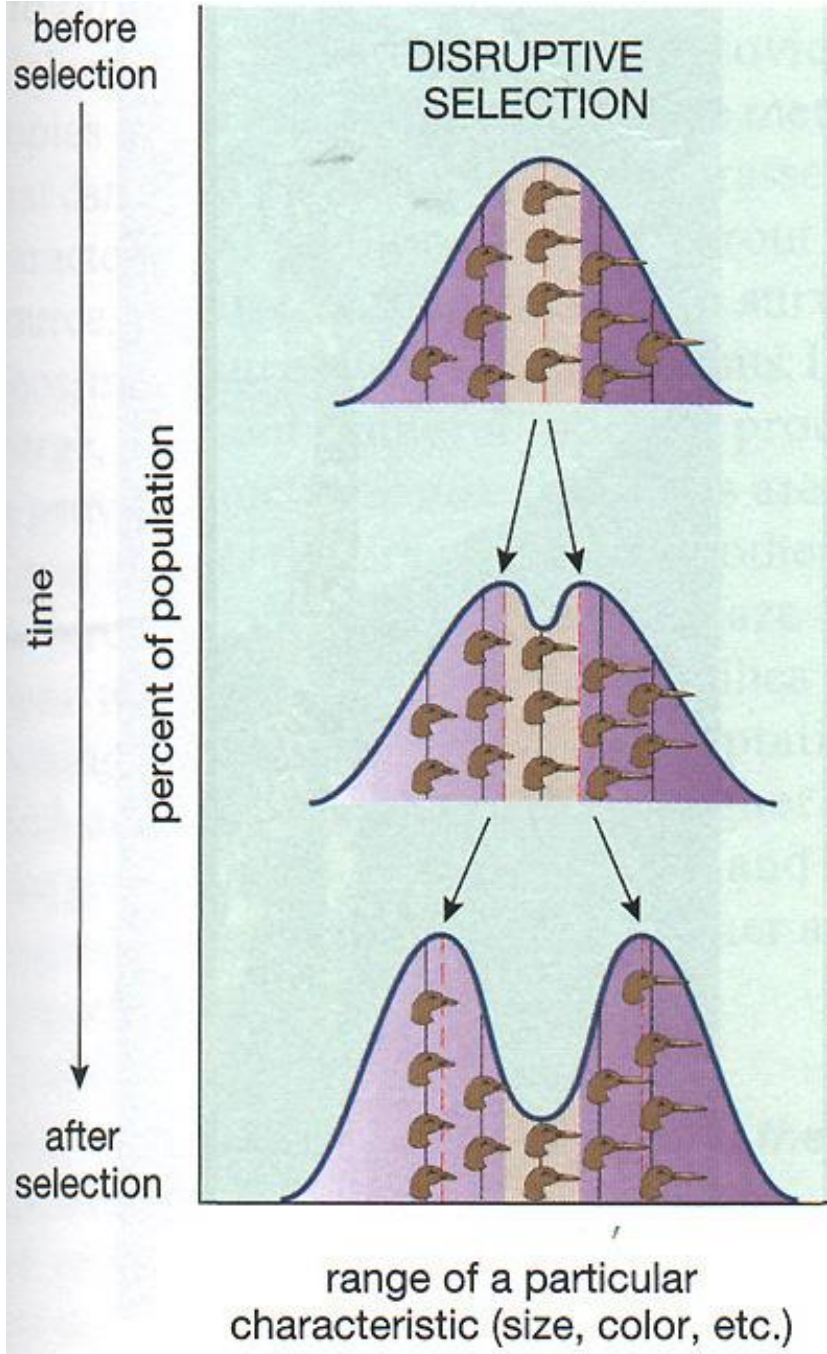
- E.g. Darwin's Finches



(c) Diversifying selection



In a hypothetical population, gray and Himalayan (gray and white) rabbits are better able to blend with a rocky environment than white rabbits, resulting in diversifying selection.

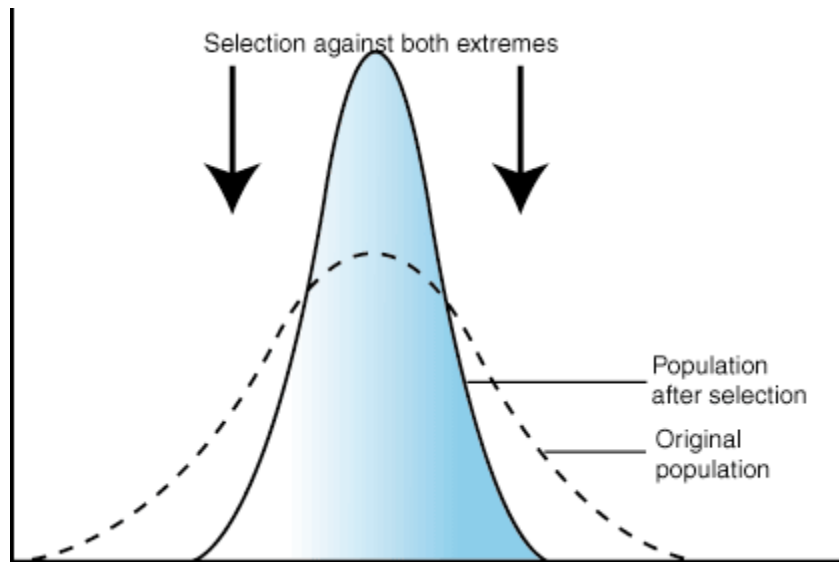


range of a particular characteristic (size, color, etc.)

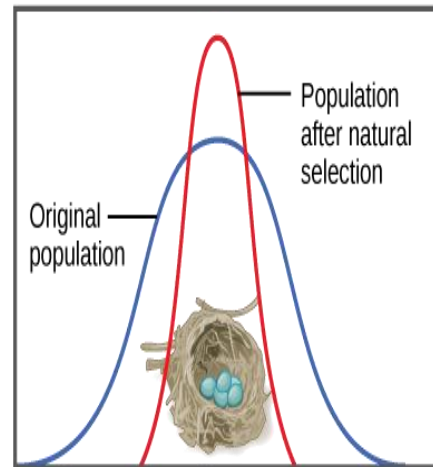
. STABILIZING SELECTION (NORMALIZING SELECTION)

- Stabilizing Selection operates when the environment is unchanging or constant. Acts against extreme phenotypes and favours intermediate variants. This mode of selection reduces variation and maintains the status-quo for a particular phenotypic character. Arrests evolutionary change.

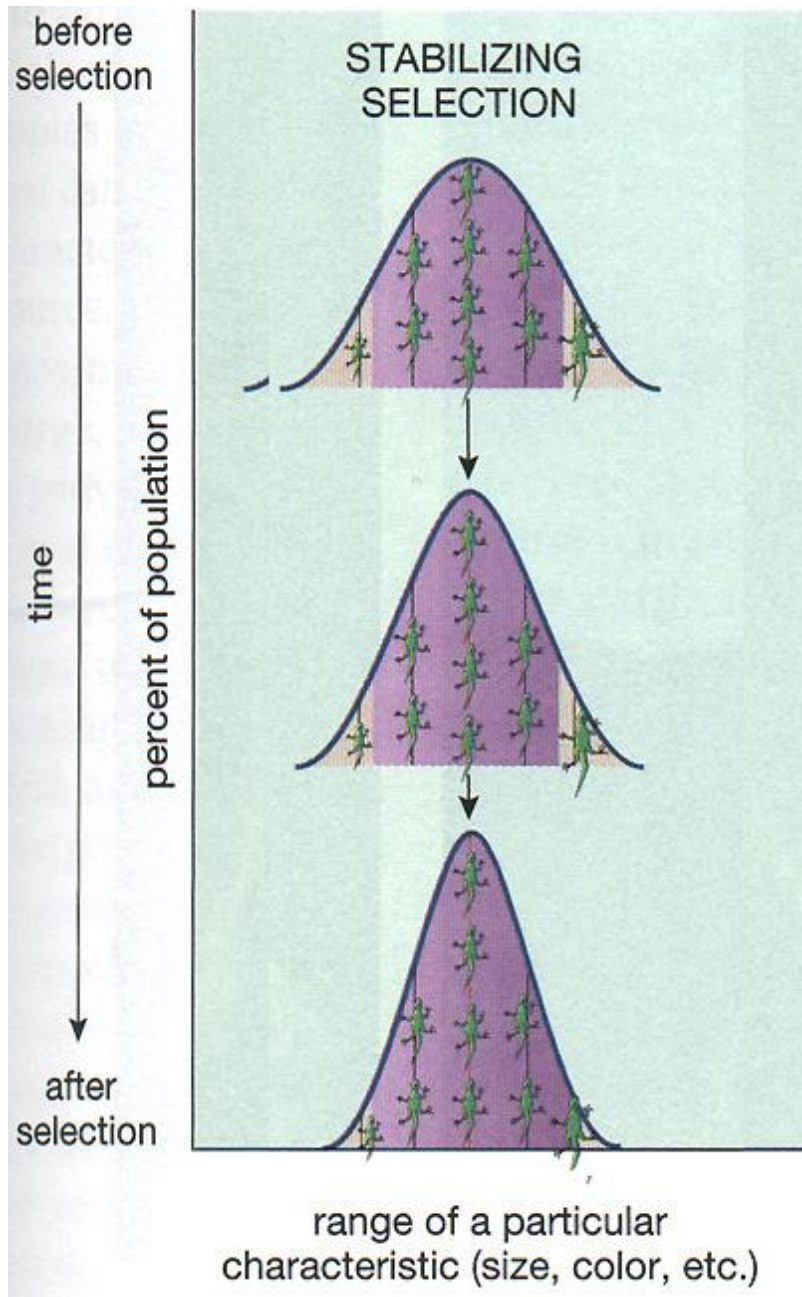
- When the extremes of the trait aren't as well suited
- For eg. In humans infants with intermediate weight at birth (3-4 kg) have the highest survival rate, babies who are much smaller or larger have high rates of mortality. . In ducks and chickens, eggs of intermediate weight have the highest hatching success.



(a) Stabilizing selection



Robins typically lay four eggs, an example of stabilizing selection. Larger clutches may result in malnourished chicks, while smaller clutches may result in no viable offspring.



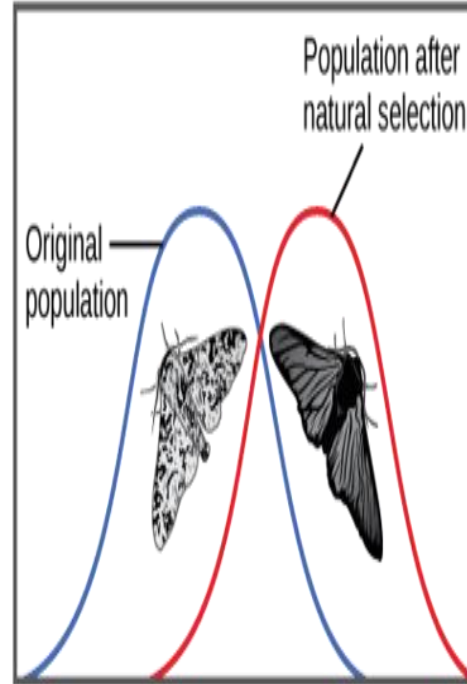
DIRECTIONAL SELECTION

- When selection acts to eliminate one extreme from an array of phenotypes, the genes promoting this extreme become less frequent in the population.
- Operates when a population's environment changes or when members of a population migrate to a new environment with different environmental conditions than their former one.
- Directional Selection shifts the frequency curve of some phenotypic character in one direction or the other.
- Examples-Industrial melanism, Resistance of bacteria to drugs

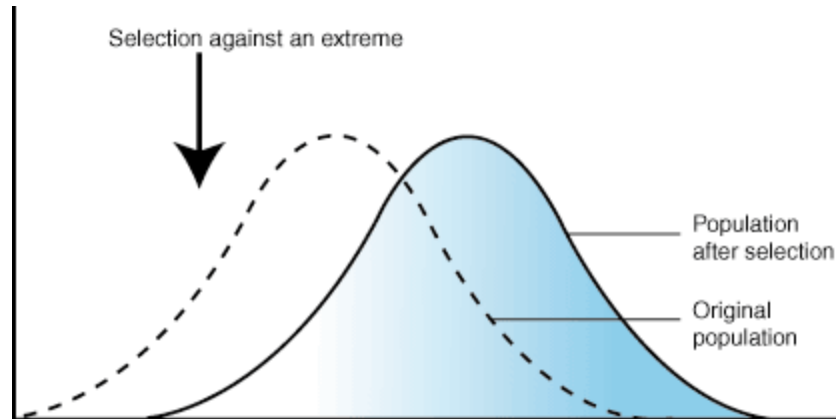
- Natural selection favors one extreme of the population for that trait



(b) Directional selection



Light-colored peppered moths are better camouflaged against a pristine environment; likewise, dark-colored peppered moths are better camouflaged against a sooty environment. Thus, as the Industrial Revolution progressed in nineteenth-century England, the color of the moth population shifted from light to dark, an example of directional selection.



Natural selection in islands

- Darwin observed the Galapagos finches had a graded series of beak sizes and shapes and predicted these [species](#) were modified from one original mainland species.
- Darwin called differences among species [natural selection](#), which is caused by the inheritance of traits, competition between individuals, and the variation of traits.
- Offspring with inherited characteristics that allow them to best compete will survive and have more offspring than those individuals with variations that are less able to compete.
- Large-billed finches feed more efficiently on large, hard [seeds](#), whereas smaller billed finches feed more efficiently on small, soft seeds.
- When small, soft seeds become rare, large-billed finches will survive better, and there will be more larger-billed birds in the following generation; when large, hard seeds become rare, the opposite will occur.
- ADD MORE NOTES

SEXUAL SELECTION THEORY

- By Charles Darwin
- Traits selected by male combat are called secondary sexual characteristics (including horns, antlers, etc.), which Darwin described as "weapons".
- while traits selected by mate (usually female) choice are called "ornaments".

SEXUAL SELECTION

- Intrasexual selection is selection within the same sex. For example, some male animals compete against one another, physically, for access to females. So something like big antlers, huge sharp teeth, or similar weaponry that can be used against other males of the species as a means of mating with females is a selective advantage.
- Intrasexual refers to selection within a sex - often called male-male competition. Males will compete amongst one another for access to females. This can include stronger males killing or driving off the competition.

- Intersexual selection is selection between the two sexes. For example, the bright plumage of a male peacock does not help it physically overcome rival males. But female peacocks tend to prefer male peacocks with bright plumage: a brightly colored male peacock has a selective advantage. It is selection based on one sex of the species preferring some characteristic in the other sex of the species.
- Intersexual is between sexes - usually called mate or female choice. In this case, males compete against each other to be chosen by the females.

GOOD GENE HYPOTHESIS

- **Good genes hypothesis**, in biology, an explanation which suggests that the traits females choose when selecting a mate are honest indicators of the male's ability to pass on genes that will increase the survival or reproductive success of her offspring.
- Ex: male ornaments

- The genes that enable males to develop impressive ornaments or fighting ability may simply show off greater disease resistance/efficient metabolism, features that also benefit females.

SEXY SON HYPOTHESIS

- The sexy son hypothesis in evolutionary biology and sexual selection—proposed by Ronald Fisher in 1930.
- It states that a female's ideal mate choice among potential mates is one whose genes will produce male offspring with the best chance of reproductive success and implies that a potential mate's capacity as a parental caregiver or any other direct benefits the father can offer the mother such as nuptial gifts, or good territory are irrelevant to his value as the potential father of the female's offspring.

- In a society where males compete with each other to be chosen as he-men by females, one of the best things a mother can do for her genes is to make a son who will turn out in his turn to be an attractive he-man.
- If she can ensure that her son is one of the fortunate few males who wins most of the copulations in the society when he grows up, she will have an enormous number of grandchildren.
- The result of this is that one of the most desirable qualities a male can have in the eyes of a female is, quite simply, sexual attractiveness itself.

- If females choose physically attractive males, they will tend to get physically attractive sons, and, thus more grandchildren, because other choosy females will prefer their attractive, sexy sons.
- The theory will function regardless of the physical or behavioral trait a female chooses, as long as it is heritable (that is, the trait varies between individuals of the population), because it is possessing the trait that makes males attractive, and not the qualities of the trait in itself. Thus, traits culturally perceived as negative can still be seen as desirable;
- for example, females who stay with or are attracted to males they know to be disloyal in a monogamous relationship. If this trait is passed to any male children, they are more likely to themselves be non-monogamous, have several mates and spread the female's genes to multiple grandchildren.