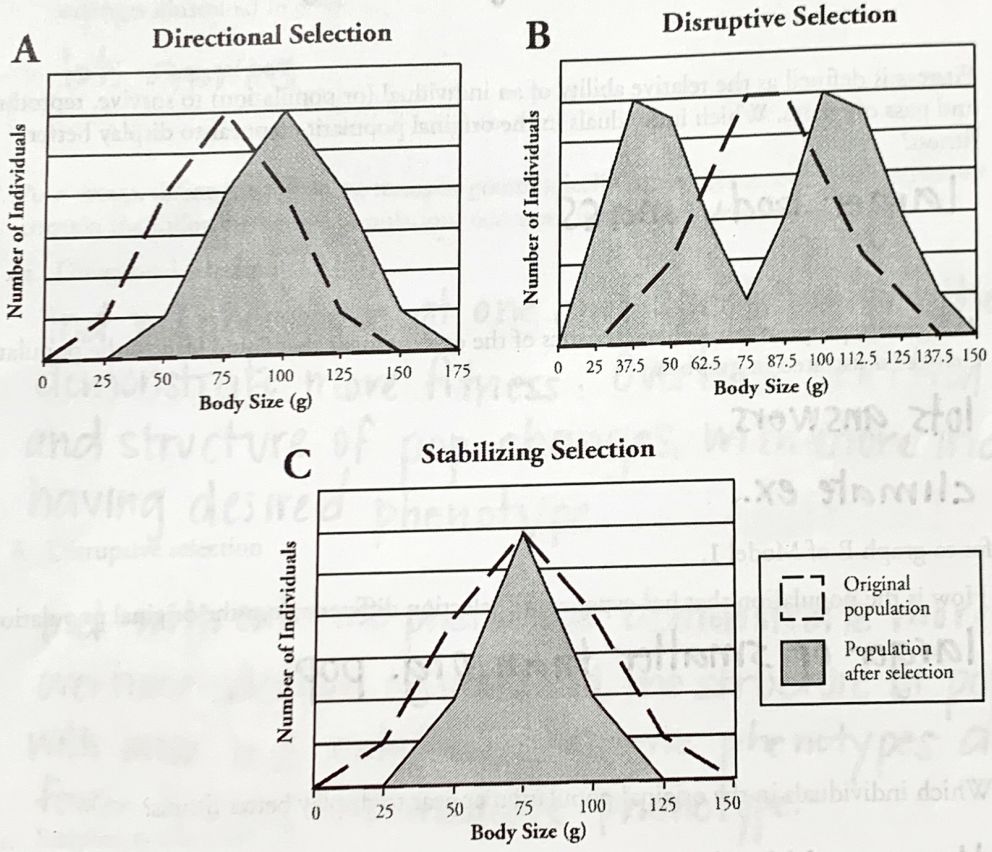
# Selection and Speciation

How can changes in a population result in the formation of a new species?

## Why?

Have you ever wondered how the great diversity of life on Earth has come about or how a single new species forms? Environmental pressures may cause populations to change over time or evolve. This is because an organism's ability to live to adulthood in its current environment will determine its reproductive success and ability to pass on its genes. But changes within a population can occur without creating a new species. At what point do scientists start thinking of a new name for a species?

## Model 1 – Three Types of Selection




1. What variables do the graphs in Model 1 compare?

Body size & # of individuals

2. What are the three types of selection illustrated in the graphs in Model 1?

Directional, Stabilizing, Disruptive

3. According to the graphs in Model 1, there is variation in the body mass in the original population. Using your knowledge of genetics, describe how this variation is possible.

Diff. alleles possible with in a pop. due to random mutations that may occur. Food supply may differ causing diff. body mass

4. Refer to graph A of Model 1.

   *a.* How is the population that has experienced selection different from the original population?

   Ind. new pop are larger on avg.

   *b.* **Fitness** is defined as the relative ability of an individual (or population) to survive, reproduce, and pass on genes. Which individuals in the original population appear to display better fitness?

   larger body mass

   *c.* As a group, propose some characteristics of the environment that could lead to the population changes illustrated in graph A.

   lots answers

   climate ex.

5. Refer to graph B of Model 1.

   *a.* How is the population that has experienced selection different from the original population?

   larger or smaller than org. pop.

   *b.* Which individuals in the original population appear to display better fitness?

   those with large or small mass

   *c.* As a group, propose some characteristics of the environment that could lead to the population changes illustrated in graph B.

   lots answers

   ex. protection from predators
   small can hide better while large can flee better

6. Refer to graph C of Model 1.

*a.* How is the population that has experienced selection different from the original population?

most are intermediate few on sides

*b.* Which individuals in the original population appear to display better fitness?

intermediate mass

*c.* As a group, propose some characteristics of the environment that could lead to the population changes illustrated in graph C.

lots answers

7. As a group, define the following terms in grammatically correct sentences. Each definition should contain the following words: population, selection, fitness, and environment.

*a.* Directional selection

'ind w/ phenotype at one end spectrum or other demonstrate more fitness. Overtime selection occurs and structure of pop changes, with more ind having desired phenotype

*b.* Disruptive selection

ind. with extreme phenotype demonstrate more fitness overtime selection occurs and the structure of pop. changes with more ind. exhibiting extreme phenotypes and fewer having intermediate phenotype.

*c.* Stabilizing selection

STOP

8. In each of the following examples, describe the likely outcome due to the environmental pressure and state the type of selection. Justify your choice.

*a.* Finches with a small beak cannot crack open seeds.

A pop with larger beak will eventually be selected b/c they can more easily open seeds. Directional

*b.* Human babies with very high or very low birth weights have a higher mortality rate.

Conditions will favor intermediate weight babies stabilizing

*c.* A population of seed cracker finches feeds on seeds available in two sizes, small or large.

Two pop will emerge if diff. beak types are best for diff. sized seeds. Disruptive

*d.* Overfishing occurs in two rivers in British Columbia, Canada, where larger salmon are preferentially caught.

Small size will become an advantage b/c they are not harvested so pop. size will shift from large to small. Directional

9. Refer to Model 2. Identify the pairs of organisms that are able to produce offspring.

A/B, C/D, & E/F

10. Which pair of organisms in Model 2 are members of the same species?

A and B

11. Consider all of the pairs of organisms in Model 2 that are not of the same species. What criterion are missing in all cases that could be used to define a species?

The pairs of organisms that are not the same species can't produce viable, fertile offspring

**Read This!**

The primary criteria for animals to be classified as different species is that there must be **reproductive isolation**, meaning for some reason organisms from the two populations cannot pass on their genetic code through reproduction for several generations. Other criteria such as differing morphology (appearance and body structure) and how much DNA the organisms share are also used to make a final determination when comparing two similar organisms.

12. A common farming practice is to breed a female horse with a male donkey. The result is a very robust animal – the mule. Most mules however are sterile, and therefore cannot reproduce. Are horses and donkeys members of the same species? Justify your answer with a specific example from Model 2.

No horses and donkeys are diff. species b/c when they mate their offspring infertile. Similar to the organism pair C/D in model 2.

13. Many species of birds have elaborate mating rituals that include bird calls, nest construction, and courtship displays. A researcher is comparing two populations of birds with similar morphology that live in similar niches. Male birds in one population build a nest before attempting to court a female, while males in the other population build the nest in cooperation with the female. Is it likely the researcher will classify these birds as the same species? Justify your reasoning.

No, these 2 birds would be NOT classified as same species b/c it is unlikely that they would be able to mate due to difference in mating rituals.

14. Could directional selection lead to the creation of a new species? Justify your reasoning using what you've learned from Models 1 and 2.

Yes, directional could lead to new species if the pop. changed to point members of org. pop no longer mate w/ members of new pop. and produce viable, fertile offspring

15. Could disruptive selection lead to the creation of a new species? Justify your reasoning using what you've learned from Model 2.

Yes disruptive selection could lead to new species if two resulting pop. were not able to mate and produce, viable, fertile offspring

16. Could stabilizing selection lead to the creation of a new species? Justify your reasoning using what you've learned from Model 2.

No, ind w/in species just become more alike unlikely this would change ability to mate w/in pop

STOP

Prezygotic Barriers

Mechanical - Parts don't fit!
Temporal - breeding seasons
Habitat - living diff. parts of world
Gametic - receptors on sperm/egg don't match

Postzygotic Barriers

Hybrid breakdown
Hybrid sterile

2 ways species can come about:

Allopatric - populations that are segregated by a geographical barrier

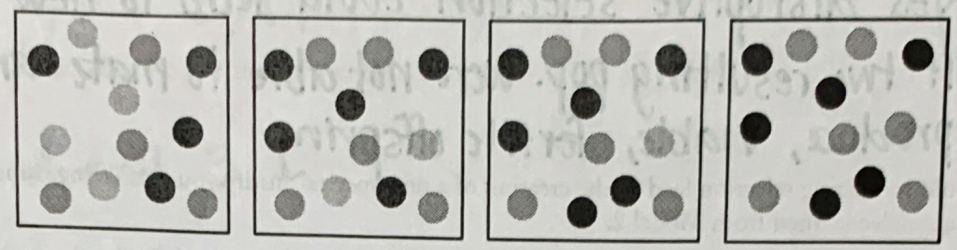
Sympatric - reproductively isolated population in midst of a parent population.

Tempo of Speciation - Punctuated equilibrium - rapid burst of speciation

gradualism - slow change to lead to new species

## Extension Questions

### Model 3 – Genetic Drift



1st Generation 2nd Generation 3rd Generation 4th Generation

17. Refer to Model 3. Fill in the table below with the number of alleles of each type in each generation.

| | 1st Generation | 2nd Generation | 3rd Generation | 4th Generation |
|---|---|---|---|---|
| Light | 4 | 2 | 1 | 0 |
| Medium | 4 | 5 | 5 | 6 |
| Dark | 4 | 5 | 6 | 6 |

18. Compare the frequency of the three alleles in the 1st generation of the small population illustrated in Model 3.

equally represented

19. In the scenario illustrated in Model 3 two of the light alleles were lost (through the death of the individual who had these two alleles) before reproduction occurred in the 1st generation. How did this affect the distribution of the three alleles in this small population?

fewer light alleles in next generation b/c that particular allele was not passed on as often.

20. The phenomenon illustrated in Model 3 is called genetic drift. It mainly occurs in small, isolated populations. Propose an explanation for why the light allele disappears from the population by the fourth generation.

Since fewer organisms have light allele, future generations will have the allele is reduced so eventually pop will no longer really have allele

21. Will the light allele ever reappear in this population? If yes, describe the circumstances that would need to occur for the light allele to reappear.

No. No organisms contain DNA sequence to pass on

22. If the population in Model 3 had been very large (hundreds of organisms), would the loss of two alleles from that population have led to the disappearance of that allele? Justify your reasoning.

if pop. large unlikely a death of a very small % of its ind. would have led to disappearance of their alleles.