

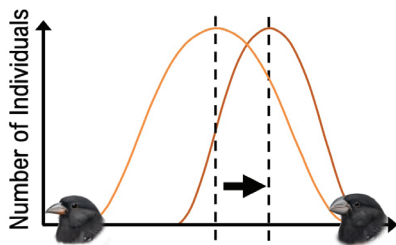
## TOPIC: NATURAL SELECTION

### Natural Selection

- ◆ Only mechanism of evolution that can produce \_\_\_\_\_.
- ◆ Three basic patterns: depending on which traits have a greater \_\_\_\_\_.

Effect on allele frequency:  
\_\_\_\_\_ frequency of  
\_\_\_\_\_ alleles.

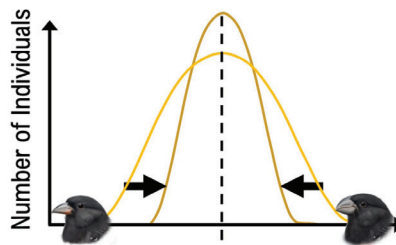
**Directional Selection:** Favors  
\_\_\_\_\_ end of the distribution.



*E.g., Only large seeds available.*

- \_\_\_\_\_ phenotype changes.

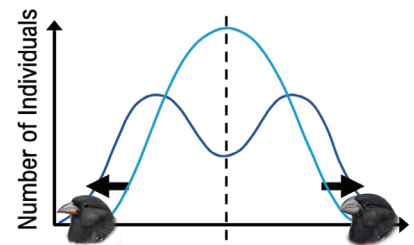
**Stabilizing Selection:** Favors  
\_\_\_\_\_ of the distribution.



*E.g., Food is a stable mix of seeds.*

- \_\_\_\_\_ are eliminated.

**Disruptive Selection:** Favors  
\_\_\_\_\_ ends of the distribution.



*E.g., Only small or big seeds.*

- \_\_\_\_\_ variation in population.

### EXAMPLE

In each situation below, identify what type of selection is being described. Then, predict how the average phenotype in the population will change as a result of this selection. If you do not expect the population to change, write “no change”.

- a) In a population of ginkgo trees, trees that are very short do not get adequate sunlight, while trees that are very tall are subject to more wind damage. Medium-height trees have the highest fitness.

**Type of selection:** \_\_\_\_\_ **Change to population:** \_\_\_\_\_

- b) In a population of oysters, light-colored oysters can camouflage on shallow rocks, while dark oysters can camouflage against dark shadows. Medium-colored oysters are easily caught as prey.

**Type of selection:** \_\_\_\_\_ **Change to population:** \_\_\_\_\_

- c) Over the course of many generations, servals, a medium-sized wild cat native to sub-Saharan Africa, have evolved from having normal-sized ears to having large ears optimized for hunting.

**Type of selection:** \_\_\_\_\_ **Change to population:** \_\_\_\_\_

## TOPIC: NATURAL SELECTION

### PRACTICE

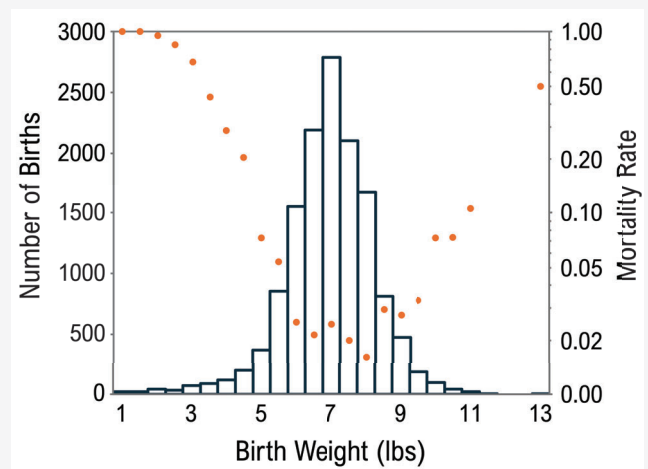
Which of the following statements regarding disruptive selection is true?

- a) The average phenotype has the highest fitness.
- b) It can lead to an increase in genetic variation.
- c) One particular trait becomes more common.
- d) Genotype frequencies remain constant.

### PRACTICE

The graph below shows the birthweights and infant mortality rate as recorded by researchers in London between 1935 and 1946. The bars represent the number of births recorded in 0.5-pound increments. The orange dots represent the mortality rate for each birthweight and are shown on a logarithmic scale. What type of selection does this graph suggest directly affects human birth weight?

- a) Diversifying selection.
- b) Stabilizing selection.
- c) Artificial selection.
- d) Directional selection.

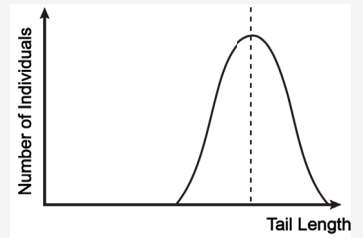
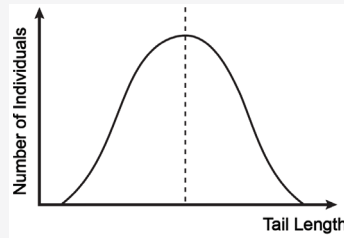


Graph adapted from: M.N. Karn and L.S. Penrose, Birth Weight and Gestation Time in Relation to Maternal Age, Parity, and Infant Survival. *Annals of Eugenics*, January 1951, Vol. 16 No. 1., Page 147-164.

## TOPIC: NATURAL SELECTION

### PRACTICE

The graph below shows the average tail length of a population of deer mice. The first graph shows the tail length of the mice while living in a prairie ecosystem, and the second shows the tail length many generations after a group of mice moved into a forest ecosystem. Which of the following types of natural selection describes this scenario, and what conclusion could you draw from these data?



- a) Stabilizing selection: shorter-tailed mice had increased fitness in the forest ecosystem.
- b) Stabilizing selection: longer-tailed mice had increased fitness in the forest ecosystem.
- c) Directional selection: shorter-tailed mice had increased fitness in the forest ecosystem.
- d) Directional selection: longer-tailed mice had increased fitness in the forest ecosystem.

## TOPIC: NATURAL SELECTION

### Balancing Selection

◆ **Balancing selection:** selection favors \_\_\_\_\_ than one allele.

◆ Two common types:

▪ **Frequency-dependent selection:** Favors \_\_\_\_\_ common phenotype.

- E.g., Birds learn to recognize specific *Cepaea nemoralis* shell patterns.
- \_\_\_\_\_ phenotype is always favored.



Effect on allele frequency:

maintains \_\_\_\_\_ alleles.

▪ **Heterozygote advantage:** higher fitness as a \_\_\_\_\_ than either \_\_\_\_\_.

- E.g., In areas where malaria is prevalent, heterozygote advantage is observed with the sickle cell allele.

Phenotype	Normal Hemoglobin	Sickle Cell Trait	Sickle Cell Disease
Genotype	AA Homozygotes	AS Heterozygotes	SS Homozygotes
Risk of Death from Malaria	Medium	_____	High
Risk of Death from Sickle Cell	None	_____	High
Fitness	_____	_____	_____

### EXAMPLE

A population has the following allele and genotype frequencies for the R gene. Assume that this population is not in Hardy-Weinberg equilibrium due to the presence of natural selection. What type of selection may be happening, and how do you know?

$$\begin{array}{lll} p = .4 & q = .6 & \\ RR = .14 & Rr = .52 & rr = .34 \end{array}$$

Type of selection: \_\_\_\_\_.

How do you know? \_\_\_\_\_.

## **TOPIC: NATURAL SELECTION**

### **PRACTICE**

In many species of salmon, there are two mating types in males: large aggressive males and small sneaker males. Large aggressive males fight for territory in which they mate with resident females, while small sneaker males hide and try to quickly enter larger males' territories to mate with females. "Sneaking" is, on average, a more successful strategy when there are many large males competing for territory, while "Fighting" is, on average, a better strategy when there are few large males present. As described, this scenario describes what two types of selection?

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- a) Frequency-dependent selection and stabilizing selection.
- b) Heterozygote advantage and stabilizing selection.
- c) Frequency-dependent selection and disruptive selection.
- d) Heterozygote advantage and disruptive selection.

### **PRACTICE**

Which of the following statements about frequency-dependent selection are true?

- I. In frequency-dependent selection, the rare phenotype is favored.
- II. Frequency-dependent selection leads to a loss of genetic variation over time.
- III. Frequency-dependent selection is a form of balancing selection.

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- a) I & II only.
  - b) I & III only.
  - c) II & III only.
  - d) I, II, & III.

## TOPIC: NATURAL SELECTION


### Sexual Selection

- ◆ **Sexual Selection:** selection for traits that affect the ability to \_\_\_\_\_ mates.
- ◆ During reproduction, there is often a \_\_\_\_\_ investment sex and a \_\_\_\_\_ investment sex.
  - Females: \_\_\_\_\_ gametes, \_\_\_\_\_ parental care.      Males: \_\_\_\_\_ gametes, \_\_\_\_\_ parental care.
- ◆ Leads to **Sexual Dimorphism:** differences in \_\_\_\_\_ sexual characteristics.

◆ **Intersexual selection:** 2 sexes - mate \_\_\_\_\_.

- High investment sex (\*females) = \_\_\_\_\_.
- Leads to \_\_\_\_\_ males; *e.g.* peacocks.




 **ERRRR** Do I want to mate with you?

◆ **Intrasexual selection:** 1 sex - \_\_\_\_\_.

- Low investment sex (\*males) = \_\_\_\_\_.
- *e.g.*, Seals fighting for territory.



 **RAAAA!!!** I'm gonna win the mate!

- ◆ Warning! Mating systems are complex – don't over-generalize! (especially in humans).

### EXAMPLE

Three bird populations are described below. For each population, determine which sex is the high investment sex, or if both sexes have equal investment. Then, circle whether intersexual selection, intrasexual selection, or neither type

- a) Red-necked Phalarope males are responsible for paternal care. While males are caring for the clutch, female red-necked phalaropes will often attempt to mate with other males and will compete with other females for access to available males, leading to larger and more aggressive females.

**High investment sex:** \_\_\_\_\_      **Intersexual selection / intrasexual selection / neither**

- b) Both male and female Laysan Albatrosses raise their offspring. Birds typically form a pair bond with one other bird of the opposite sex that they maintain for life. There is little visible difference between male and female albatrosses.

**High investment sex:** \_\_\_\_\_      **Intersexual selection / intrasexual selection / neither**

- c) Red-capped Manakin males perform impressive dances that females evaluate when deciding whether to mate. Males have a black body with a red head and bright yellow legs, while females, who are responsible for caring for the young, are dull green and brown.

**High investment sex:** \_\_\_\_\_      **Intersexual selection / intrasexual selection / neither**

## **TOPIC: NATURAL SELECTION**

### **PRACTICE**

Mudskippers, fish that leave the water to mate, perform elaborate dances involving jumping a few inches off the ground to attract mates. This is an example of:

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- a) Intersexual selection because it is an example of mate choice.
- b) Intrasexual selection because it is an example of mate choice.
- c) Intersexual selection because it is an example of competition within one sex.
- d) Intrasexual selection because it is an example of competition within one sex.

### **PRACTICE**

In a 1990 study on caribou by Barrette and Vandal in *Behavioral Ecology and Sociobiology*, it was observed that in confrontations between male caribou, the males with the larger antlers won 90% of the time. If this is a case of purely intrasexual selection, what else would you expect to be true?

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- a) Fighting is a display trait, and females choose males with the larger antlers.
- b) Males with the larger antlers would be expected to provide more paternal care.
- c) Winning a confrontation provides males access to more breeding females.
- d) Winning confrontations would signal to females that the male has higher fitness.