Biology Lesson

April 10

What is Speciation?

I Can Statement:

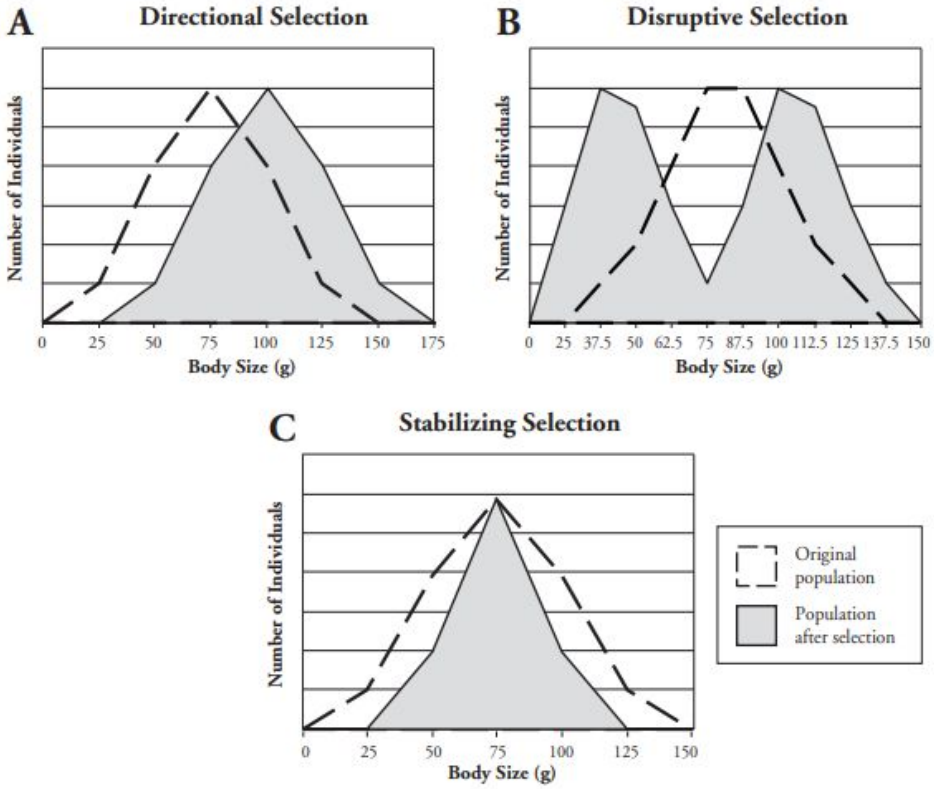
I can explain speciation and how data can help us understand speciation.

Let's Get Started:

1. What variables do the graphs compare?

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

3. 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?

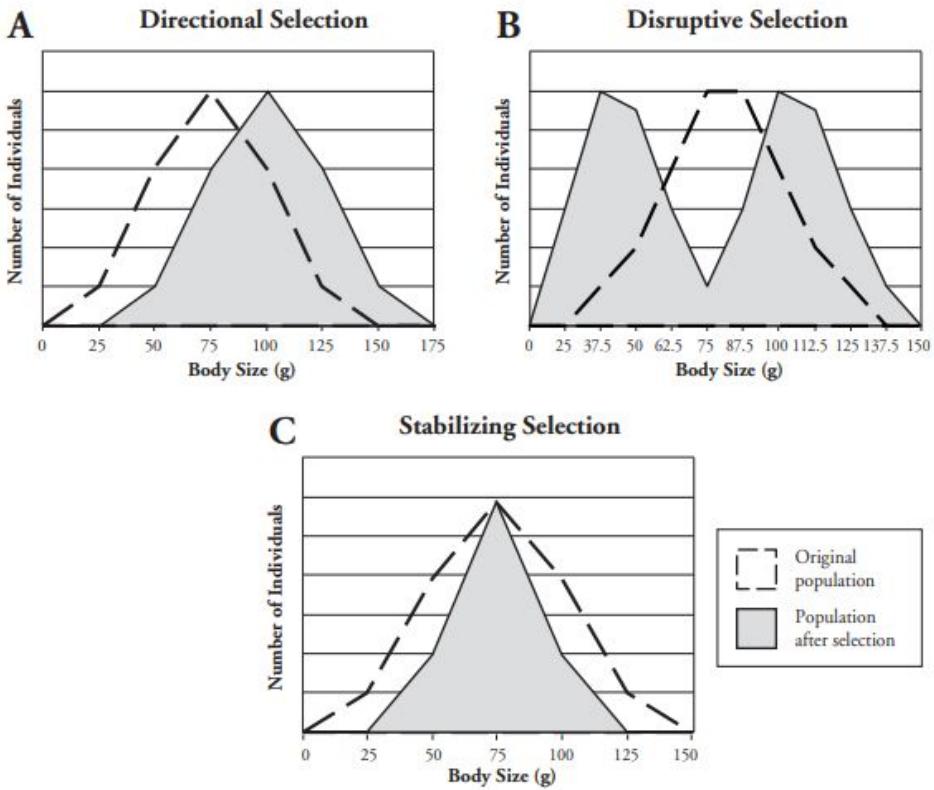


Let's Get Started:

1. What variables do the graphs compare? Number of individuals to body size

2. According to the graphs, there is variation in the body mass in the original population. Using your knowledge of genetics, describe how this variation is possible. Mendel's Laws of Independent Assortment, Segregation, and Dominance increase the genetic variation within a gene pool.

3. 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? In graph A, those with the larger body size. In graph B, those at both extremes of body size. In graph C, those of average body size.

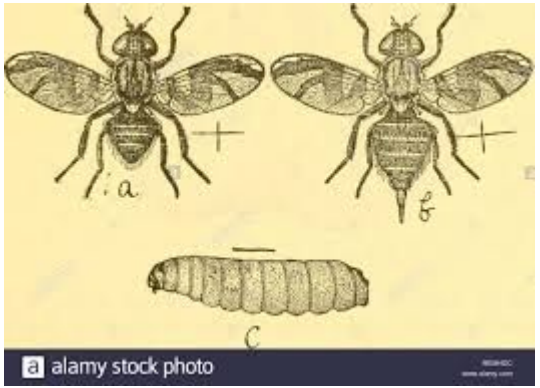


Lesson Activity

Directions:

1. Watch the video over speciation for background information.
2. Then, answer the practice questions using the experiments provided (on the following slides)

Link(s): [Hawthorns to Apples Video]



Practice

Complete the following questions based off of what you learned from the video.

Directions:
Review experiment 1 to the right:

Question:

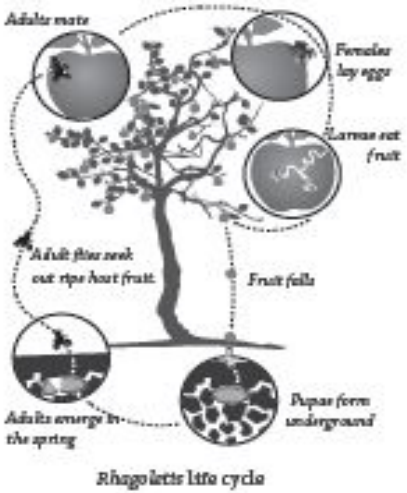
1) Summarize the results found.

Guiding Question

Apples were brought to North America about 400 years ago. Sometime around 1850, some *Rhagoletis* flies moved from living on their native hawthorn fruit to living on apples. Is the population of hawthorn flies living on the apples becoming a new species?

Background

Adult *Rhagoletis* flies go to ripe fruit to find a mate and lay eggs. The offspring overwinter directly underneath the host tree they hatched in, and then emerge from the ground in the spring—and the cycle repeats.



Rhagoletis life cycle

Experiment 1

Research question: When flies come out of the ground as adults, do they go back to the host fruit they hatched from, or instead randomly fly to either apples or hawthorns?

If the offspring from apple and hawthorn fly populations go back only to the same type of fruit they hatched from to mate and lay eggs, then the populations will be reproductively isolated.

Procedure

1. Catch adult flies as they emerge out of the ground under apple or hawthorn trees.
2. Mark each fly to show which host it came from. Release.
3. After a few days, re-capture flies from ripe fruit and count them.

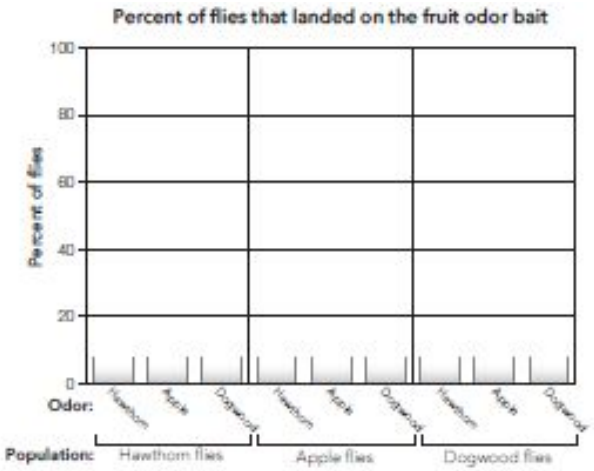
Results *(data based on Feder et al, 1994)*

Host fruit that flies grew up in	Total re-captured	Host fruit where flies went to mate	
		Same fruit	Different fruit
Hawthorn fruit	45	43	2
Apple fruit	71	66	5

Directions:
Review experiment 2 to the right:

Question:

2) Make a bar graph of the data from the table. For each fly population, fill in 3 bars, one for each odor.



Experiment 2

Different types of host fruit have different odors. Odors from fruit are important signals that flies use to find a place to mate and lay eggs.

Research question: Is fruit odor preference a reproductive barrier?


apple fruit

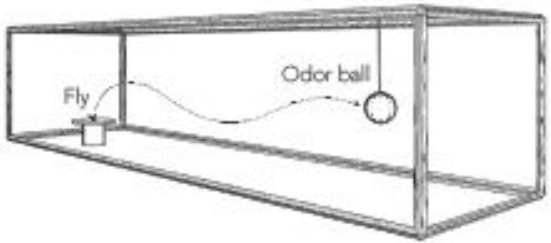

hawthorn fruit


dogwood fruit

Using dogwood flies as a control (they are known to be a separate species), researchers compared fruit odor preferences among dogwood, apple, and hawthorn flies.

Procedure

1. In the fall, collect fruit with fly larvae living inside of them.
2. Take the fruit back to the lab and store each type of fly separately.
3. When flies emerge as adults in the spring, test them in a flight tunnel.
   a. To mimic ripe fruit, paint synthetic apple odors onto a red rubber ball.
   b. Place a fly onto a stand in the tunnel.
   c. Record whether the fly lands on the ball.



   d. Using a new fly each time, repeat until you have tested 100-200 flies. Repeat for hawthorn and dogwood odors. **Test each fly only once using only one of the three possible odors.**

Results *(data based on Dambroski, 2004)*

Population	Percent of flies that landed on the fruit bait		
	Hawthorn Odor	Apple Odor	Dogwood Odor
Hawthorn Flies	77	21	15
Apple Flies	15	79	11
Dogwood Flies*	21	13	82

* Dogwood flies are known to be a separate *Rhagoletis* species.
Note: No flies landed on a plain, odorless ball.

Directions:
Review experiment 2 to the right:

Question:

3) In one sentence, summarize the results.

Experiment 3:

According to one definition, two populations are considered to belong to the same species if they can produce fertile offspring together.

When researchers put hawthorn and apple flies together in the lab, they found that they could produce offspring together. These are referred to as hybrid offspring.

Research question: Which fruit odors are the hybrid offspring attracted to?

To find out, researchers tested the hybrid offspring in the same flight tunnel that they had used for experiment 2. For each odor, they tested over 100 flies.

Results *(data based on Lin et al, 2004)*

Population	Percent of flies that landed on bait	
	Hawthorn Odor	Apple Odor
Apple x Hawthorn hybrid	0	< 1

Questions:
Answer the following questions with information from the previous experiments.

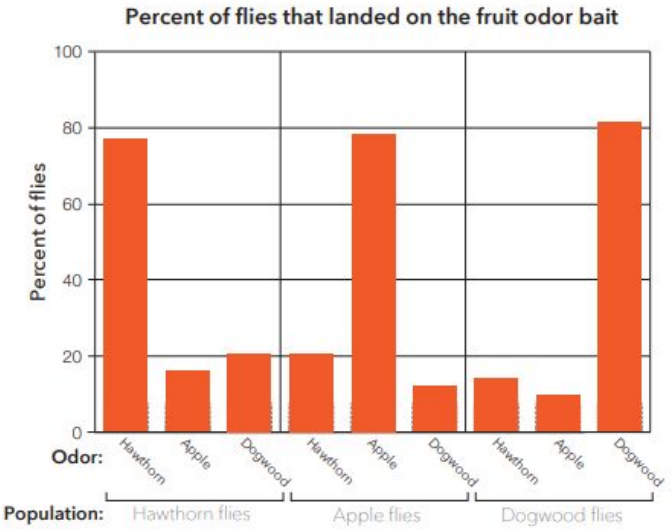
4. Compare and contrast the odor preferences of the hybrid offspring to those of the parent populations (from experiment 2).

5. Do you think that fruit preference is a reproductive barrier for the apple and hawthorn fly populations? Make a claim, and support it with evidence and reasoning from experiments 1 and 2.

6. Attraction to fruit odor is a heritable trait influenced by genes. Do you think that differences in fruit odor attraction are being acted on by natural selection differently in apple vs. hawthorn flies? Make a claim, and support it with evidence and reasoning.

Once you have completed the practice questions check with the answer key.

1. When flies come out of the ground as adults, they usually go back to the host fruit they hatched from.
2. See graph to right ->
3. Very few of the hybrid flies were attracted to either fruit odor.
4. Hybrid offspring fly to fruit odors far less often than their parents do. Parental flies must either be better at detecting fruit odors or more attracted to fruit odors than hybrid flies are.
5. Fruit preference is a reproductive barrier for apple and hawthorn fly populations. Experiments 1 and 2 show that adult flies usually go back to the same type of fruit they grew up on. Since ripe fruit is where flies mate and lay eggs, they are most likely to mate with a fly of their same type.
6. Differences in fruit odor attraction are being selected for in apple vs. hawthorn flies. Apple flies are most attracted to apple odors, and hawthorn flies are most attracted to hawthorn odors. Because attraction to fruit odor is important for reproduction, natural selection will favor flies that are attracted to good food sources.



More Practice:

Complete the following over Speciation

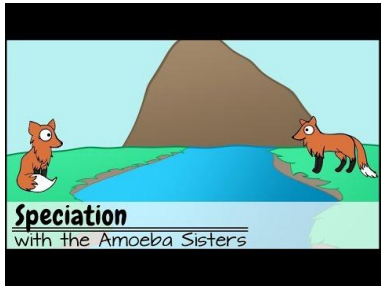
Follow the directions on the practice sheets to answer the questions.

1. Life Cycle Timing Practice

2. Allele Numbers Practice

Additional Practice and Resources

Speciation Interactive



Worksheet to go with Video #2 (below)