



Biology Classwork
PHET Natural Selection Simulations



Name: _____

Date: _____

Go to the PHET simulation: Natural Selection:
<http://phet.colorado.edu/en/simulation/natural-selection>

The simulation: Today you will be using the simulation software to run natural selection experiments. Follow the directions below to collect the required data then use that data to answer the analysis questions that follows. Familiarize yourself with how the simulation software works. Notice the following:

The population graph under the environment window: This is where you will get the number of each type of rabbit. You can zoom in or out to get a more accurate reading of population size.

Generation Counter: Indicates the number of generations that have elapsed.

Data Probe: Reads data on population graph.

The screenshot shows the PHET Natural Selection simulation interface. A central window displays a landscape with a white rabbit labeled 'Lonely Rabbit'. A pink dial at the top center is labeled 'Generation counter'. Below the landscape is a 'Population Graph' showing population over generations, with a 'Data Probe' button. To the right, there are control panels for 'Add Mutation' (Dominant/Recessive fur) and 'Environmental Factors' (Wolves, Limited Food). A 'Reset All' button is at the bottom right. The Windows taskbar is visible at the bottom.

Try this first:

Hit the "Reset All" button. Click "Add a Mate" and let the simulation run. What eventually happens? Check the generation counter (center pink dial). How many generations does it take for this to happen?

Experiment #1A: Rabbits with Brown & White Fur & Wolves

Before you start: Read through the experiment. In the space below hypothesize how the effect of a recessive mutation in a desert population of rabbits that changes the color of the rabbit's fur from white to brown will affect predation.

It is hypothesized that...

1. Hit the "Reset all". Make sure the background is set to "sand" (upper right – sun icon). Click "Add a Mate". This will start the simulation. Watch the generation counter (pink disk in center); let it run for two generations. Hit the pause button (lower right) just after the generation counter dial passes 2. Click on the data probe and slide the probe over the graph to generation 2. Record the data from the graph at Generation 2 in Data Table 1A.
2. Add Mutation: From the "Add Mutations" box, select "Recessive" brown fur (white fur becomes dominant).
3. Start the simulation and let it run for two more generations. Pause the simulation just after the generation counter dial passes "4". Click on the data probe and slide the probe over the graph to generation 4. Record the number of white fur and brown fur rabbits in Data Table 1A.
4. Environmental Factors: Now add "Wolves" as an "Environmental Factor" and start the simulation. Let the simulation run for three more generations (to generation 7). Hit pause just after the generation counter dial goes past the "7" (before the wolves come again!). Record the data for generation 7 in Data Table 1A.
5. Let the simulation run for three more generations. Hit pause just after the generation counter dial goes past the "10" (before the wolves come again!). Record the data for generation 10 in Data Table 1A.

Data and Analysis: Data Table 1A

Generation Number	Data #1A			Proportions (% Calculation)	
	Number of White Rabbits	Number of Brown Rabbits	Total # of Rabbits	% White Rabbits	% Brown Rabbits
2					
Add Mutation: Brown Fur (recessive)					
4					
Add Environmental Factor: Wolves					
7					
10					

Analysis for Experiment #1A

1. Explain how the brown fur mutation affected the overall population fur color. Use the data in Data Table 1A to explain.

2. Does the data in Data Table 1A support your hypothesis for this experiment about how the rabbit fur mutation from white to brown affected predation? Use your data to explain how the data does or does not support your hypothesis.

Experiment #1B: Rabbits with Brown & White Fur & Wolves

Before you start: Read through the experiment. In the space below hypothesize how changing the background on a population of brown and white fur rabbits will affect will affect predation.

It is hypothesized that...

1) Hit the “Reset all”. Make sure the background is set to “sand” (sun icon at upper right) then click on the “Add a Mate”. Watch the generation counter; let it run for three generations. Hit the pause button (lower right) just after the generation counter dial passes “3”. Record the data from the graph after three generations in Data Table 1B.

2. Add Mutation: From the “Add Mutations” box, select “Recessive” brown fur (white fur becomes dominant). Let the simulation run for two more generations (to generation 5). Hit the pause button (lower right) just after the generation counter dial passes “5”. Slide the data probe to Generation 5. Record the data after the fifth generation in Data Table 1B.

3. Environmental Factors: Now add “Wolves” as an “Environmental Factor” and start the simulation. Let the simulation run for five more generations (to generation 10). Hit the pause button (lower right) just after the generation counter dial passes “10”. Slide the data probe to Generation 10. Record the data for Generation 10 in data Table 1B.

4. Change the Background: Change the background from “sand” (sun icon) to “snow” (snowflake icon). Run the simulation for three more generations to generation 13. Hit the pause button (lower right) just after the generation counter dial passes “13” (before the wolves come again!).

Data and Analysis: Data Table 1B

Generation Number	Data #1B			Proportions (% Calculation)	
	Number of White Rabbits	Number of Brown Rabbits	Total # of Rabbits	% White Rabbits	% Brown Rabbits
3					
Add Mutation: Brown Fur (recessive)					
5					
Add Environmental Factors: Wolves					
10					
Change Background from Sand to Snow (upper right corner)					
13					

Analysis for Experiment #1B

1. When and why was it an advantage for rabbits to have brown fur?
2. When and why was it an advantage for rabbits to have white fur?
3. Does the data in the table above support your hypothesis for this experiment about how the background will affect predation of white furred and brown furred rabbits? Use your data to explain how the data does or does not support your hypothesis.

Experiment #2: Rabbits with Short & Long Teeth & Food

Before you start: Read through the experiment. Then in the space below hypothesize how tooth length (from short teeth to long teeth) will affect the evolution of tooth length in the population as the type of food changes.

It is hypothesized that...

1. Hit the "Reset all". Click on the "Add a Mate". Watch the generation counter; let it run for two generations. Hit the pause button (lower right) just after the generation counter dial passes "2". Record the data from the graph after two generations in Data Table 2.
2. Add Mutations: In the "Add Mutations" box, select "teeth" as Dominant.
3. Environmental Factors: In the Environmental Factors box select "Tough Food".
4. Let the simulation run for two generations. Hit the pause button (lower right) just after the generation counter dial passes "4". Slide the data probe to Generation 4. Record data in Data Table 2.
5. Let the simulation run for three more generations. Hit the pause button (lower right) just after the generation counter dial passes "7". Slide the data probe to Generation 7. Record in Data Table 2.
6. Let the simulation run for three more generations. Hit the pause button (lower right) just after the generation counter dial passes "10". Slide the data probe to Generation 10. Record in Data Table 2.

Data and Analysis: Data Table 2

Generation number	Data #2			Proportions (% Calculation)	
	Number of Rabbits with Normal teeth	Number of Rabbits with Long teeth	Total # of Rabbits	% Short Tooth Rabbits	% Long Tooth Rabbits
2		0		100	0
Add Mutation: Long Teeth (Dominant) Add Environmental Factors: Tough Food					
4					
7					
10					

Analysis for Experiment #2

1. What effect did tough food have on the rabbit population's tooth length?
2. What effect did tough food have on the rabbit population with normal tooth length?
3. Does the data in the table above support the hypothesis for this experiment? Use your data to explain how the data does or does not support your hypothesis.

Experiment #3: Rabbits with Floppy & Straight Ears vs Wolves

Before you start: Read through the experiment. Then in the space below hypothesize how floppy or straight ears will affect the predation rate of rabbits by wolves.

It is hypothesized that...

1. Hit the "Reset all". Click on the "Add a Mate". Watch the generation counter; let it run for two generations. Hit the pause button (lower right) just after the generation counter dial passes "2". Record the data from the graph after two generations in Data Table 3.
2. Add Mutations: In the "Add Mutations" box click on "Ears" (floppy) as Dominant.
3. Let the simulation run for three more generations to generation 5. Hit the pause button (lower right) just after the generation counter dial passes "5". Slide the data probe to Generation 5. Record in Data Table 3.
4. Environmental Factors: Add "Wolves" as an Environmental Factor and start the simulation. Hit the pause button (lower right) just after the generation counter dial passes "8" (before the wolves come again!). Slide the data probe to Generation 8. Record in Data Table 3.
6. Run the simulation for 2 more generations. Hit the pause button (lower right) just after the generation counter dial passes "10" (before the wolves come again!). Slide the data probe to Generation 10. Record in Data Table 3.

Data and Analysis: Data Table 3

Generation Number	Data			Proportions (% Calculation)	
	Number of Straight Ears	Number of Floppy Ears	Total	% Straight Ear Rabbits	% Floppy Ear Rabbits
2		0		100	0
Add Mutation: Ears (floppy): Dominant					
5					
Add Environmental Factor: Wolves					
8					
10					

Analysis for Experiment #3

1. Were floppy ears an advantage or disadvantage when avoiding wolf predation?
2. Were straight ears an advantage or disadvantage when avoiding wolf predation?
3. Does the data in the table above support the hypothesis for this experiment? Use your data to explain how the data does or does not support your hypothesis.