

**Chapter 16 Evolution of Populations**

# Modeling Natural Selection

## Introduction

In the process of natural selection, organisms that are better adapted to their environment than other members of their species reproduce more successfully. This difference in reproduction causes evolution—that is, a gradual change in the genes of a population. In this investigation, you will examine how natural selection results in evolution in a small population of animals.

## Problem

How does natural selection bring about a change in the genetic makeup of a population?

## Pre-Lab Discussion

Read the entire investigation. Then, work with a partner to answer the following questions.

1. What advantage does a white mouse have over a brown one in this sand dune environment?

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2. Is chance a factor in determining whether or not a brown mouse survives? Explain your answer.

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3. Do you expect the proportion of brown mice to white mice to increase from one generation to the next? Explain your answer.

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4. In this experimental model, two variables interact to influence the responding variable. What are these two independent variables?

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5. What is the responding variable?

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## Materials (per group)

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|--------------------------|-----------------------|
| scissors                 | white crayon or chalk |
| metric ruler             | marking pen           |
| black construction paper | 25 index cards        |


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## Safety

Be careful when handling sharp instruments. Note the safety alert symbol next to step 1 in the Procedure and review the meaning of the symbol by referring to Safety Symbols on page 8.

## Procedure

### Part A. Building the Model

-  1. Cut out 50 6-cm-square cards from the black construction paper.  
**CAUTION:** *Be careful when handling the scissors. Point the blades away from you when you cut.*
2. Using the white crayon or chalk, mark 25 of the black cards on one side with a capital "W." These cards will represent the allele that encodes white fur, which is dominant.
3. Mark the other 25 black cards on one side with a lowercase "w." These cards will represent the allele that encodes brown fur, which is recessive.
4. Mark 15 of the index cards on one side with an "X." These cards will represent predators. Leave the rest of the index cards blank.
5. Shuffle the black cards so that the W cards and the w cards are mixed together at random. Then place the stack of black cards face down on a desk or table.
6. Shuffle the index cards so that the predator cards and the blank cards are mixed together. Then place the stack of index cards face down next to the black cards.

### Part B. Using the Model

1. Draw the two top cards from the stack of black cards. If the two cards together read WW or Ww, you have a white mouse. If they read ww, you have a brown mouse. Record the type of mouse you have by making a tally mark in the appropriate column next to Generation 1 in the Data Table.

Data Table

Generation	White Mice	Brown Mice	Live	Die
1				
2				
3				
4				

2. Draw the top card from the stack of index cards. The mice must survive in a white sandy desert. If you choose a card with an X and you have a brown mouse, the mouse will be caught and eaten by the predator. If you choose a card with an X and you have a white mouse, the mouse will escape the predator by hiding in the white sand and live. If you choose a blank card, there is no predator and either color mouse will live.

3. Record the fate of your mouse by making a tally mark in the appropriate column of the Data Table. If your mouse survived, return the gene cards to the bottom of the stack of black cards. If your mouse died, set aside the gene cards. Then return the index card to the bottom of the stack.

4. Repeat steps 1–3 until you have selected all 25 pairs of cards. This completes the first generation of mice.

5. Count the number of black cards in the stack. On the line below, record the number of allele pairs remaining. (This is the total number of black cards divided by 2.)

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6. Repeat steps 1–3 as many times as you have allele pairs remaining. Record your results in the Data Table next to Generation 2.

7. Count the number of black cards. On the line below, record the number of allele pairs remaining.

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8. Repeat step 6, but this time record your results next to Generation 3 in the Data Table.

9. Count the number of black cards. On the line below, record the number of allele pairs remaining.

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10. Repeat step 6, but this time record your results next to Generation 4 in the Data Table.

## Analysis and Conclusions

1. **Analyzing Data** How many brown mice were produced in the first generation?

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2. **Comparing and Contrasting** How did the proportion of brown mice produced in the third and fourth generations compare to the proportion produced in the first generation?

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3. **Evaluating** Which allele, W or w, was removed from the gene pool by predation?

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4. **Using Models** Does this model illustrate the concept of evolution by natural selection? Explain your answer.

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5. **Predicting** If the main predator of mice in this white-sand desert were an animal that hunted by smell rather than sight, would you expect the same results as this model produced? Explain your reason.

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### Going Further

In this experimental model, the total number of mice decreases each generation. Do you think this represents what would occur in a real situation? In a brief paragraph, explain how you could change the model to make it more realistic.