NATURAL SELECTION

Is everyone you know exactly the same? Or are some taller or shorter than others? Do some have darker skin? Are some heavier? Do their differences make them better at some things, but not well-suited for others?

Goal

To demonstrate that natural selection results in populations different from the original.

Activity Time

50 minutes

Time to Get Ready

15 minutes

What You Need

Have the following for each team of 4:

5 cups of various sizes of beans or different colored beads
1 pencil
5 wooden dowels with assorted diameters
2 pieces of paper
2 Styrofoam™ bowls

Getting Ready

- Lentils, pinto beans, kidney beans, navy beans, red beans, black beans, great northern beans, split-green peas, and black-eyed peas work well for this activity. Dry, multi-bean soup mixes also can be used.
- Lima and garbanzo beans are not advised. They tend to clog the holes in the bowl.
- Use the largest Styrofoam™ bowls available. Meat trays may be used in their place.
- Combine the packages of beans and distribute the mixed samples to each group of participants.

Useful Information

If you look at the people around you, are they all the same? What would happen if we lived in a world where all the food was kept 8 feet off the ground and there was absolutely no way you could get it if you weren't tall enough? Most likely, the short people would die off. The taller ones would multiply. And before long, instead of a population of people of all sizes, you would have a population of only tall people. Living things that are best-suited, or adapted, to their environment survive and multiply. Those that are not don't survive. This process is known as natural selection. Within a population of microbes, many environmental factors such as temperature, pH, nutrients, light, magnetism, radiation, and chemical agents can cause some individuals to die. Those that survive go on to produce hardier future generations. Those factors that determine which microbes survive or which do not are called "selective pressures."

Suggestions to Modify the Activity for Those Who Are Exceptional

Specific modifications for this activity are found here. For common considerations when modifying activities for exceptional participants, see page V of the **Introduction**.

Blind or Visually Impaired

- Allow for participants to touch the various beans for size and shape. This provides a better understanding of the variable and allows for independent counting.
- Emphasize class and group discussions. The cause and effect presented in this activity will enable the participant to grasp the concept easily. References to how natural selection affects us daily will strengthen the concept.
- Use the beans to your advantage. They can be used to create the chart and the graphs. For the chart, use a heavy piece of cardboard and create a graph outline using yarn. The beans could then be glued in the correct group amounts to the chart. The graphs could be created a similar way, however a bar graph will be more feasible.
- Construct bar graphs outlining the bars with heavy string. Fill the bars in with beans.

Deaf or Hard-of-Hearing

- See the ***General Modifications*** for *Blind or Visually Impaired* listed in the **Introduction**, page V.

Mobility Impaired

- See the ***General Modifications*** for *Mobility Impaired* listed in the **Introduction**, page V.

Physically Impaired

- See the ***General Modifications*** for *Physically Impaired* listed in the **Introduction**, page V.

Cognitively Impaired

- See the ***General Modifications*** for *Cognitively Impaired* listed in the **Introduction**, page V.

For More Information

Fiero, B. & Mackie, S. (1997). A natural selection lab for environmental biology. *The American Biology Teacher, 59*(6), 354-359.

Maret, T.J. & Rissing, S.W. (1998). Exploring genetic drift & natural selection through a simulation activity. *The American Biology Teacher, 60*(9), 681-683.

McCarty, R.V. & Marek, E.A. (1997). Natural selection in a petri dish. *The Science Teacher, 64*(8), 36-39.

Nolan, M.J. & Ostrovsky, D.S. (1996). A gambler's model of natural selection. *The American Biology Teacher, 58*(5), 300-302.

Yoon, C.K. (1998). In growth of body parts, Darwinian competition. *The New York Times, CXLVII*(51,148).

Yoon, C.K. (1996). Parallel plots in classic of evolution. *The New York Times, CXLVI*(50,609).

How to Start the Activity

- Provide the participants with a mixture of beans and a Styrofoam™ bowl. Have them punch a hole in the bottom of the bowl with their pencil. Instruct them to place beans in the bowl and shake. Which ones pass through the hole? Why? Why don't the others?
- What if the beans were a population of microbes and only the types that stay in the bowl survive to reproduce? Would the next generation look like the one in the bowl?
- Help participants make a table of generations as described in Step 4 of **What to Do** on the **Participant Page**.

Let's Make a Hypothesis

Discuss the following questions to help guide the participants to make hypotheses.

- What if the hole was larger than each bean?
- What if the hole was smaller than each bean?
- Which bean population will increase most significantly? Why?
- What changes might occur in microbes that would cause selective pressure?

What the Data Mean

Table 1. Generation Totals

	Generation	1	1	2	2	3	3	4	4	5	5
Bean-Rice Mixture	Starting Number	Number left	Doubled	Number left	Doubled	Number left	Doubled	Number left	Doubled	Number left	Doubled
Lentil	5	2	4	4	8	2	4	1	2	2	4
Split-green pea	5	3	6	4	8	6	12	10	20	11	22
Rice	5	2	4	2	4	2	4	1	2	0	0
Pinto	5	5	10	10	20	20	40	40	80	80	160

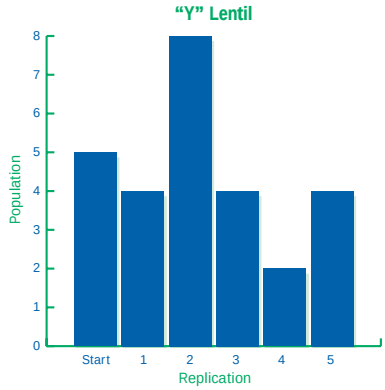

Figure 1. Graph of lentil replication.

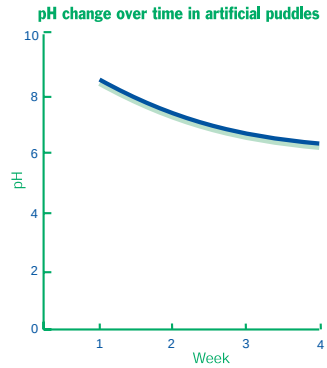

Figure 2. Graph of split-green pea replication.

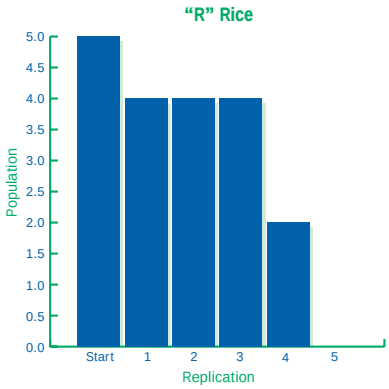

Figure 3. Graph of rice replication.

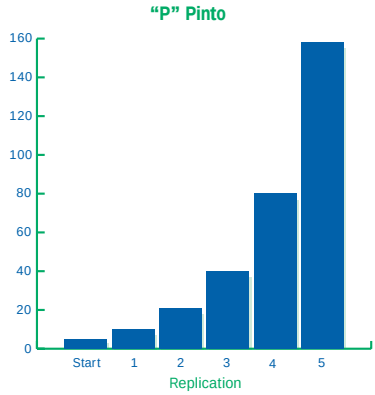

Figure 4. Graph of pinto bean replication.

NATURAL SELECTION

PARTICIPANT

Questions to Think About

Look at the people around you. Are they all the same? Or are some taller or shorter than others? Do some have darker skin? Are some heavier? Do their differences make them better at some things, but not well suited for others? What would happen if we lived in a world where all the food was kept 8 feet off the ground and there was absolutely no way you could get it if you weren't tall enough?

Safety Notes

- Exercise care with a pencil when punching holes in the Styrofoam™.

What to Do

1. Use your pencil or 1 of the different-sized dowels to punch 6 different-sized holes in the bottom of your unused bowl. A living population of microbes would include millions, billions, or even more individuals, but you will work with much smaller numbers. To create the initial "microbe" population, select 5 beans of each type. Place this population of 25 in the bowl.

2. Shake the bowl 15 times and note which beans fall through the holes as shown in Figure 1. You will probably get the best results if you shake the bowl from side to side similar to the motion you use just before you throw dice. A group recorder must keep accurate records of the numbers that fall as well as those remaining. The ones that fall through the holes are considered dead. The ones in the bowl are considered the first generation and will be used to represent the "parents" for the next generation. Only "microbes" that survive reproduce. So, for each of the beans that remain in the bowl, add another one of the same type to indicate that the "microbe" reproduced. Look at the beans/microbes that fell out of the bowl. Did all types fall out in the same numbers? Look at your new population in the bowl. Does it resemble your original or are the proportions different?

3. Repeat the same procedure with the population from the first generation. Shake the bowl 15 times. Count and record the number of beans both in the bowl and those falling through the holes. Again duplicate the beans remaining in the bowl. Look at the new population in the bowl. Is it changing? How? After 5 generations, analyze the data. Graph the results.

4. Compare the numbers of each type of bean in each generation to see if there are changes in the proportions. Organize this information in a table. List the types of beans in the first column. Put their starting numbers in the second column. In the third column, write the numbers of each type of bean left after shaking. Multiply the numbers by 2 and write the quantities in the next column. Continue the table for each generation. Create graphs to show your results. Once the graphs have been completed, predict the numbers in the next 2 generations if the same trends occur.

What Did You Find Out By Doing the Activity?

Before doing "Natural Selection," did you know:

- some factors that determine if an organism can live in an environment?
- what could lead to the extinction of a group of organisms?
- how organisms adapt to new environments?

From this activity, did you discover:

- why organisms evolve over time?
- how natural selection works in a population of microbes?
- what factors determine your own survival in your everyday life?
- some factors that make you different from your parents and how to explain that difference?

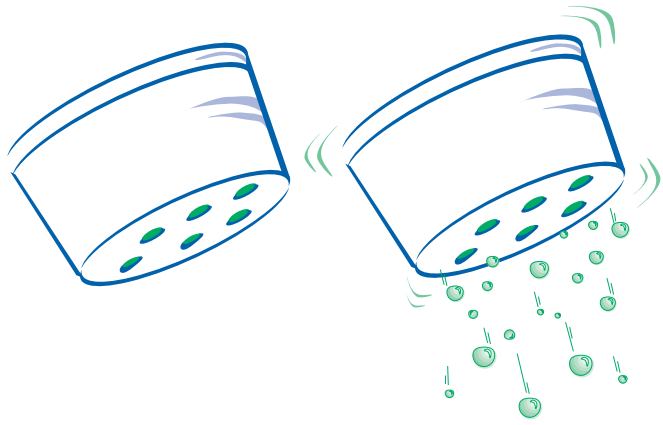

Figure 1. Shaking the bowl of beans.