Microevolution in a Population

Introduction

The pan of beans is the habitat. The beads are prey. One of you is the predator. The predator will capture and remove prey from the habitat. The predator captures and removes prey according to his or her sensory capabilities and prey preference.

Instructions for Activity

1. Put 10 red, 10 off-white, and 20 pink beads in the pan of white beans. Stir well.
2. Round 1: (Generation 1) One "predator" pulls out as many beads as possible in **10 sec**.
   - Count number of each bead type "eaten" and enter count in the table below.
   - Survivors = Start – Eaten
   - Allow each survivor to have 1 offspring (ex: 8 survivors produce 8 offspring). Add beads representing offspring into the pan (habitat).
   - Survivors + Offspring = Start for Round 2.
   - Stir well.
3. Round 2: (Generation 2) The predator pulls out as many beads as possible in 10 sec.
   - Repeat counting, calculations, and addition of offspring as above.
4. Round 3: (Generation 3) The predator pulls out as many beads as possible in 10 sec.
   - Repeat counting, calculations, and addition of offspring as above.
5. Round 4: (Generation 4) The predator pulls out as many beads as possible in 10 sec.
   - Repeat counting, calculations, and addition of offspring as above.

Phenotype Frequencies over Several Generations

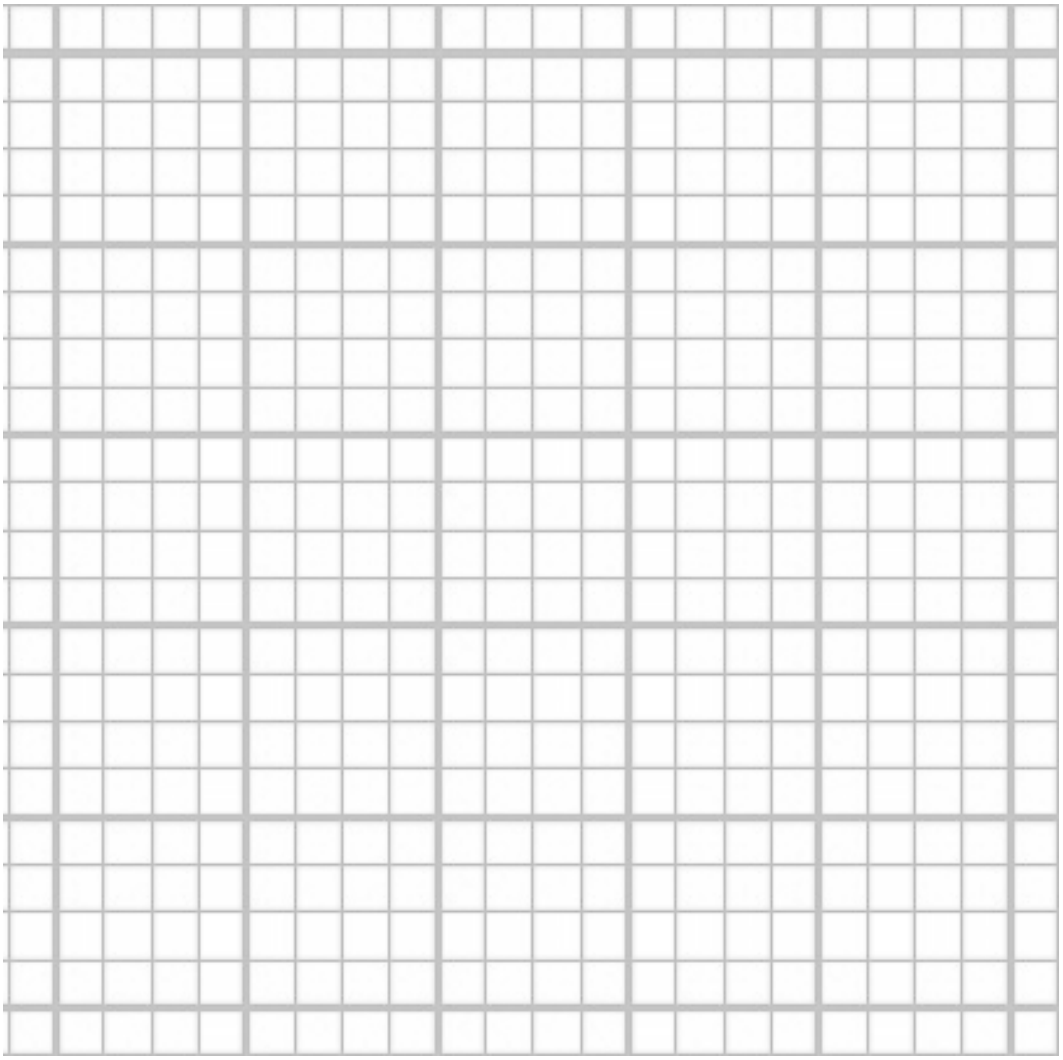
		Phenotype		
		Red	Pink	White
Round 1	Start	10	20	10
	Eaten			
	Survivors			
	Offspring			
Round 2	Start			
	Eaten			
	Survivors			
	Offspring			
Round 3	Start			
	Eaten			
	Survivors			
	Offspring			
Round 4	Start			
	Eaten			

	Survivors			

1. Calculate the **proportion** of each phenotype at the start (Round 1) and the proportion of each phenotype of survivors of round 4.

		Phenotype		
		Red	Pink	White
Round 1	Start			
Round 4	Sruvivors			

2. Graph the starting proportions of each phenotype in your group's population and the proportion of each phenotype after 4 rounds of predation (= generations) have occurred in your population. Label x and y axes and provide a legend.



3. Is the proportion of phenotypes in the population different after 4 generations than it was at the start?

4. In this example, what is the selection pressure?

5. Which type of selection occurred in your population?

6. Enter data on the count (numbers) for each phenotype after 4 generations in each population in your recitation section. (Each pan represents a habitat & a population). Enter the number of each phenotype and calculate the proportion of each phenotype within each population.

Population	After 4 Generations	Red	Pink	White	Total
A	count				
	proportion				
B	count				
	proportion				
C	count				
	proportion				
D	count				
	proportion				
E	count				
	proportion				
F	count				
	proportion				
G	count				
	proportion				
H	count				
	proportion				

7. Is the most common phenotype the same in all populations after 4 generations? If so, what is it?

8. If the most common phenotype is different between populations, group populations by most common phenotype after 4 generations. Give a name to each group and list the populations in it.

9. Formulate a hypothesis about selection pressure experienced by each population group.

Teaching Tips for Peer Mentors

- Students should work in groups of 2 – 4. Each group needs a pan of beans and approximately 50 beads of each color. Each group must designate a predator, a time keeper, a scribe to write down the data in the table, and a bead counter to add the right number of offspring to the pan to begin the next round. Jobs can be combined if the group is smaller than 4.
- The predator can capture prey however he/she chooses – eyes open, eyes closed. It's their choice but they must use the same approach for every round.
- The predator must adhere strictly to the "start" and "stop" commands of the time keeper.
- Graphing. Don't tell students what to put on the x and y axes. Encourage them to make an attempt, then guide them if they ask questions. Each student should make a graph.
  - Make sure students are graphing the proportion of each phenotype, **not** the count.
  - Students may use a bar graph or plot points. Make sure the x-axis is phenotype (a category axis) and the y-axis is proportion with a maximum of 1.0 or 100% however they choose to represent it.
- Questions 3 – 5 apply to each group's population (1 population).
- Question 6. Comparing all populations in the recitation section. Have each group write their Round 4 survivor count and proportion numbers on the board (the letters are designations of different groups/populations).
- Question 7-9. Using the data in the table of all populations, each group should discuss answers to questions 7 – 9. Question 9 is asking students to make a specific hypothesis about the predator, whether it had a strong preference for a particular color or not.
- Make sure students clean up any beads or beans they drop on the floor or scatter on the tables. Beads and beans will be re-used, so don't have them throw away their spills.

IMPORTANT NOTE:
Selection may differ among groups, depending on predator preferences. There is no predetermined correct answer for whether a population will show directional, stabilizing, or disruptive selection. Some predators will preferentially eat high-contrast beads, so the frequency of red will decrease in the population, resulting in directional selection. Some predators actively search for pink beads, in which case, the frequency of pink will decrease while the frequency of both red and white will increase, resulting in disruptive selection.

For question 8, students should only group together populations that have the same color (or colors) of bead at highest frequency, ie, only group populations with high frequency white & red with other populations that experienced the same type of selection.

Notes to Faculty

Supplies: Aluminum foil cake pans 9" diameter, beans, 3 colors of plastic beads.
Cover the bottom of the pan with a 1 cm layer of beans. Provide approximately 50 beads of each color per group of students. Be sure to have extra beads of each color

In order to have strong selection pressure, one color of bead must be well-camouflaged in the beans. Plastic beads come with several finishes: iridescent, translucent, and opaque. Opaque beads will be camouflaged better in the beans than iridescent or translucent beads. All colors should have the same type of finish or selection pressure may be weaker or stronger than expected. One color should be well-camouflaged in the beans, one color should contrast well with the beans, and the third color should be intermediate. Example: Cream-colored opaque beads are

camouflaged well in white beans, pink opaque beads are less well camouflaged and red beads contrast sharply. (Note: white plastic beads contrast too starkly with white beans.)