

The Chips are down: Natural Selection by Predators on Prey

The process of natural selection occurs because organisms vary in their heritable characteristics, and because some variants survive and reproduce better than others. As a result, the genetic structure of a population changes through time, which is a factor in evolution. Although evolution may be defined in terms of genetic change, natural selection occurs by the interaction of the environment and whole organisms.

This inquiry uses a model to see how competition between members of a species (The Chips) to avoid predation, leads to change in that species over time. We also model the role of predation as the environmental selection pressure.

In this model you will be the predator species. We will use pieces of paper to represent a single prey species (the "Chips"). The Chips come in different colors to represent natural variation in the prey species. (Think of dogs. They all belong to the same species, but may look very different, e.g., a Chihuahua vs. a Great Dane.) We will be looking at the effect of the variants' ability to avoid predation on their survival and reproduction rates.

Materials

One big sheet of newspaper with small printing (the classified pages are the best). This represents the environment that the Chips "live" in.

An envelope containing the Chips – 1-cm square bits of paper:

50 white, 50 pink, 50 from newsprint pages.

1. Write a hypothesis about the relationship between the how well camouflaged Chips are and how well they will survive to reproduce.
2. Consider your hypothesis, if it is correct, predict what you expect to happen to the number of "newsprint" Chips by the end of the fourth generation?

The number of "pink" Chips?

The number of "white" Chips.

Work in Groups:

Work in groups of four.

One member of the group will be the "Keeper" who will set up the playing board each time.

The other three members of the group will be Predators. They remove 5 Chips before the Chips have a chance to reproduce.

All four members of the team collect and analyze the data.

How to Play

1. Lay out the big piece of newspaper on the desk.
2. Sort the Chips into piles by color, with at least 50 in each pile. Each Chip represents an individual.
3. The Keeper begins by taking 10 of each type of Chip, for a total of 30.
4. The Predators cover their eyes or turn away *until it is their individual turn*.
5. The Keeper spreads the Chips out on the environment, mixing the colors well and spreading out the Chips
6. The first Predator may look at the board and as quickly as possible, remove 5 Chips.
7. The next Predator may now look at the board and remove 5 Chips as quickly as possible.
8. The last Predator may look at the board and remove 5 Chips as quickly as possible.
9. These 15 Chips are dead.
10. Now shake the remaining Chips off the environment and count these survivors according to their type.
11. Record the number of surviving Chips in the table.
12. Each of these survivors reproduces one more Chip in their same color to make a population total of 30.
13. Record the total number of each color of Chip as the next round begins (after reproduction).
14. Play this game (from step 4-13) for a total of four rounds, recording your data each time.

Table 1: Effect of Natural Selection on Different Varieties of Chips (Individual group)

Generation		Paper Chip Variants		
		Newsprint	White	Pink
1	Starting No. (after 0 th reproduction)	10	10	10
	# left after 1 st predation			
2	# after 1 st reproduction			
	# left after 2 nd predation			
3	# after 2 nd reproduction			
	# left after 3 rd predation			
4	# after 3 rd reproduction			
	# left after 4 th predation			
Final	# after 4 th reproduction			

Table 2: CLASS DATA Effect of Natural Selection on Different Varieties of Chips

Generation		Paper Chip Variants		
		Newsprint	White	Pink
1	Starting No. (after 0 th reproduction)	10	10	10
	# left after 1 st predation			
2	# after 1 st reproduction			
	# left after 2 nd predation			
3	# after 2 nd reproduction			
	# left after 3 rd predation			
4	# after 3 rd reproduction			
	# left after 4 th predation			
Final	# after 4 th reproduction			

- Examine the data in Table 1. Does any Chip variant have more survivors than the others? Which?
- Does your individual data agree with the class data? Similar or different? Why?
- Does it take Predators a longer or shorter period of time to find one prey individual as they proceed through the generations? Give an explanation for this.
- Were your hypothesis in Question 1 and your predictions in Question 2 supported?
- If they were not supported, revise them here:

Using Class Data in Table 2, Please calculate the % change over the four generations, as follows

$$\left(\frac{\text{number after the fourth reproduction}}{\text{the number you started with in generation 1}} \right) \times 100\%$$

Data Table 3: Percent Change in Chip Varieties After Four Generations, based on class data

	<i>% of each Chip Variant Remaining</i>		
	<i>Newsprint</i>	<i>White</i>	<i>Pink</i>
Overall Change			

8. Based on Data Table 3, which of the Chip variants was the best competitor (least affected by natural selection) in this habitat? Why?
9. What do you suppose will happen to the Predator species over time if the Chips become well camouflaged? (Now think about the Predator as being affected by natural selection).