Stick Bug Survival **Name:** _____

Introduction: Predator/prey relationships can influence the nature and size of a population over time. Organisms that are killed before they reproduce do not contribute genes to the next generation! What can killing of selected individuals from a population do to the makeup of that population over time? How do populations change over time?

Concepts:	Carrying capacity	Predator/prey	Gene pool
	Population size	Natural selection	Camouflage

Background: A species is a group of similar organisms capable of reproducing and producing viable offspring of their kind. Those individuals that are involved in the production of offspring have their unique genetic material passed on to the next generation. Those individuals that are unsuccessful at reproducing do not pass their genetic traits to the next generation and their unique set of genes dies with them. All of the collective genes of a given population are referred to as the population's ***gene pool.*** Since there is usually an uneven rate of reproduction among individuals in a population, the nature of the gene pool tends to vary from one generation to the next. If conditions during a given time period are detrimental to certain types of individuals and if the conditions affect the ability of the individuals to reproduce, then the gene pool of the population will be altered and changed over time. If "selection" for or against certain individuals affects their ability to reproduce offspring, it is referred to as ***natural selection.*** Biologists study populations and gene pools over time and study the trends in the makeup of populations resulting from natural selection.

This simulation activity will illustrate population changes resulting from selection pressures. Several generations of stick bugs will be tracked as they are being preyed upon by their enemy --- "forcep birds". After each generation, the individuals that have not been eaten will be allowed to reproduce in proportion to their group survival rate. The total number of individuals of a species that can be sustained indefinitely in a given area is called its *carrying capacity.* It will be shown that even if the total stick bug population is maintained at the carrying capacity, the genetic makeup of the population will change over time.

There are four color variations of stick bugs in the simulated population – red, yellow, green, and tan. Stick bugs live in a forest of wooden sticks which affords them good camouflage and hiding places. The forceps birds (predator of stick bugs) have their favorite color stick bugs and search for their favorite color stick when they are feeding. In the simulation there will be periods of eating and capturing stick bugs, followed by a recovery and reproductive period. The nature of the total stick bug population will be tracked for several generations.

After each predator attack, the number of stick bugs of each color will be counted and then allowed to reproduce in proportion to the number that survived. The following formulas will be used to calculate the number of new stick bugs of each color that will be added to the forest. The letter abbreviations are used on the Stick Bug Worksheet.

(1) $A = \frac{B}{C}$ where

A = **Ratio** of the individuals of each color that will reproduce for the next generation

B = **Number** of individuals (specific color) that survived. Count the number of individuals eaten (X). Subtract X from the initial number (Y). Then **B = Y – X.**

C = **Total** number of individuals (all colors) that survived.

(2) D = A(100-C) where D = Actual number of a specific color to add to the forest for the next generation.

(3) The new number of individuals of each color is the number where **H = B + D.**

(4) E = 100 where E = Total starting population for each generation (carrying capacity).

Materials:

Forest Box	Toothpicks, wooden, flat: box 750	Toothpicks, plastic: Red	50 - 75
		Green	50 – 75
4 Forceps	Toothpicks, wooden, round ends: 50 – 75	Yellow	50 – 75

Procedure:

1. Organize into working teams of four. Assign an initial stick bug color to each team member (yellow, red, green, tan).

2. Place one box of flat wooden toothpicks into the forest box. These flat toothpicks represent the background environment typical of the home of the stick bugs. Place the forest box on the table in front of your team.
3. Carefully count 25 toothpicks of your assigned color and place them in the forest box. (*Note:* The tan stick bugs are different than the forest background – they are round and have pointed tips.)

4. Locate a forceps for each team member. Your teacher will instruct you when to do the following:
   a) Shake the forest box without looking into the box.
   b) Set the box where it can be reached equally by all team members (forceps birds).
   c) Start to feed on your color of stick bug.
   d) Stop feeding on the stick bugs.

5. Feeding Rules:
   a) Start and stop precisely when the stop and start signals are given.
   b) Only the forceps can be used to pick up and remove the stick bugs from the forest.
   c) Only one stick bug can be removed at a time.
   d) Stick bugs must be removed from the forest and placed on the table in front of you.
   Warning: Be careful during the feeding activity – the toothpicks and forceps are sharp.

6. Count the number of each color of stick bug that was eaten during the specified feeding time (X). Record the number of survivors of each color (Y – X). (Subtract the number eaten from the 25 original bugs). Calculate the ratio of reproduction (A) and the number of individuals of each color that should be added for the next generation (H). Record all of these calculations on the chart for the first generation on the Stick Bug Worksheet.

7. Count out the number of each offspring of each color needed to bring the population to 100 (carrying capacity) for the next generation. Add these newly reproduced individuals to the forest box.

8. Each team member should select a different color stick bug for the next generation feeding.

9. Repeat 4 – 8 for the next generation at the direction of your instructor.

10. When data and calculations for all the studied generations have been recorded, answer the following questions.

Please do not dispose of any of the materials!!

Name: _____

Analysis:

1. ***Make a Graph: Generation vs Stick Bug Population***
   a) Use one graph for all 4 types of stick bugs. Provide a key for each stick bug type.

2. *Prediction:* What do you think the killing of selected individuals from a population will do to the makeup of that population over time?

3. Define the following:
   a) Gene pool-

   b) Natural selection-

   c) Carrying capacity-

4. Did the population of stick bugs change through the generations? How?

5. Think about a real forest – what factors might cause a specific color of stick bugs to disappear? Is this likely to occur?

6. What would happen if all of the red stick bug predators became extinct? What would likely happen to the stick bug population? How might this affect the tan stick bugs?

7. What happened to the gene pool of the stick bugs over the generations studied?

Stick Bug Data Charts

Starting Population	Tan	Yellow	Red	Green	Total
H	25	25	25	25	(E) 100

Generation One	Tan	Yellow	Red	Green	Total
B					(C)
A					
D					
H					(E) 100

Generation Two	Tan	Yellow	Red	Green	Total
B					(C)
A					
D					
H					(E) 100

Generation Three	Tan	Yellow	Red	Green	Total
B					(C)
A					
D					
H					(E) 100

Generation Four	Tan	Yellow	Red	Green	Total
B					(C)
A					
D					
H					(E) 100