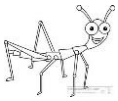
Name: _____



Mechanisms of Evolution

In these activities, you will investigate the mechanisms of evolution, which are the processes that lead to genetic change in populations. You will model natural selection, gene flow, and genetic drift. Then you will be able to compare and analyze the effect of each of these mechanisms on the populations.

Activity One: Evolution via Natural Selection

In this simulation, you will model the effect of a predator (you) on the evolution of an insect population (toothpicks). This species of insect varies in color: red, blue, green, yellow, and tan. You will "eat" insects in two different habitats and compare changes that occur in the frequency of the colors in the populations. Work in partners and decide who Partner A is and who Partner B is before beginning.

<u>You should begin with:</u>
-Plastic bag: the "stomach"
-8 toothpicks of each color (40 total): the "insects"

1) Find an area outside that's about 10ft x 10ft away from other groups. It should be grass, dirt, or leafy.
2) Partner A randomly scatters all 40 of the toothpicks around the area without Partner B looking.
3) Partner B is the first predator, so they collect the first 20 toothpicks they see and places them in the plastic bag. Look away from the ground after each toothpick is picked up. Partner A should help count the toothpicks to make sure exactly 20 are collected.
4) Count how many toothpicks of each color were collected and record it in your data table. Calculate how many toothpicks of each color are remaining in the habitat.
5) The insects reproduce! Each surviving insect in the habitat will produce one offspring. For each toothpick that is remaining in the habitat, add one new toothpick of the same color to the habitat. Partner B should scatter the offspring into the habitat while Partner A isn't looking. Record this in your data table. (Example: If 5 blue toothpicks remain, add 5 new blue toothpicks, and record 10 total remaining after reproduction)
6) Partner A is now the predator for the next generation. Collect exactly 20 toothpicks from the habitat while Partner B helps count.
7) Repeat steps 4 and 5 in which you record data and add offspring to the habitat.

Name: _____

8) Partner B is now the predator again for the last generation. Collect 20 toothpicks and record the data.
9) Do not put anymore toothpicks into the habitat. Clean up the toothpicks still remaining the habitat and return them to containers.

Generation 1

COLOR	# IN HABITAT	# COLLECTED	# REMAINING	TOTAL # REMAINING AFTER REPRODUCTION
Red	8	3	5	10
Yellow	8	5	3	6
Blue	8	4	4	8
Green	8	5	3	6
Tan	8	3	5	10
TOTAL	40	20	20	40

Generation 2

COLOR	# IN HABITAT	# COLLECTED	# REMAINING	TOTAL # REMAINING AFTER REPRODUCTION
Red	10	7	3	6
Yellow	6	4	2	4
Blue	8	2	6	12
Green	6	5	1	2
Tan	10	2	8	16
TOTAL	40	20	20	40

Name: _____

Generation 3

COLOR	# IN HABITAT	# COLLECTED	# REMAINING	TOTAL # REMAINING AFTER REPRODUCTION
Red	6	4	2	4
Yellow	4	2	2	4
Blue	12	8	4	8
Green	2	2	0	0
Tan	16	4	12	24
TOTAL	40	20	20	40

Does your data suggest that a certain color of toothpick has a survival advantage?

Why might some colors/phenotypes survive better than others in this habitat?

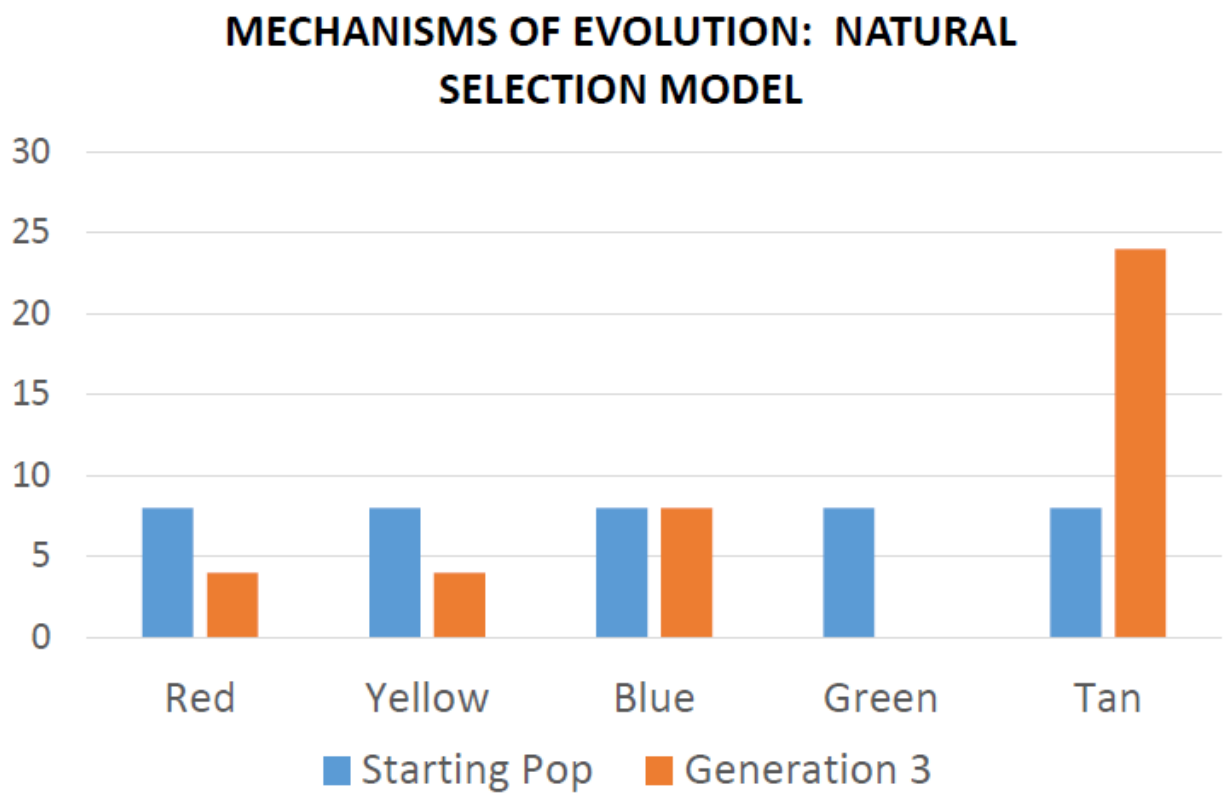
How might the results be different if this activity was performed on a red surface?

Describe a real example of this mechanism of evolution.

The fastest rabbit eludes the fox and passes on the fastness genes to offspring.

How does this process lead to changes in gene frequencies in the population after the mechanism occurs?

Name: _____



Activity Two: Evolution via Genetic Drift

<u>You should begin with:</u>
-8 toothpicks of each color (40 total): the "insects"
-Plastic bag: the "environment"

1) Place all toothpicks in the plastic bag.
2) Disaster strikes the habitat! An event such as a fire, flood, or meteor strike causes half of the population to die. Partner A closes their eyes and removes 20 toothpicks from the bag at random. Partner B should help count.
3) The remaining toothpicks will reproduce similarly to the natural selection activity. Add one new toothpick of the same color to the bag for each toothpick remaining in the bag after the disaster. Record in your data table.
4) Reset the experiment and run 2 more trials. This means you should begin again with 8 toothpicks of each color and perform 3 separate trials total.

Name: _____

Trial 1

COLOR	STARTING POPULATION	# AFTER EVENT	# AFTER REPRODUCTION
Red	**8**	**6**	**12**
Yellow	**8**	**3**	**6**
Blue	**8**	**5**	**10**
Green	**8**	**3**	**6**
Tan	**8**	**3**	**6**
TOTAL	**40**	**20**	**40**

Trial 2

COLOR	STARTING POPULATION	# AFTER EVENT	# AFTER REPRODUCTION
Red	**8**	**3**	**6**
Yellow	**8**	**4**	**8**
Blue	**8**	**5**	**10**
Green	**8**	**3**	**6**
Tan	**8**	**5**	**10**
TOTAL	**40**	**20**	**40**

Trial 3

COLOR	STARTING POPULATION	# AFTER EVENT	# AFTER REPRODUCTION
Red	8	**5**	**10**
Yellow	8	**3**	**6**
Blue	8	**5**	**10**
Green	8	**5**	**10**
Tan	8	**2**	**4**
TOTAL	40	**20**	**40**

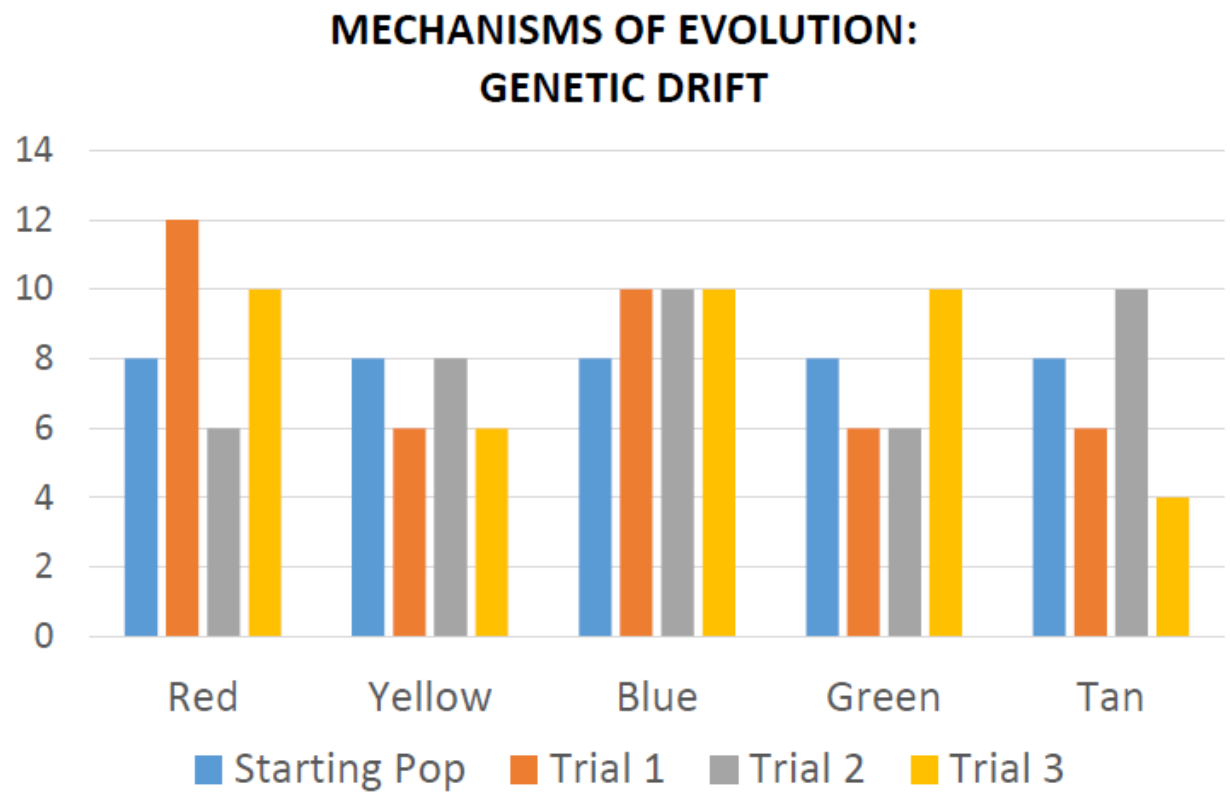
How many colors/phenotypes did you begin with, and how many were present at the end of the 5th generation?

Describe a real example of this mechanism of evolution.

Name: _____

Forest fire wipes out half the population of squirrels **randomly** killing a majority of the short eared members.

How does this process lead to changes in gene frequencies in the population after the mechanism occurs?



Activity Three: Evolution via Gene Flow

<u>You should begin with:</u>
-20 toothpicks each of 2 different colors (40 total): the “insects”
-Plastic bag: the “environment”

1) Record the number of toothpicks of each color in your data table.
2) Your population will exchange individual organisms with a different population. Partner B closes their eyes and removes 4 toothpicks from your bag at random. Give your 4 toothpicks to a different group and add the 4 toothpicks they gave you to your bag.
3) Count the number of each color toothpick you have in your bag and record your results.
4) Trade with 3 more groups, counting and recording your data at each generation. After you have exchanged toothpicks 4 times total, you should still have 40 toothpicks total.

Name: _____

COLOR	STARTING POPULATION	GENERATION 2	GENERATION 3	GENERATION 4	GENERATION 5
Red	**0**	**2**	**1**	**2**	**3**
Yellow	**20**	**17**	**14**	**13**	**11**
Blue	**20**	**19**	**21**	**19**	**21**
Green	**0**	**0**	**0**	**2**	**1**
Tan	**0**	**2**	**4**	**4**	**4**
TOTAL	40	40	40	40	40

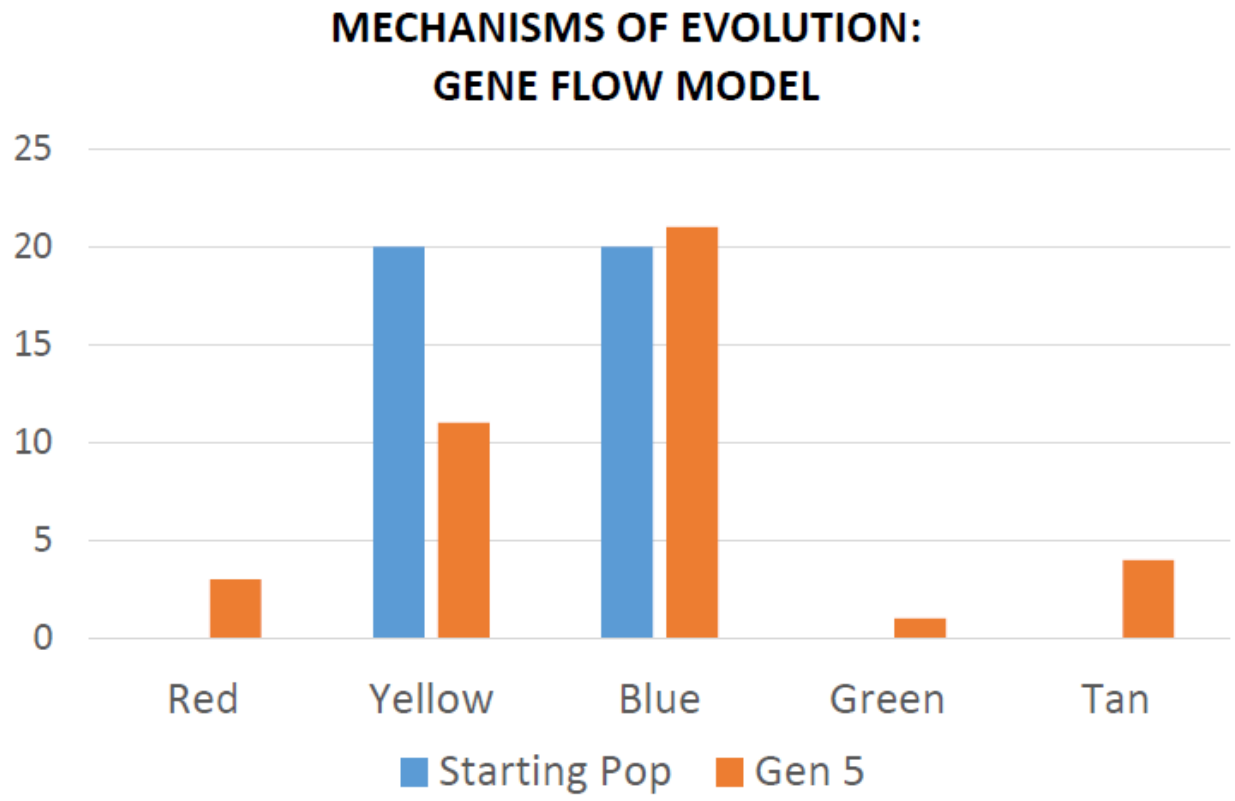
What happens to the amount of variation/diversity within a trial?

Is this mechanism based on an organism's fitness or is it random?
How might the end result be different if originally a) 10 individuals were removed? b) 30 individuals were removed?

Describe a real example of this mechanism of evolution.
Africanized honey bees interbreeding with European honey bees.

How does this process lead to changes in gene frequencies in the population after the mechanism occurs?

Name: _____


MECHANISMS OF EVOLUTION:
GENE FLOW MODEL
25
20
15
10
5
0
Red
Yellow
Blue
Green
Tan
Starting Pop
Gen 5