



Name \_\_\_\_\_ Date \_\_\_\_\_

## Ninja Sea Turtles Lab

*A simulation of population genetics*

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### I. Introduction

*Which type of population will survive better: a group that has a lot of similarities or a lot of differences?*

You will be acting as a sea turtle to create turtle populations over the course of 5 generations. This particular species of turtles lives among a cluster of islands. You will be swimming between the islands, meeting and producing offspring with other turtles. All of your turtle offspring will follow you in your travels.

Sea turtles can have hundreds of eggs, but only about one out of every hundred survives to adulthood. For this reason, your turtle will only make 1-3 offspring per mating. Turtles can live to be 150 years old, but often die before their maximum life span due to environmental changes or predation.

Small differences between turtles can make them more likely to survive or to die. The winner is the person with the largest turtle population in the class after 5 generations. Choose your turtle-mate carefully, because you don't want your population to die out!

### II. Pre-Lab

We are going to investigate four characteristics: color, size, webbed feet, and gender. In our simulation, each trait will be controlled by two alleles (or sex chromosomes, in the case of gender). Each allele is represented by one side of a popsicle stick.

Color will be determined by two alleles that show *complete* dominance. Dark color is dominant. Light color is recessive. Write the phenotypes for the following genotypes:

|    |    |    |
|----|----|----|
| DD | Dd | dd |
|    |    |    |

Size will be determined by two alleles that show *incomplete* dominance. "A" represents large size, and "a" represents small size. Write the phenotypes for the following genotypes:

|    |    |    |
|----|----|----|
| AA | Aa | aa |
|    |    |    |

Webbed feet will be determined by two alleles that show *complete* dominance. Webbed feet are recessive. Write the phenotypes for the following genotypes:

|    |    |    |
|----|----|----|
| FF | Ff | ff |
|----|----|----|

|  |  |  |
|--|--|--|
|  |  |  |
|--|--|--|

Gender is determined by two sex chromosomes. Write the gender for the following sex chromosome combinations:

|    |    |
|----|----|
| XX | XY |
|    |    |

### III. Materials

Multi-colored popsicle sticks (alleles)

Markers

Life Event and Mutation Cards

Blank Turtle Cards

Mainland Immigrant Turtle Cards

Islands

Offspring Dice and Life Event Dice

### IV. Procedure

1. Take a turtle card to represent their parental generation. Label the head with a P to represent the parental generation. All turtles in the parental generation are heterozygous for color, size, and webbed feet. You can choose if you want to start with a girl or boy turtle.
2. Fill out your turtle's genotype and phenotype on your turtle card.

*→ Is the parental population genetically diverse? Why/why not?*

3. Get your alleles ready based on your genotype. One side of a popsicle stick represents one allele. Use the following key to label your turtle's alleles and sex chromosomes on the appropriate color popsicle stick:

Color: \_\_\_\_\_ (color) popsicle stick

Size: \_\_\_\_\_ (color) popsicle stick

Feet: \_\_\_\_\_ (color) popsicle stick

Gender: \_\_\_\_\_ (color) popsicle stick

4. Now you are ready to mate! Swim to a nearby island and meet with a turtle there. There must be one female and one male at each island (no more than two turtles per island). Swim quickly - your turtle can die if it is underwater too long!
5. One player must roll the offspring dice to see how many offspring you are going to have together.
6. To reproduce:

- A. Each player should throw their allele sticks onto the “Mom” or “Dad” side of the island.
- B. The alleles facing up are what determine the genotype of your first offspring.
- *What percent of Mom’s DNA was given to the offspring? What percent of Dad’s DNA was given to the offspring?*
- *Were you able to choose which alleles to give to your offspring? How is this like real life?*
7. Each player needs to get a new turtle card and label the head F<sub>1</sub> to represent the first filial generation. (Each consecutive generation is labeled with increasing numbers: F<sub>2</sub>, F<sub>3</sub>, F<sub>4</sub>, and F<sub>5</sub>) Each player should record this offspring’s genotype on this new turtle card and determine the phenotype.
8. Repeat steps 6 and 7 for as many offspring as were determined by rolling the dice in step 5.
- *If you had more than one offspring – were your offspring the same or different? Why? (If you only had one offspring, write what you expect would happen.)*
9. A different player should roll the life event dice.
- If a life event is rolled, a card must be read and the event affects BOTH populations (you and your partner)
  - If any turtles die, you must put a big X across that turtle’s record card, but continue to keep the card as you play
  - If a mutation is rolled, the mutation affects ONE organism from the roller’s population (roller can choose which organism)
10. After the life event, you are ready to go to a new island and mate again. But you will now be taking the form of one of the offspring that was just created. Choose which of your turtles you would like to mate to perform the next (F<sub>2</sub> then F<sub>3</sub>, F<sub>4</sub>, F<sub>5</sub> generation) mating. **BEFORE YOU LEAVE YOUR ISLAND, get new allele sticks for your turtle and label them with your new turtle’s alleles!**
- *Why is it important to change out the alleles?*
11. Go to a new island with a new turtle and repeat this process until you have produced F<sub>5</sub> offspring.

12. If your population dies out before F<sub>4</sub> generation, get a mainland immigrant turtle from your teacher and try to rebuild a population.

## V. Analysis Questions

1. How many offspring did you end with?
2. For the populations that died out, do you think the genes of the last generation of turtles were similar or different?
3. Do you think the genes of the surviving populations were similar or different? Why?
4. If water levels increased, and the turtles could not swim from island to island, would that help or harm their populations? Why?
5. What do you think would have happened to the turtle population if everyone started their parental generation with homozygous dominant alleles? What would the F<sub>5</sub> generation offspring look like?
6. Can a population evolve (change) if its gene pool (all of the alleles in the population) stays the same? Explain.
7. What does a turtle's DNA (its alleles) have to do with its chances of survival?
8. Is there one genotype or phenotype that was better to have than another? Is it always better in every situation?
9. If you were to play the game again starting with ten turtles, would you want your turtles to be genetically similar or genetically different? Why?

10. How would the turtle population be different if humans protected the turtle's environment rather than harmed it? What are some specific things that humans could do?