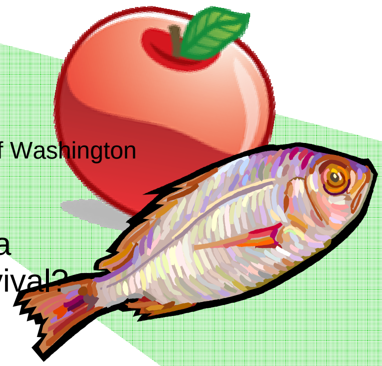
LS – Activity #44

Toothpick Fish

Adapted from materials created by the GENETICS Project, University of Washington



QUESTION: How are genetic traits passed on to offspring within a population and how do the inherited traits affect survival?

MATERIALS:

- green toothpicks - 8
- red toothpicks - 8
- plastic container
- yellow toothpicks - 8

The colored toothpicks represent three different forms of a gene (green, red, and yellow) that controls one fish trait: skin color. The table below tells you which forms (alleles) of the gene are dominant, which are recessive, and which are equal (or codominant).

The green gene (G) is	• dominant to all other genes
The red gene (R) is	• recessive to green • equal (co-dominant) to yellow*
The yellow gene (Y) is	• recessive to green • equal (co-dominant) to red*

* Combining red and yellow genes result in a fish with orange skin color.

PROCEDURE:

1. Place all 24 of your toothpicks (8 of each color) into the *gene pool* (the plastic container).
2. Figure out which gene combinations give rise to which fish colors and complete Table A in the Data section.
3. Make a ***first generation*** of fish. To do this, pull out genes (toothpicks) in pairs without looking, and set them aside carefully so they stay in pairs. Record the results of your 12 combinations in Table B.
4. Count the numbers of each color of fish offspring and record the number in table C where it says *first generation.*

The stream where the fish live is very green and lush with lots of vegetation and algae covering the streambed and banks. The green fish are very well camouflaged from predators in this environment and the red and orange fish fare well also. However, none of the yellow fish survive or reproduce because predators can easily spot them in the green algae environment. If you have any yellow fish (fish in which both toothpicks are yellow), set those toothpicks aside.

5. Put all the genes you have left back in the gene pool **(remember you have set aside any yellow fish)**. Draw a ***second generation*** of fish, again without looking. Record your gene pairs in Table B. Count the numbers of each color and record the numbers in the second generation row in Table C. Set aside any yellow fish and return the surviving fish to the container.

6. The well-camouflaged fish live longer and have more offspring, so their numbers are increasing. Draw toothpicks to make a ***third generation*** of fish. Record you data in Table B and then write in the total numbers of each color of fish in the *third* generation row of Table C. Return survivors to the gene pool.

***STOP HERE*. DO NOT PROCEED TO STEP 7. DISCUSS QUESTIONS 4 - 6 WITH YOUR PARTNER.**

7. Draw more pairs of genes to make a ***fourth generation***. Record the data in Tables B and C. ***DO NOT REMOVE YELLOW FISH***.

STOP! *An environmental disaster occurs. Factory waste harmful to algae is dumped into the stream, rapidly killing much of the algae. The remaining rocks and sand are good camouflage for the yellow, red, and orange fish. Now the green fish are easily spotted by predators and can't survive or reproduce.*

8. Because green fish don't survive, set them aside. Now record the surviving offspring (all but the green) in the last row of Table C (fourth generation).
9. Now combine your *fourth generation* data with the rest of the groups in the class and record the combined totals in Table D.

DATA: See next page

QUESTIONS:

1. Can two red fish mate and have green offspring? Why or why not?

2. Can two orange fish mate and have red offspring? Why or why not?

3. Can two green fish mate and have orange offspring? Why or why not?

QUESTIONS 4-6 ARE TO BE ANSWERED BASED ON THE THIRD GENERATION OF FISH

4. Has the population of fish changed compared to earlier generations? Why?

5. Have any genes disappeared entirely?

6. Yellow genes are recessive to green; green genes are dominant to both red and yellow. Which color of genes disappeared faster when the environment was hostile to them? Why?

7. Hatchery fish populations often have less genetic biodiversity than wild fish population. How might lowered biodiversity affect a fish population's ability to adapt to environmental disasters such as the pollution disaster described in this simulation?

8. If the fish from a particular stream have become genetically adapted to their home stream over many generations, what might happen if fertilized eggs are used to restock a different stream that has become depleted of fish?

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TABLE A

FISH COLOR	GENE COMBINATIONS
Green	
Red	
Yellow	
Orange	

TABLE B - Gene Pairs and Resulting Fish Colors in Generations 1 – 4

	First Gene/Second Gene				Resulting Fish Color			
	- - - G E N E R A T I O N - - -							
Offspring	1st	2nd	3rd	4th	1st	2nd	3rd	4th
example	G/R				green			
1								
2								
3								
4								
5								
6								
7								
8								
9								
10								
11								
12								

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TABLE C - Offspring Color for Toothpick Fish Generations

ENVIRONMENT	GENERATION	GREEN	RED	ORANGE	YELLOW
There is lots of green algae growing everywhere					
The algae all dies and leaves rock and sand					

TABLE D - Fish Surviving the Pollution Disaster (pooled data)

FISH COLOR	GREEN (G)	RED (RR)	ORANGE (RY)	YELLOW (YY)
TOTALS				