Hybrid Oyster Genetics

(Adapted from "Genetic Engineering Activity")

Objective

This activity is a simplified version of an attempt to produce a hybrid oyster. As this activity shows, future generations of the hybrid lose the advantage bestowed on the original generation.

Standards

Grade 7: Genetics 2c,d,e

Materials

- 100 objects, 50 of one color and 50 of a second color
  (e.g.,bingo markers, poker chips, dried beans, coins, M&M's)
- pencil
- graph paper
- paper
- two containers large enough to hold all 100objects

Background Information

People have been selecting desirable traits in crops since they changed from being hunter-gatherers to living in agricultural societies. Various breeding techniques have given us many improved organisms, among them tomatoes and roses.

Aquaculturist have developed techniques for producing hybrids, offspring with the desirable properties of each parent. Geneticists select for desirable characteristics that will give the hybrid organisms a competitive edge (hybrid vigor). Oyster breeders have selected for such desireable traits as fast growth, disease resistance, healthy esthetics, and survivorship.

However, there is a downside to selective breeding. Hybrids tend to lose the hybrid vigor of the original due to a process called *genetic recombination*. This means future generations of the original hybrid gradually lose the advantages of the original as more generations are produced.

Prior to this activity, students should have been exposed to basic genetic concepts before beginning this activity. They need to know, for example, that genes occur in pairs and that offspring inherit one copy of each gene from each parent and that the copy of each parent's gene is inherited at random.

Students also need a clear understanding of Punnett Squares. Students do not need previous exposure to molecular genetics concepts, such as the structure of DNA or the genetic code.

The Activity

Oyster A has a high resistance to disease, which is important when raising them in areas where disease is a problem. Oyster B has a fast growth rate compared to other individuals. Producing a hybrid of these two oysters will combine the good characteristics of each to produce an oyster that has the best chance of survival.

In this activity, one color represents the gene for disease resistance. The second color represents the gene for the ability to grow fast. You want to produce oysters that have the ability to grow fast in areas that are prone to diseases, combining the best characteristic of each oyster.

Each hybrid oyster inherits one gene from each of its purebred parents. In this activity, one parent oyster has both A genes (AA) for fast growth. The other has both B genes (BB) for ability to resist disease.

If each parent contributes one of its pair of genes to its offspring, the AA individual will always contribute an A gene while the BB individual will always contribute a B gene. The resulting offspring of such parents will always be AB. This oyster will be capable of surviving in areas of disease and low food abundance better than either parent since it will be able to resist disease and growth rapidly to be able to reproduce.

Procedure

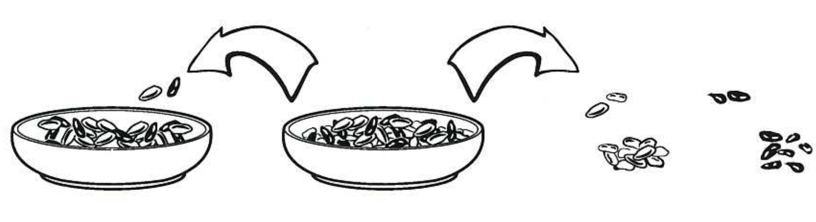
1. Put the 50 objects of color A in one pile to represent parent A's gene pool. Do the same for the 50 objects of color B, creating a gene pool for parent B.

2. Take one object from group A and one object from group B. Place them in one of the containers. Each time you do this, put a tally mark in the *first-generation* column of Table 1. How many hybrid oysters did you produce?

NOTE: By making pairs, you are simulating hybrid production. All of these first-generation offspring are hybrids; they would survive a disease outbreak and low food abundance because each has those genes.

3. All 100 objects should now be in one container. Mix them thoroughly. Without looking, remove two objects. If you get two of color A, set them aside. If you get two of color B, also set them aside. If you get one of each color (AB), make a tally mark in the *second-generation* column of Table 1. Then, place these objects in the second container. These are the oysters that have the best characteristic of the parent oysters.

   Keep doing this, discarding any pair of the same color and saving any pair that is one of each color, until all objects are removed from the first container.



4. Mix up the objects that you put in the container. Repeat the selection process for the third-generation column using only the AB objects in the container. Draw two objects, discard pairs of the same color and save pairs of two colors. Make a tally mark in the third-generation column only when a mixed pair is drawn.

5. Repeat the process for the fourth-, fifth- and sixth-generation columns of Table 1 (unless you wind up with zero sooner). If the total number of mixed pairs for the sixth-generation column is still greater than zero, you could continue further generations until you reach zero.

6. Plot the population of hybrids (number of mixed pairs) on the y-axis and the generation number on the x-axis and connect with a smooth curve.

Questions

1. What happened to the number of hybrid individuals in succeeding generations after the first generation?

2. Why does the number of hybrids change as it does?

3. How do these results explain why aquaculturist must keep using new hybrids each year, instead of their hybrid offspring to produce a new generation?

Hybrid Population for Each Generation

Generation	1	2	3	4	5	7	8
Number of Hybrids							