The Huntington Library, Art Collections, and Botanical Gardens

Quickie Genetics (A Supplement to Genetic Crossing Labs)

The procedure, analysis and evaluation, and student sheets for these labs are available as "3, 2, 1 – Countdown to Genetics" or "Who's the Father" from Carolina Biological.

Motivation

What a different world it would be if we could create designer babies and mix and match different genes responsible for desirable phenotypes to get our "golden child". On the other hand, we have been mixing and matching desirable plant phenotypes for thousands of years. (For example, how many of you have eaten a Pluot? A Pluot is the result of a cross between an apricot and a plum. There are many types of Pluots.) As horticulturalists have gotten more sophisticated in their knowledge of genetics, they have been able to predict the outcomes of their crosses with greater success. How would you do in your predictions?

Associated California State Biology Standards

2d. Students know new combinations of alleles may be generated in a zygote through the fusion of male and female gametes.
2e. Students know why approximately half of an individual's DNA sequences come from each parent.
2g. Students know how to predict possible combinations of alleles in a zygote from the genetic makeup of the parents.
3a. Students know how to predict the probable outcome of phenotypes in a genetic cross from the genotypes of the parents and the mode of inheritance (autosomal or x-linked, dominant or recessive).
3b. Students know the genetic basis for Mendel's laws of segregation and independent assortment.

Evaluation

The following questions may be used as part of a report, class discussion, or assessment.

1. Why is it necessary to remove any other flowers around a flower that has been manually crossed?
2. Why is it important to use an unopened flower when performing a cross?
3. Write out the steps you would go through to create your own designer species of fruit?
4. Why might it make a difference which parent was used for the pollen?
5. Write out the crosses used to establish the F1 and F2 phenotypes in your lab and the percentage of offspring you would expect for each cross.
6. In corn, a gene for colored (C) kernels is dominant over one for colorless (c) kernels and a gene for smooth (S) kernels is dominant over one for shrunken (s) kernels. Describe a controlled genetic experiment to demonstrate that those genes are linked.
7. Explain why marrying your first cousin is probably not the best idea.

Extension Activities

1. Complete "Who's the father" or "3, 2, 1 –Countdown to Genetics" for another example of scoring a genetic cross. Both are examples of dihybrid crosses.
2. Use either Wisconsin Fast Plants or *Arabidopsis* seedlings to grow to a stage where the students can perform the crosses on the plants, collect the seed and plant their F1 seed to see the results from their crosses. This will obviously take more time and planning than the kits, where you buy F1 and F2 seed. Plan on 6-7 weeks growing time for each generation and a couple weeks in between to age the seed. So if you are going to look just at the F1 generation you should allow roughly 14-16 weeks time.
3. If you used mutagenized *Arabidopsis* seed to look at mutations, you can backcross some of your mutants to wildtype plants to see if the mutation is dominant or recessive. This makes a nice long term project.

Test Preparation

1. A couple has 6 children, all girls. If the mother gives birth to a seventh child, what is the probability that the seventh child will be a girl?
   (A) 6/7
   (B) 1/128
   (C) 1/2
   (D) 1
   (E) Not enough information is given because the sperm determines the sex of the child.

2. An organism has three independently assorting traits: *AaBbCc*. What fraction of its gametes will contain the dominant genes *ABC*?
   (A) 1
   (B) 1/8
   (C) 1/4
   (D) 1/2
   (E) 3/8

3. In peas, the trait for tall plants is dominant (*T*) and the trait for short plants is recessive (*t*). The trait for yellow seeds is dominant (*Y*) and the trait for green seed is recessive (*y*). A cross between two plants results in 292 tall yellow plants and 103 short green plants. Which of the following are most likely to be the genotypes of the parents?
   (A) *TtYY* x *Ttyy*
   (B) *TTYy* x *TTYy*
   (C) *TTyy* x *TTYy*
   (D) *TtYy* x *TtYy*
   (E) *TtYy* x *TTYy*