

Flower Genetics: AlaskaBops

Materials

- Foam flowers (or paper alternative) with more than enough flowers for the class (some colors will be used more than others)
- 2 colors of green chenille sticks, enough of each color for most students
- Cotton ball for each student
- 2 sheets of green craft foam cut into 1.5-2-inch triangles for leaves.

Objectives

Introduce or reinforce concepts of genetics

Suggested grade levels

4-10 (adaptable for all)

Alaska Content Standards

Science A1-3, C1-2, E3, G1-4



This project presented by Alaska Agriculture in the Classroom

through funding from the Alaska Farm Bureau. For information, visit www.agclassroom.org/ak

Introduction

Genetics and meiosis are important aspects of all life. In agriculture, the science of genetics helps with selective breeding and improvements in crop and livestock production.

Background for Teachers and Older Students

Every day, the body makes billions of new cells by cell division. There are two types of cell division: mitosis and meiosis. Mitosis produces two cells with exactly the same genetic material as the original cell. It's like a photocopy. Somatic cells divide only by mitosis. Nearly all of the cells in our bodies are somatic cells.

Meiosis is the type of cell division that produces differing cells. The genetic materials split into alleles (alternate forms of a gene) and recombine. Each of the two new cells has half of the genetic material of each parent cell. Sex cells or gametes are formed by meiosis.

How these genes combined may not have been understood by scientists hundreds of years ago, but for many centuries farmers have been cross breeding their livestock to get the most desirable characteristics.

In the mid to late 1800s, Gregor Mendel, an Austrian monk and teacher, crossed pod peas to trace inherited characteristics. Mendel's work laid the groundwork for modern genetics. By tracing the characteristics of pea plants, Mendel discovered three basic laws of inherited characteristics:

1. Sex cells of a plant may contain either of two different traits, but not both of those traits.
2. Characteristics may be inherited independently from another.
3. Each inherited characteristic is determined by two hereditary factors (alleles), one from each parent, which determine whether a gene is dominant or recessive.

Teacher Preparation

Using construction paper, cut four small squares per student of nine* different colors. On each square, write with marker a letter representing a trait. It does not matter which color you use for which trait, but you must be consistent. For each set, you will mark half with lower case letters and half with upper case letters. The decoder enclosed uses the following letters: F, S, C, E, G, M, D, L, T. When you are done, put each set into a small baggie. Each baggie should contain 36 total cards of nine different colors with two each of all nine letters in upper and lower case. Each baggie should be identical. (As an alternative, you can have students write down upper and/or lower case letters in pairs on a sheet of paper.)

Draw on the board the following illustrations. You are only interested in one cross in each square in these examples. In the sketches below, you are interested only in the dark letters. You will use these later to explain dominant/recessive, homozygous/heterozygous.

Terms to Define

alleles
meiosis
mitosis
gametes
selective breeding

♀♂	F	F
F	FF	
F		

Square A

♀♂	F	F
f	Ff	
f		

Square B

♀♂	F	f
f		ff
f		

Square C

Introduction for Students

(middle elementary and older; adaptable for younger)

Meiosis, part of the study of genetics, helps explain the diversity within species. Meiosis is how certain cells in our body multiply, making two new and different cells. This is how plants and animals produce offspring.

How can a Chihuahua and a Great Dane both be the same species, *Canis familiaris*, the domestic dog? How can there be so many colors of roses? Why do people have so many different looks?

It is because all living things inherit characteristics from their parents. There are many, many characteristics, including ones that are very easy to see, like the colors of our eyes or hair. Some of these characteristics are dominant and some are recessive. What do dominant and recessive mean? Let's do a demonstration.

Have two students come to the front of the room. Have one student shout or loudly say "dominant" while the other whispers "recessive" at the same time. Ask the class which student they heard. Explain that dominant overshadows recessive even though both students were speaking in the same room.

Some genes carry homozygous characteristics. Homozygous characteristics are the same — either both dominant or both recessive. Some genes carry heterozygous traits. Heterozygous traits are different — one dominant and one recessive.

It is because of these different traits, carried on genes, that botanists can produce many different types of crops. For example, we can grow yellow beans, green beans and even purple or white beans. There are string beans, beans that climb and beans that form bushes. All of these are characteristics carried in the genes of the same family of beans.

Activity

We are going to make flowers today based on meiosis. Each of you will receive a small plastic bag with nine characteristic cards. These are your parent flowers' genes. You must pick two cards of each color and set them aside to make your flower. You may choose two upper case letters, two lower case letter, or one of each. That is up to you. But you must have two cards of each of the nine colors when you are through. Put the



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Adapted and expanded by Victoria Naegele, AAITC, from a St. Louis Science Center activity based on the original Reebops created by Patti Soderberg, University of Wisconsin.

rest of the cards back in your plastic bag when you are done and keep the plastic bag by your station.

When you have all of your cards selected, please (*CHOOSE APPROPRIATE SIGNAL*) so I know you are ready to proceed. Once you have chosen your cards and indicated you are finished, you may not change your cards. The cards you have chosen will indicate what sort of flower you have made. The letters indicate the genes your flower possesses. To make your flower, you will poke your stem through your flower parts, hooking the top of the stem over the center of the flower.

Have students raise their hands based on the letter combinations for the first trait: flower color (Fs). Helpers can pass out flower pieces but remind them they must give each student the color indicated by their cards. They are not to trade or otherwise get a different color.

Indicate Punnet squares you have drawn on the board. These grids called Punnet squares show how genetic crosses give us different offspring. The circle with the arrow indicates the male genes of the father and the circle with the cross indicates the genes from the female or mother. When we bring the father's genes down and the mother's genes across, we get the genes of the offspring. Punnet Squares show how genes will be passed down to four typical offspring. In these examples, we are only looking at one of the offspring.

For those of you who have two capital Fs, you have a hot pink flower. Both of your parent flowers passed down the gene for hot pink flowers. That means your hot pink flower carries homozygous, or the same, type gene for color. They may not have both been pink flowers but because they both passed down the dominant hot pink characteristic, your flower is hot pink. (*indicate Mendel square A*)

For those of you who have an upper case and a lower case F, you have an orange flower. One of your parent flowers may have been a hot pink or an orange flower and one a yellow flower or both may have been orange. (*indicate Mendel square B*) In either case, these traits are heterozygous - a mix of dominant and recessive.

Those of you who have two lower cases Fs have a yellow flower. Both of your parent flowers must have been yellow or orange flowers that passed down the yellow flower recessive trait. It is homozygous like the pink flowers (*indicate Mendel square C*).

Key out flower characteristics for the rest of the flower parts, using Mendel squares again if appropriate. Note the long- and short-season crop stem length in relation to Alaska's short growing season, especially in the Interior. Alaska's farmers and gardeners must pay careful attention to the number of days to a plant's germination and to maturity.

Leaf veins will be drawn on with a pen or marker. Cotton balls serve as both tap and fibrous roots. Tap root is drawn down like a carrot; fibrous root is pulled out horizontally. Curl end of stem over root as needed to hold it in place.



Further activities

1. Have older students work backward to determine what the parent flowers of their flower might have looked like. Eliminate what traits the parent flowers could NOT have possessed and offer hypotheses on what the flowers might have looked like. Take the students' flower cross another generation further, having two students cross their flowers.

♀ ♂	F	F
f		
f		

Pink x Yellow

♀ ♂	F	F
F		
f		

Pink x Orange

.....

♀ ♂	F	f
f		
f		

Orange x Yellow

2. Students can develop their own virtual Alaska crops by selecting characteristics they think would be important. They can start with a conventional variety and cross that with a new or genetically altered crop (real or fictitious) that has desired traits. These may include frost tolerance, short growing period, fast germination, natural herbicide against certain weeds, early germination, cold soil germination, blight resistance, etc. Use a seed catalog to find others. These traits will likely be recessive. Have students generate enough Punnett squares to speculate how long it will take to generate enough improved parents to begin producing seed commercially. How do economics effect improvements in seed production? How might Alaska be at a disadvantage in research and production of improved seeds?

Related Websites

http://www.biology.arizona.edu/mendelian_genetics/mendelian_genetics.html

http://www.biologyinmotion.com/cell_division/

<http://www.lewport.wnyric.org/jwanamaker/animations/meiosis.html>

<http://curriculum.calstatela.edu/courses/builders/lessons/less/les4/casino/casino1.html>

<http://curriculum.calstatela.edu/courses/builders/lessons/less/les4/casino/cas1ck.html>

Related Lesson Plans

Biotechnology: Changing our Future (grades 7-12)

Fast Plant Power Point Lesson Overviews

Baby Flowers

*** Note to teacher:**

The attached key is based on precut foam flowers available in craft and discount stores. Because only limited colors can be used in each exercise, the key can be changed in Microsoft Word to reflect other color combinations in subsequent uses of this lesson. The exercise may also be done substituting flower parts cut from foam or construction paper. Squares threaded onto end of pipe cleaner may be used instead of flower shape. Number of petals can be used instead of discs and centers as a characteristic. Other characteristics can be added or deleted per teacher's preference and availability of supplies and time devoted to exercise. This will affect the number of letter cards that need to be made, as outlined on the first page of these instructions.