Super Strawberries

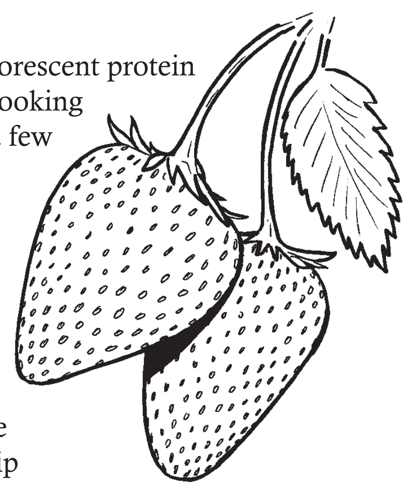
Name: ______________________________________

Background

Farmers have been practicing traditional plant breeding for thousands of years. In traditional plant breeding a plant that shows a desired trait is crossed with another plant that also shows that same desired trait or another desired trait. For example, a farmer may have noticed that one of their tomato plants resists mildew and a different tomato plant produces an abundance of fruit. These are two traits that the farmer would like all of her plants to have, so she cross breeds these two plants in hopes of breeding tomato plants that are resistant to mildew and produce an abundance of fruit. Next, the farmer will evaluate the seedlings to determine if they have the desired traits. The best seedlings are selected for breeding and the process is repeated. Plant breeders call this type of selection, direct selection because it is based on plant phenotypes which are the traits that we can observe.

Direct selection can be costly and often takes decades to successfully develop plants with the desired traits. It is also difficult to use this type of plant breeding to select plants for traits that aren't easily observed such as increased levels of nutrients in fruits or a longer shelf life.

Biotechnology is the manipulation (as through genetic engineering) of living organisms or their components to produce useful usually commercial products, for example pest resistant crops. A type of biotechnology called *Marker Assisted Selection (MAS)* is known as indirect selection because it is not based on a trait that we can observe. Instead it is based on genetic markers that will bind to the genes that code for the trait we are looking for. Genetic markers are sequences of DNA that have been built in the lab to be complementary to a certain gene of interest, such as frost resistance in plants.



Markers are built to include the gene pGLO, which will produce a green fluorescent protein when the marker finds and binds to the gene that codes for the trait we are looking for. Plant cells or DNA can be deposited on a microscope slide along with a few drops of the marker. The plant has the gene you are looking for if its DNA glows green under the microscope. If the plant is found to have the specific gene it can be selected for breeding. MAS is more accurate, less expensive, and much faster than traditional plant breeding.

Here's a fun analogy for MAS…

Imagine that your class goes on a night hike in a corn maze. You all become separated as you are finding your way through the maze. You see a spaceship overhead and realize aliens are coming to get you. The only way you can be saved is if your teacher finds you before the aliens do. Good thing your teacher gave everyone flare guns before you went into the maze. You shoot off your flare gun so you can be identified and saved by your teacher.

This is a very rough comparison to how MAS works to identify traits of interest. If your teacher had not given everyone a flare gun, the only chance she would have had to find you would be if she happened to wander through the maze in the dark and bumped into you. She might find a few of your classmates this way but she probably wouldn't find them all and it would take a lot longer. This would be similar to how selection through traditional breeding compares to MAS.

Directions

You work for a plant breeder who grows a variety of strawberries that exhibit an interesting range of traits. You want to find out which strawberry plants have inherited these traits. You are going to speed things up by using Marker Assisted Selection.

1. The following markers will bind to genes for the following traits. Write complementary base pairs of the gene that will bind to each marker.

   Marker A: GGTTGGTTCGCGA = binds to gene for High Level of Vitamin C

   Marker B: CTAGACCTTAATATTA = binds to gene for Extended Shelf Life

   Marker C: TCTAAAATT = binds to gene for Super Sweet Taste

   Marker D: GTCGTTTCTCT = binds to gene for Fuzziness

   Marker E: ATGCCCAGCTAGT = binds to gene for Jumbo Size

   Marker F: GCTTATTACCGTCT = binds to gene for Small Size

   Marker H: GGGCCTGGTT = binds to gene for Pink Flesh

   Marker I: GAAGCCTTCGGTT= binds to gene for Disease Resistance

   Marker J: ATCCCGAGCTAGT = binds to gene for Chocolate Flavor

   Marker K: TTCTAACGGA = binds to gene for Minty Flavor

2. You have a DNA sample from four different strawberry plants. You add the markers to each sample to determine if any of the strawberry plants have the genes you want to select for your breeding program. Search the DNA strands below for complementary regions that match the markers. When you locate an area where the markers will bind, highlight each section of DNA with a fluorescent pen.

Strawberry Single Stranded DNA Sequences

Strawberry Plant 1

AAAACGACTTCGGAAGCCAATTTACGCGCGAATTACCGAATCCGGGCCTCTCGCCCT
TTCCCGGAATTTATTACCGGT

Strawberry Plant 2

TTCTCGCCTAATTACGACTTCGACCCAAATTGGAATTAACCAACCAACCAAGCGCTG
CTAAAGCTGCTGCATGCCTGG

Strawberry Plant 3

TCCCGCTTTCGCTATTAGGGCTCGATCAGGATATAGCCAACCTTCCGAGCATCGATG
AATAGGATCCATGGATTAGAT

Strawberry Plant 4

AAACCGATAGATAGATTTTAAAAAAAAGTTTAGATAGATAGATAGATAGACCGCT
ATAGCAGCAAAGAGATTATTA

3. Describe the characteristics of each strawberry plant.

4. On a separate piece of paper draw the strawberry plant you would choose for your breeding program. Color your strawberry plant and label the desired characteristics.