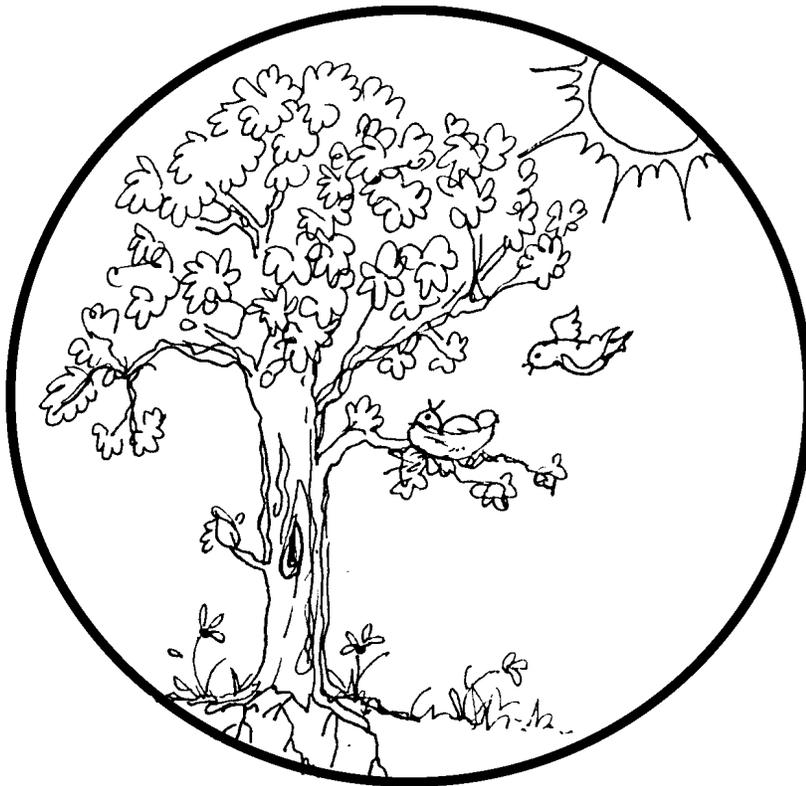




**Life Cycle**  
Diversity in a Balance



**SIXTH GRADE**  
**PLANT LIFE**



2 weeks  
LESSON PLANS AND  
ACTIVITIES

## LIFE CYCLE OVERVIEW OF SIXTH GRADE

### ORGANISMS

#### WEEK 1.

PRE: *Defining classification.*

LAB: *Exploring characteristics of the lower kingdoms*

POST: *Comparing classification and taxonomy.*

#### WEEK 2.

PRE: *Exploring how food gets rotten.*

LAB: *Discovering why food rots.*

POST: *Defining the parameters of the kingdom system.*



### HUMAN BIOLOGY

#### WEEK 3.

PRE: *Exploring the endocrine system.*

LAB: *Analyzing the different stages of human growth.*

POST: *Comparing mitosis and meiosis.*

#### WEEK 4.

PRE: *Distinguishing bacteria, protozoa, and viruses.*

LAB: *Distinguishing bacteria and viruses.*

POST: *Comparing genetic disorders with diseases.*

### PLANT LIFE

#### WEEK 5.

PRE: *Distinguishing land from aquatic plants.*

LAB: *Comparing growth factors of plants.*

POST: *Exploring uses of auxins.*

#### WEEK 6.

PRE: *Exploring the history of genetics.*

LAB: *Testing heredity models.*

POST: *Developing a mutation theory.*

### NATURAL ENVIRONMENT

#### WEEK 7.

PRE: *Exploring ecosystem requirements.*

LAB: *Comparing the pH of different soils.*

POST: *Interpreting the results of soil pH.*

#### WEEK 8.

PRE: *Adapting to the local environment.*

LAB: *Researching factors on adaptation.*

POST: *Comparing different theories on evolution.*

## LIFE CYCLE - PLANTS (6A)

### PRE LAB

Students use a worksheet to compare plant groups.

### OBJECTIVES:

1. Comparing thallophytes, bryophytes and tracheophytes.
2. Distinguishing land from aquatic plants.

### VOCABULARY:

bryophyte  
nonvascular  
thallophyte  
tracheophyte  
vascular



plant cell

### MATERIALS:

Internet  
worksheet

### BACKGROUND:

The study of plants is called botany or plant biology. Biologists believe that the plants that live on the land today are descendants of tiny green plants that lived about 350 million years ago in the ancient seas.

Plants are divided into two major groups: the nonvascular (Bryophytes and Thallophytes) and the vascular plants (Tracheophytes). They are divided by their characteristics which are listed below.

#### **THALLOPHYTES (algae, diatoms, kelp, seaweed)**

1. small to medium (one cell--microns to meters in length)
2. aquatic (marine or fresh water)
3. found in cold to warm water, upper 200 meters of water

#### **BRYOPHYTES (liverworts, hornworts, mosses, and "whiskferns")**

1. small in size
2. live in the arctic and antarctic, mainly found living in the tropical and temperate areas of the world
3. need shade and moisture to survive
4. not well adapted to land conditions, have such small anchoring structures that their plant body size must remain small in order to stay clinging to surfaces

#### **TRACHEOPHYTES (horsetails, ferns, conifers, and flowering plants)**

1. large in size compared to Bryophytes

2. live where extreme cold and heat does not exist
3. need direct sunlight to survive
4. all have a long root system
5. all produce seeds

Plants which produce seeds are the plants which dominate the land today. Aquatic plants do not produce seeds. The first seed plants appeared during the Devonian period (approximately 350 million years ago) and were known as the seed ferns. Biologists believe that the seed ferns are the ancestors of the seed plants living today. The two most abundant plant groups of the Tracheophytes are the gymnosperms and angiosperms. Gymnosperms produce naked seeds and angiosperms produce seeds within flowers, fruits, or vegetables. Students should look at the worksheet and try to determine whether the plants are thallophytes, bryophytes or tracheophytes.

### **PROCEDURE:**

1. Students need to examine the different types of plants and then classify them into Tracheophytes, Thallophytes, or Bryophytes. The answers to the worksheet are the following: - Tracheophytes (1,3,4,6,9,10); Thallophytes (2,8) ; Bryophytes (5,7)

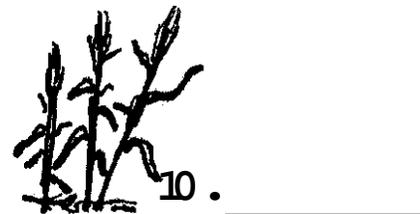
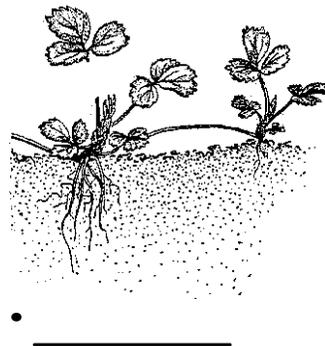
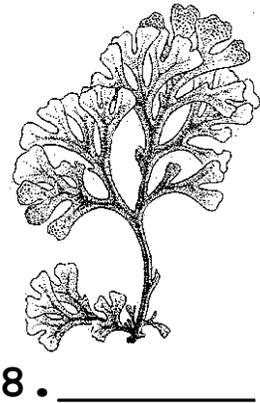
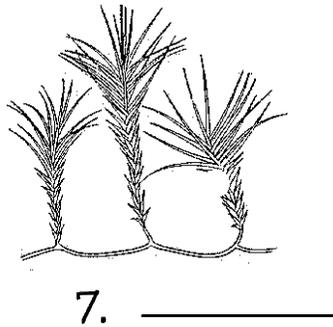
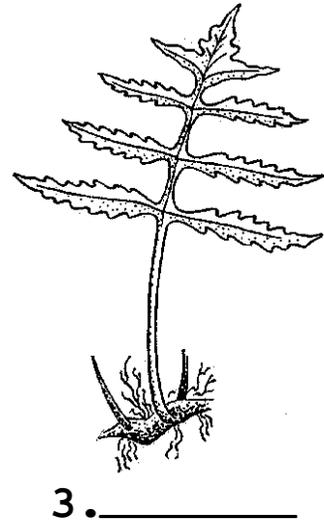
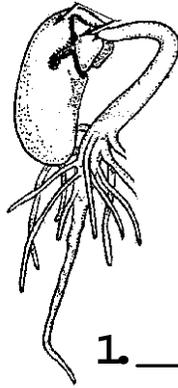
2. If you have internet access have the students look up different plants and have them group them into the 3 groups.

<http://plants.usda.gov/>

The PLANTS Database provides standardized information about plants, and it focuses primarily on plants of the USA and its territories, including checklists, distributional data, references and other plant information.

LIFE CYCLE - PLANTS (6A) PRE

LABEL THE THALLOPHYTES, BRYOPHYTES, AND TRACHEOPHYTES



## LIFE CYCLE - PLANTS (6A)

### LAB

Students experiment with light and the growth of plants

### OBJECTIVES:

1. Comparing growth factors for plants.
2. Limiting and observing growth factors in plants.

### VOCABULARY:

auxin  
hormone  
phototropism

### MATERIALS:

seedlings  
gelatin (or other plant cap)  
milk container  
soil  
exacto knife  
rooted plants (geranium, ivy) START THIS A FEW WEEKS PRIOR TO LAB



### BACKGROUND:

Charles Darwin in 1880 exposed seedlings to light and charted how they bent toward the light only if the tips were exposed to light. He exposed grass to light and noted that it curved toward the source. He covered the top of the seedlings with light proof caps, no bending occurred. He wasn't quite sure what was going on. Boysen-Jensen's study between 1910-1913 with beheaded seedlings, demonstrated that placing a bit of gelatin on the stump, replacing the top on the gelatin, caused curvature toward light to occur just as with intact seedlings. If the tip is not replaced, curvature does not result. Paal (1918) demonstrated that if a cut tip is replaced off center growth results and it will be curved.

The reason for the bending of plants toward light is that growth hormones called "auxins" on the non-illuminated side will cause the plant to grow more than on the illuminated side. Since the elongated cells on the non-illuminated side will grow faster than on the other side, the plant will bend. It looks as if the plant is moving toward light to make food, but no plant can seek anything. The higher concentration of auxins on the darker side stimulate growth. Growth responses resulting from external stimuli are termed tropisms and since this has to do with light (photo=light) this is called phototropism.

## **PROCEDURE:**

1. In the first part of the lab, students will duplicate Darwin's and Boysen-Jensen's experiment. They will utilize three similar seedlings. They need to cut the tips off of two seedlings, cover the tip of one with a cap (have them experiment on how to do this), leave the other plant with the cut top exposed, and leave the last seedling as a control.

Remind students how a "control" is used. A control represents what will happen if nothing is done at all. This is used to compare whether an action has an effect or if it is due to chance.

2. In the second part of the lab, students will set up an experiment that determines how long it takes different plants to "bend." They need a geranium, a seedling (tomato, or other vegetable), and an ivy (using different plants are acceptable).

3. Students will plant the rooted geranium and ivy in new containers and need to place the plants in the same general area. Over the next week, they will observe how the plants grow in light. The experiment will proceed quicker if you have an area of intense light that the plants will turn towards. They will notice that some plants take longer to bend than others.

**LIFE CYCLE - PLANTS (6A)**

**PROBLEM:** Do all plants "bend" toward light?

**PREDICTION:** \_\_\_\_\_

**MATERIALS:** rooted plants, seedling, soil, milk container

**PROCEDURE: Exercise 1.** Duplicate Darwin's and Boysen-Jensen's experiment as described by your teacher. Describe what you did and record what happens on each day that you observed the plant with and without a cap, and with no top.

\_\_\_\_\_

\_\_\_\_\_

\_\_\_\_\_

	DAY ____	DAY ____	DAY ____	DAY ____
NO CAP				
CAP				
NO TOP				

**Exercise 2.** Plant rootings as described by your teacher. Make sure that you water the plants and that they are all in the same place. Describe how they bend for one week.

DAY OF OBSERVATION							
TYPE OF PLANT	1	2	3	4	5	6	7

**CONCLUSIONS:** Is there a difference amongst the plants?

\_\_\_\_\_

\_\_\_\_\_

## LIFE CYCLE - PLANTS (6A)

### POST LAB

Students investigate weed killers.

### OBJECTIVES:

1. Exploring the uses of auxins.
2. Comparing different methods of weed control.

### VOCABULARY:

defoliant  
herbicide

### MATERIALS:

empty bottles of different weed killers



### BACKGROUND:

Learning more about how plants grow can help scientists find ways of controlling unwanted weeds. Scientists have found that growth hormones, like the ones that were studied in lab, can be artificially synthesized. A plant hormone (growth regulator) is defined as an organic substance produced by a plant that when acting in very small amounts regulates plant physiological processes. Three hormones have been isolated, auxins, gibberellins, and kinetin. We will only deal with auxins, which are the hormones that were discussed in lab.

Scientists have also found that larger amounts of hormones are toxic to plants and can kill certain plants with no adverse reaction to other plants. Some of the synthetic growth regulators affect certain types of plants more than others. Spraying an area with these growth regulators to affect only certain plants is called selective spraying. This is different from chemical weed killers that usually kill all vegetation because they are toxic to the individual plant cells. Many of these weed killers are generally used because they are cheaper, including ferrous sulfate, sulfuric acid, arsenical preparations, and aromatic fractions of fuel oils. Some plants may have a "tougher" outer skin, thereby not allowing the material to penetrate and hence not killing them, but for those cells that it does penetrate, it kills them by upsetting their photosynthetic process. Hormone herbicides are selective on the other hand and tend to affect broad leaved plants (dicots) more than narrow leaved monocots. Grasses on our lawns tend to be monocots, and the "weeds" tend to be dicots. A product on the market like 2,4 D-dichlorophenoxyacetic acid is a hormone herbicide which can eradicate plants like dandelions and morning glory. A chemical weed killer will kill the tops, but not the roots, so the weed will come back. Yes it is cheaper to buy the weed killer, but the hormone herbicide will do a better job.

There are many other applications for these growth hormones. Some of the

synthetic herbicides are effective defoliants which are used to take the leaves from the cotton plants before harvesting so the leaves don't plug up the mechanical cotton harvester.

This practical application of weed control was never thought about by the early scientists who were just interested in learning why a plant bends toward light.

**PROCEDURE:**

1. Go over the information provided above.
2. Have a few cans of weed killer, and show students how to read the ingredients.
3. Ask students to go home and list the ingredients in any weed killer they may have at home. When they come to school go over the ingredients and see if you can identify some of the ingredients. If you are not sure of whether the ingredients are hormones or not, you probably can go to the web sites of the companies and ask them a question. You may also use some of the search engines like <http://www.altavista.com/> and type in the name of the ingredient to find out what it is.

## LIFE CYCLE - PLANTS (6B)

### PRE LAB

Students play the Mendel Pea game on the internet.

### OBJECTIVES:

1. Exploring the history of genetics.
2. Investigating Mendel's research on plant genetics.

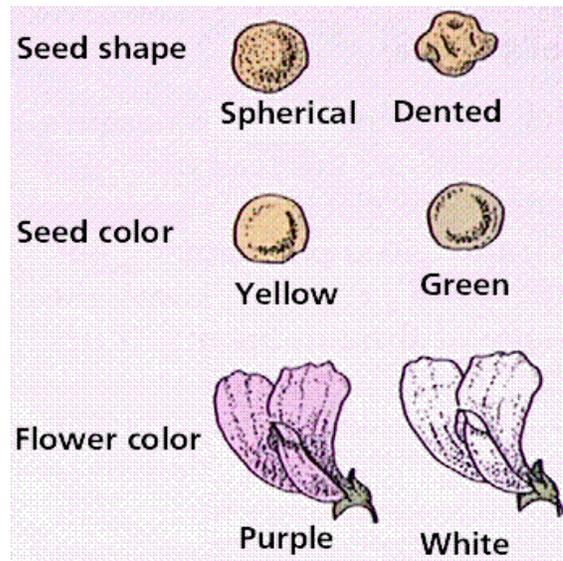
### VOCABULARY:

dominant  
genetic  
heredity  
hybrid  
recessive

### MATERIALS:

Internet  
overhead

### BACKGROUND:



Genetics is the study of heredity or the passing of traits from parents to offspring. Offspring can inherit dominant traits or recessive traits. A dominant trait is one that prevents another trait from appearing. A recessive trait is one that does not appear when a dominant trait is present. A pure trait (homozygous) is one that is made up of all dominant traits or all recessive traits. A hybrid trait (heterozygous) is a trait that is made up of a combination of dominant and recessive traits.

A gene is the unit of inheritance which is passed from parents to offspring. Genes occur in pairs in chromosomes inside the nucleus of a cell. There are dominant genes for dominant traits and recessive genes for recessive traits. Dominant genes mask recessive genes when paired. Gregor Mendel's experiments on hybridizing garden peas was the first recorded experiment on plant breeding. Mendel successfully studied the inheritance of unit characters. He also kept accurate records of how the characters reappeared in the offspring of selected parents. Mendel was also the first to control pollination techniques. These procedures are understood today, but in 1865 when Mendel's work was done, this was revolutionary. Mendel's work laid unnoticed for 35 years until European plant breeders rediscovered his work.

Mendel selected garden peas for his experiment. He took pollen from a dwarf growing pea and dusted it on a tall growing variety. The seeds resulting from this cross pollination were collected and planted the following season. All the plants that grew from these seeds were tall. Mendel reversed the situation and dusted the dwarf peas with

pollen from the tall variety, and this resulted in offspring that were all tall.

Mendel then allowed the tall plants to self pollinate and found that 3/4 were tall plants and 1/4 were dwarf. From this result Mendel concluded that the expression of a given character was dominant, while the other character was recessive.

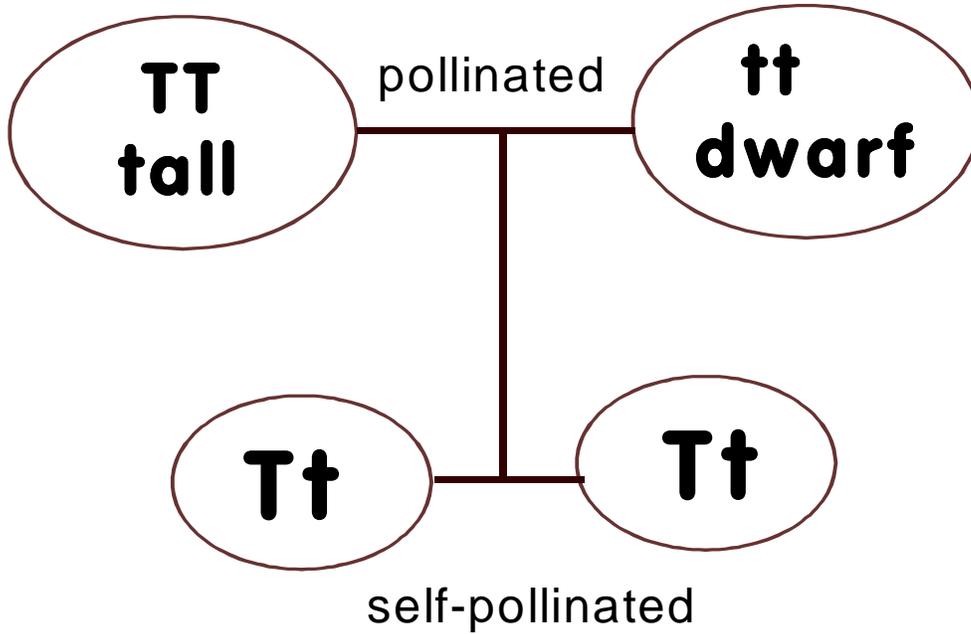
### **PROCEDURE:**

1. Make an overhead of "Mendel's Garden Peas" to illustrate Mendel's result. It is important to go over this graph carefully with students because they will need to understand this for the lab. Capital T is the dominant and small t is recessive. The dominant character will make the plants tall, while only two recessives together will form a dwarf.

2. After students understand how to use the grid, go to the following web site and have the students breed their own hybrid pea with this interactive pea experiment.

<http://zippy.sonoma.edu/kendrick/projects/anthro201/exper/>

## MENDEL'S GARDEN PEAS



	<b>T</b>	<b>t</b>
<b>T</b>	<b>TT</b>	<b>Tt</b>
<b>t</b>	<b>tT</b>	<b>tt</b>

**TT** = tall dominant  
**Tt** = tall dwarf recessive  
**tT** = tall dwarf recessive  
**tt** = dwarf

## LIFE CYCLE - PLANTS (6B)

### LAB

Students determine different genotypes.

### OBJECTIVES:

1. Testing heredity models.
2. Comparing and interpreting hereditary plant data.

### VOCABULARY:

genotype  
phenotype

### MATERIALS:

## LIFE CYCLE - PLANTS (6B)



Mendel



### BACKGROUND:

A phenotype is a visible, noticeable, and recognizable trait. An organism's genotype is his genetic make-up which is located in the nuclei of his cells. For example, the physical traits of a tall pea may be made of a dominant tall pea gene and a recessive dwarf pea gene. The phenotype of this plant will be tall, whereas the genotype will be heterozygous (i.e., a dominant and a recessive gene).

When a cross is performed upon parents that differ in only one single character (i.e., tall, short, etc.) it is termed a monohybrid cross. However, in many cases genes have more than one trait. When two sets of hereditary traits are considered it is called a dihybrid. Mendel continued his experiments with a pure (homozygous) tall, red flowering pea plant (TTRR) and crossed it with a pure dwarf, white flowering pea plant (ttrr). All the offspring will be hybrid (heterozygous) tall, red flowering (TtRr). Since the genes for height are on a different pair of chromosomes from the genes for flower color, the genes assort independently. This allows for four different types of "gametes" to form: TR, Tr, tR, and tr. There can be 16 different combinations that the offspring can have, with any one of them just as likely to occur. However, there are only nine different combinations (different genotypes) and four different phenotypes possible.

### PROCEDURE:

1. In the lab the students will find the 16 different combinations by using the "gamete" circles to fill in the grid on their worksheets. There should be 32 gamete circles for each group of students.
2. Instruct the students to cut out the circles. They use the circles to find out how

to fill in the boxes.

3. On the second part of the lab sheet the students need to tabulate how many different genotypes there are.

There are 1 TTRR, 2 TtRR, 2 TTRr, and 4 TtRr; 1 TTrr, 2 Ttrr; 1 ttRR, 2 ttRr; 1 ttrr; 9 tall red, 3 tall white, 3 dwarf red, 1 dwarf white.

## LIFE CYCLE - PLANTS (6B)

**PROBLEM:** How can you predict the phenotype of a hybrid with 2 traits?

**PREDICTION:** \_\_\_\_\_

**MATERIALS:** circle "gametes"

**PROCEDURE:** 2 hybrid plants can each produce 4 possible genotypes. By using a grid like below determine the genotypes and phenotypes.

	TR	Tr	tR	tr
TR				

number	GENOTYPE	number	PHENOTYPE
_____ _____ _____ _____	TTRR TtRR TTRr TtRr	_____	tall, red
_____ _____	TTrr Ttrr	_____	tall, white
_____ _____	ttRR ttRr	_____	dwarf, red
_____	ttrr	_____	dwarf, white

**CONCLUSIONS:** Summarize the graph above.

LIFE CYCLE - PLANTS (6B) LAB

**TR**

## LIFE CYCLE - PLANTS (6B)

### POST LAB

Students find plants that were genetically engineered.

### OBJECTIVES:

1. Developing a mutation theory.
2. Exploring factors that may influence plant mutations.

### VOCABULARY:

hybrid  
mutation

### MATERIALS:

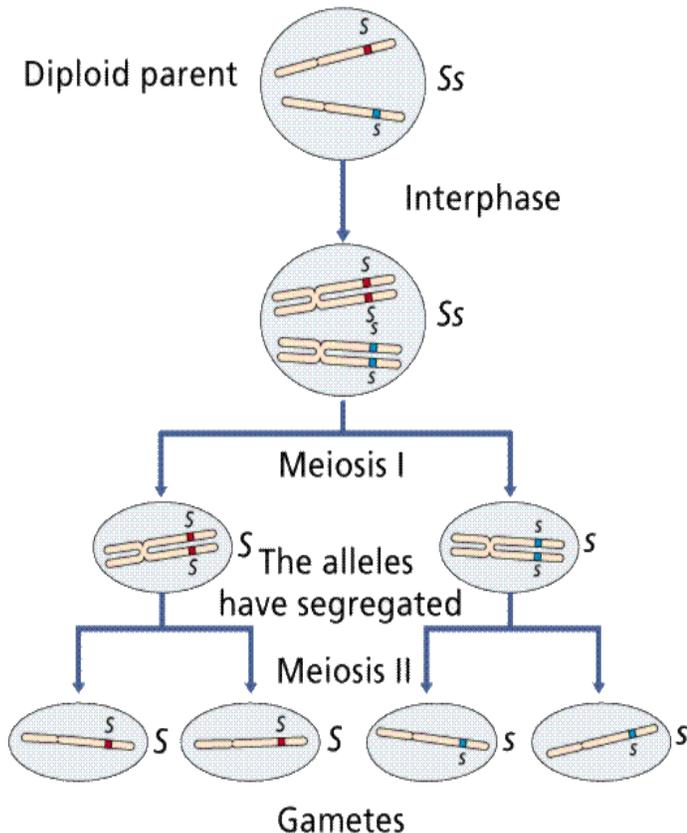
plant identifiers

### BACKGROUND:

Most genes in a uniform population tend to be similar, however there always seems to be a rare individual that differs from his neighbors. The cause of this different individual in a natural population is due to a change in one of the unit genes and is called a mutation.

Some mutations may be economically desirable or advantageous to individuals, but most mutations result in phenotypes less adapted for survival than the parent phenotype. Natural mutations are random. Radiation from some sources like alpha and beta particles, gamma rays, mustard gas, and x-rays are known to cause mutations but the exact reasons are very complicated. Some mutations in plants are desirable commercially, even though they may have no survival value to a plant. For instance, seedless grapes are missing their reproductive seeds. If humans don't vegetatively propagate the grape plant it will not survive. Other desirable mutations occur in nectarines, many ornamental flowers, peanuts and other cash crops.

Plant breeders deliberately increase hereditary variation by hybridization and stimulate mutations by radiation treatments and other techniques. Breeders will then select the most desirable phenotypes and genotypes for propagation. In general, the traits that plant breeders are looking for are: vigorous plant types, high yields, quality, and disease resistance.



Genetic engineering is a field that works with controlling "mutations," and genetic combinations resulting in superior or helpful organisms. Genetic engineering is different from the hybridization principles that were studied in this lab. Genetic engineers "design" genetic combinations that will result in specific and directed genetic combinations. Hybridization relies on random combinations that are driven by probability. Hybridization is more of a "trial and error" type of situation. Breeders try to combine different genetic combinations with hopes of producing a better phenotype and genotype and unlike genetic engineers, they do not "design" the genetic combinations themselves.

## **PROCEDURE:**

1. Collect a few plant identifiers and seeds that state they are "hybrids." Write down all the "hybrid" plants that they see. Make sure that students can recognize when a plant is labeled as a hybrid.

2. You may ask students to look around their house or go to a local nursery or even grocery store, that sells plants and look at the information about the plant. Have them either bring the identifier into class or write down the information. You may want students to go to a local plant nursery as a field trip.

3. If students have seeds at home, have them look at the package it comes in. See if they are hybrids.

They will be amazed that most of the plants on the market are products of genetic manipulation.