Topic: Mendel Pea Plant Worksheet

Summary: Students will learn how Mendel discovered classical genetics using pea plants. Students will simulate how alleles express alternate versions of genes using a monohybrid cross.

Goals & Objectives: Students will be able to describe how Mendel came up with his laws of genetics. Students will be able to use classical genetic terminology.

Standards: CA Biology *3a. Students know* how to predict the probable outcome of phenotypes in a genetic cross from the genotypes of the parents and 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.

Time Length: 40 minutes

Materials:

- Textbook
- Handouts

Procedures:
1. Student work alone to answer questions on how Mendel discovered genetics.

Accommodations: Students with an IEP can take the handout home if they need extra time or if they need modification, only answer odd numbered problems.

Evaluation:
Questions 1-8 are worth 2 points each, for a total of 16 points. Questions 9-16 are worth 1 point each, for a total of 8 points. This assignment is worth a total of 24 points.

Name: _____ Row: _____

Date:_____ Period:_____

Mendel's Pea Plants

Gregor Mendel experimented with pea plants in a garden. He would take the male part of the flower called the anther which produces pollen and the female part of the flower called the carpel which has an ovary containing ovules. Mendel had several stocks of true-breeding pea plants. The true-breeding (homozygous) pea plants were allowed to self-pollinate and produce offspring identical to the parent pea plants. The true-breeding pea plants let Mendel control his experiment when he cross-pollinated a green seed pea plant with a yellow seed pea plant. He cross pollinated the pea plants by taking pollen from the green seed stock, and fertilized the flowers of the yellow seed stock. He fertilized the flowers by brushing the pollen from the flower of yellow pea plants and wiping the pollen on the carpel of green seed pea plants. This process is known as cross-pollination where the seeds came from two different plants. Mendel studied seven different pea plant traits: plant height, the position of the flowers, pea pod shape, pea pod color, seed shape, seed color, and flower color.

1) Why was it important for Mendel to use true-breeding pea plants? (Hint: scientific method) _____

_____

2) What is a cross-pollination of pea plants? _____

_____

Mendel crossed the pea plants with contrasting traits, like tall plants and short plants, and studied their offspring. The original pair of plants is called the P (parental) generation. The offspring is called the F_1 (first finial) generation. Offspring from parents of different or contrasting traits are called hybrids. When Mendel crossed the two P generation plants, all the F_1 generations had characteristics from the P generation. Of all the F1 generation plants, only one of the characteristics was expressed and the other characteristic seemed to be lost. Mendel learned two things from these crosses: inheritance of traits (genes) is passed from one generation to the next and the principle of dominance. Alleles are usually the genetic code for a gene found in a certain location on a chromosome.

3) Explain how Mendel used the F1 generation to conclude that genes are inherited.

_____

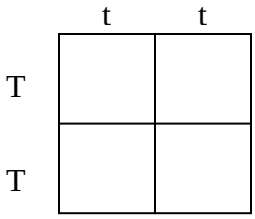
_____

_____

4) Why was only one of the parent's characteristics for a trait expressed, while the other seemed to be lost? _____

_____

Scientists today study heredity by using Punnett squares. Alleles may be represented as two letters because the plant or animal has two sets of genes, one from their father and one from their mother. When the two letters are the same, either both capitol T T or both lower case t t , they are called homozygous. When the two letters are opposite, they are called heterozygous. Since Mendel use true-bred pea plants, the purple flowers alleles are T T. The white flower alleles are t t. Fill in the Punnett square below of the trait flower color for two true-breading pea plants.



Purple = dominant
White = recessive

5) After looking at the punnett square and using the vocabulary terms above, why were all the offspring in the F_1 generation showing the dominant characteristic?

_____

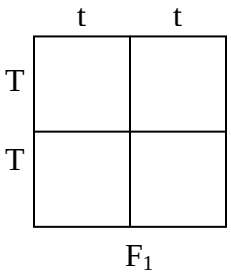
_____

_____

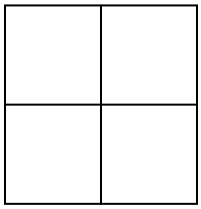
6) Any time you have a capital letter in one or both alleles, the dominant form of the trait is expressed. Only when you have both alleles as lower case letters is the recessive form of the trait expressed. In the Punnett square above, do all of the offspring express the purple or white flowers? _____

Since the offspring in the F_1 generation only displayed one of the parent's characteristics, Mendel did not know what happened to the other. He decided to cross two of the offspring of the F_1 generation to create a F_2 generation. Analogy: P = parents, F_1 = kids, F_2 = grandkids of pea plants. Mendel noticed something very different in the F_2 generation. Please fill in the two punnett squares below of three generations, from the true-bred P generation to F_2 generation. The plants from the F1 generation were allowed to self-pollinate.

Use the offspring in the F1 generation to self-pollinate to create the parents of the F2 generation.



F_1



F_2

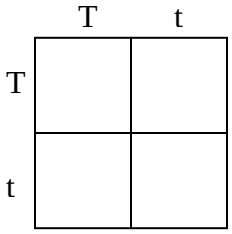
Purple = dominant
White = recessive

When a homozygous dominant plant is crossed with a homozygous recessive plant, all the offspring are heterozygous and express the dominant characteristic of the trait. But when the plants in the F_1 generation are allowed to self-pollinate, a few of the recessive plants reappear in the F_2 generation. Mendel hypothesized that alleles segregate from each other during the formation of gametes (seeds). This means that one of each paired chromosomes goes into each seed, or only one letter from each parent goes into each square (offspring) of a Punnett square. Mendel's hypothesis became the law of segregation.

7) Explain how Punnett squares use the law of segregation. _____

_____

An organism's physical appearance of the traits is called a phenotype. Mendel studied pea plant traits including seed color. For the trait seed color, its phenotype would be either yellow or green. The genotype is the gene responsible for the phenotype. A diploid organism has two copies of each chromosome and this is why there are two alleles which make up the individual's genotype. Now that you have learned how to distinguish between genotype and phenotype, you can determine their ratio or probability. The genotypic ratio is written using numbers that start with homozygous dominant, then heterozygous, then homozygous recessive. An example of genotypic ratio looks like 2:2:0.



Yellow seed = dominant
Green seed = recessive

8) Use the Punnett square above to answer the questions below?

All possible genotypes: _____

All possible phenotypes: _____

Genotypic ratio: _____ Phenotypic ratio: _____

Pea Plant Crosses

Fill in the following punnett squares and match the punnett square with the probabilities in the following questions. First, determine who were the parents, then determine the possible ratios for the offspring. Each punnett square may be used more than once.

Write the letter A, B, C, or D for the Punnett square that would represent each cross.

(A)

	t	t
T		
T		

(B)

	T	t
T		
t		

(C)

	T	T
T		
t		

(D)

	T	t
t		
t		

_____ 9) Mendel crossed dominant tall plants with tall plants. The results in the F_1 generation were 84 tall plants and 29 recessive short plants.

_____ 10) Mendel crossed dominant axial flower position plants with recessive terminal flower position plants. The results in the F_1 generation were 15 axial flower plants and 17 terminal flower plants.

_____ 11) Mendel crossed dominant green pod plants with recessive yellow pod plants. The results in the F_1 generation were 40 green pod plants and 0 yellow pod plants.

_____ 12) Mendel crossed dominant smooth pod plants with smooth pod plants. The results in the F_1 generation were 51 smooth pod plants and 0 recessive constricted pod plants.

_____ 13) Mendel crossed dominant purple flower plants with recessive white flower plants. The results in the F_1 generation were 206 purple flower plants and 197 white flower plants.

_____ 14) Mendel crossed dominant gray seed coat plants with dominant gray seed coat plants. The results in the F_1 generation had a ratio of 3 gray coat plants to every one recessive white seed coat plants.

_____ 15) Mendel crossed dominant yellow seed plants with dominant yellow seed plants. The results in the F_1 generation were all yellow seed plants and no recessive green seed plants. The results in the F_2 generation were 714 yellow seed plants and 106 green seed plants.

_____ 16) Mendel crossed dominant round seed plants with recessive wrinkled seed plants. The results in the F_1 generation were all round seed plants and no wrinkled seed plants. The results in the F_2 generation were 318 round seed plants and 121 wrinkled seed plants.