

Mendelian Principles - Work Sheet 1

Biology 30

Name: _____

1. For each of the diploid genotypes presented below, determine the genetic make up for all of the possible haploid gametes.
 - a. Rr
 - b. RrYy
 - c. rrYy
 - d. RrYY
 - e. RrYyBb

2. Use the Punnett square to determine all of the offspring genotypes (and their relative frequencies) from the following crosses:
 - a. Rr x Rr

 - b. Rr x rr

 - c. RR x Rr

3. In the problem above, the "R" allele is a dominant allele specifying for round seeds (in peas), while the "r" allele is the recessive allele specifying for wrinkled seeds. Give the expected frequencies (as percentages or ratios) for the phenotypes of the offspring resulting from each of the crosses above.

4. In humans, brown eyes are dominant over blue eyes. A woman with blue eyes marries a man with brown eyes. This man's father had blue eyes.
 - a. What would be the genotype of the man that married the blue-eyed woman?
 - b. What would be the genotype of the blue-eyed woman?
 - c. What are all the possible gametes related to eye colour that could be produced from this man and woman?
 - d. What will be the ratio of children with blue eyes from this marriage?

5. Would it make a difference to the question above, if the man had blue eyes and the woman had brown eyes, with the woman's father having blue eyes?

6. If a brown-eyed man marries a blue-eyed woman and they have ten children who all have brown eyes, what would the likely genotype of the father? Can you be certain of the man's genotype?

7. If three of the children had blue eyes in the above question, what would be the genotype of the father? Can you be certain of the man's genotype?

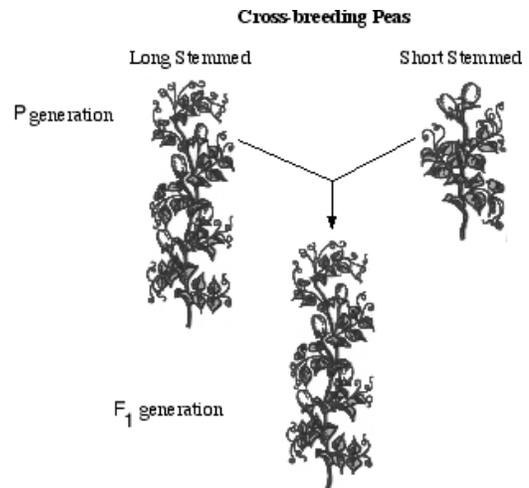
8. Thalassaemia is a type of human anemia controlled by a defective gene, *t*. The normal allele, *T*, produces hemoglobin normally. The disease occurs in two forms, minor and major. The major is more severe. Individuals with the major form are homozygous for the recessive allele and individuals with the minor form are heterozygous.
 - a) Show the expected offspring between two parents, both of whom have thalassaemia minor.
 - b) Draw a punnett square to support your answer.

Mendelian Principles - Work Sheet 2

(Practice with Monohybrid)

Name: _____

Pure-breeding long stemmed and pure-breeding short stemmed pea plants were crossed as shown to the right:



1. From the data in the diagram it can be shown that
 - a) long stems are a dominant trait
 - b) short stems are a dominant trait
 - c) genes do not segregate during meiosis
 - d) the F₂ progeny will be all long stemmed.

2. Which of the following statements about the F₂ generation in the diagram is correct?
 - a) All plants will be hybrid with short stem.
 - b) Some plants will be hybrids with long stem.
 - c) All plants will be pure breeding with long stem.
 - d) All plants will be pure breeding with short stem.

3. Papayas have yellow-flesh fruit, controlled by the dominant allele, Y, but some have straw berry-fleshed fruit, controlled by the recessive allele, y. The following crosses were performed and the data of the offspring is given below.

Cross	Parents	Offspring
1	Strawberry Papaya (x) Yellow Papaya 1	12 yellow papaya trees 10 strawberry papaya trees
2	Yellow Papaya 1 (x) Yellow Papaya 2	15 Yellow Papaya trees
3	Strawberry Papaya (x) Yellow Papaya 2	14 yellow papaya trees

Complete the following

- A) Determine the genotypes of the
 - Strawberry Papaya ___
 - Yellow Papaya 1 ___
 - Yellow Papaya 2 ___

- B) What proportion of phenotypes would you expect in the offspring if you allowed Yellow Papaya 1 to self-pollinate?

- C) What proportion of phenotypes would you expect in the offspring if one of the progeny from cross 3 were to be self-pollinated? Draw a punnett square to support your answer.

4. A brown mink crossed with a silverblue mink produced all brown offspring. When these F_1 mink were crossed among themselves they produced 47 brown animals and 15 silverblue animals (F_2 generation). Determine all the genotypes and phenotypes, and their relative ratios, in the F_1 and F_2 generations.

5. In sheep white is due to a dominant gene (W), black to its recessive allele (w). A white ewe mated to a white ram produces a black lamb. If they produce another offspring, could it be white? If so, what are the chances of it being white? List the genotypes of all animals mentioned in this problem.

6. In tomatoes the texture of the skin may be smooth or peach (hairy). The Ponderosa variety has fruits with smooth texture. The red peach variety has fruits with peach texture. Crosses between the two varieties produce all smooth fruits. Crosses between these smooth fruited F_1 plants produced 174 peach textured fruits and 520 smooth textured fruits. How are these skin textures inherited?

7. A brown mouse is mated with two female black mice. When each female has produced several litters of young, the first female has had 48 black and the second female has had 14 black and 11 brown young. Deduce the pattern of inheritance of coat color and the genotypes of all of the parents.

Mendelian Principles - Work Sheet 3

Biology 30

(Probability, Mono and Dihybrid)

Name: _____

1. The ability to taste the chemical PTC is determined by a single gene in humans with the ability to taste given by the dominant allele T and inability to taste by the recessive allele t. Suppose two heterozygous tasters (Tt) have a large family.
 - a. Predict the proportion of their children who will be tasters and nontasters. Use a Punnett square to illustrate how you make these predictions.

 - b. What is the likelihood that their first child will be a taster? What is the likelihood that their fourth child will be a taster?

 - c. What is the likelihood that the first three children of this couple will be nontasters?

2. A husband and wife are both heterozygous for a recessive gene, *c*, for albinism. They were informed that they will have dizygotic twins, a boy and a girl.
 - a. Draw a Punnett square of this cross.

 - b. What are the chances that one child will be albino?
 - c. What are the chances that both children will be normal?
 - d. What are the chances that both babies will have the same phenotype for skin pigmentation?

3. In pepper plants, green (G) fruit color is dominant to red (g) and round (R) fruit shape is dominant to square (r) fruit shape. These two genes are located on different chromosomes.
 - a. What gamete types will be produced by a heterozygous green, round plant?

 - b. If two such heterozygous plants are crossed, what genotypes and phenotypes will be seen in the offspring and in what proportions?

4. In watermelons, the genes for green colour and for short shape are dominant over their alleles for striped colour and for long shape. Suppose a plant with long striped fruit is crossed with a plant that is heterozygous for green colour and homozygous for short shape. What is the phenotype of their offspring (Show all work)?
5. In humans, a cleft chin is due to a dominant allele (D), while the recessive allele (d) produces no cleft. Most people have free ear lobes due to a dominant allele (E) and a person with attached ear lobes has two recessive alleles (e). If a mother is homozygous for cleft chin and heterozygous for free ear lobes, and the father is heterozygous for both traits, determine the following.
- What is the probability that their baby will have the following?
 - A cleft chin and attached ear lobes?
 - A cleft chin and free ear lobes?
 - No cleft chin and free ear lobes?
 - No cleft chin and attached ear lobes?
 - Draw a punnett square to support your answer.
6. The allele for black coat colour (B) is dominant over the allele for white coat colour (b) in dogs. The allele for short hair (S) is dominant over the allele for long hair (s). The phenotypes of offspring from several crosses are given below.

Cross	Parental Phenotypes	Phenotypes of Offspring			
		Black short	Black long	White short	White long
1	Black, short X black, long	16	15	0	0
2	White, short X white, short	0	0	27	8
3	Black, short X black, long	6	5	3	2
4	Black, long X black, long	0	31	0	10

Complete the following.

- What are the genotypes for parents of each of the four crosses (you can't be sure of cross one)?
- If the black coat colour and long hair offspring from Cross 3 is crossed with the black and short hair offspring from Cross 1 (assume both parents are BB), what proportion of the offspring will have black, short hair? Is it possible to have offspring with white, long hair from this cross?

Mendelian Principles - Work Sheet 4

Biology 30

(incomplete dominance, mono and dihybrid)

Name: _____

- 1) Let's assume that hair color in humans is a simple genetic situation (it really isn't). Assume there are two alleles for hair color - a dominant allele for dark hair and a recessive allele for light hair. A dark haired woman whose father is light haired marries a light haired man. Use a Punnett Square to determine the expected phenotypes and genotypes of the children.

- 2) The gene for bent little fingers is dominant over the gene for straight fingers. Two bent fingered people have a straight fingered child. What are the genotypes of all three?

- 3) Brown eyes is dominant over blue eyes. Dark hair is dominant over light hair. The mother is brown eyed with light hair. The father is blue eyed with dark hair. The child is blue eyed with light hair. What are the genotypes of all three?

- 4) In short horned cattle, red is co-dominant with white. The hybrid is called roan. A roan mates with a roan. Use a Punnett Square to determine the expected phenotypes of the offspring.

- 5) The alleles for hair type show incomplete dominance. One allele (c) is for curly hair. Another allele (s) is for straight hair. The hybrid is wavy. A wavy haired person marries a curly haired person. Use a Punnett Square to determine the expected phenotypes in the children.

- 6) Dark hair is dominant over light hair. A man with light hair has a dark haired daughter. What is the phenotype of the mother? The daughter marries a dark haired man. They have 20 children all with dark hair.

What is the most likely genotype of the husband?

- 7) In pigeons, ruffled feathers are dominant over smooth feather. A ruffled pigeon whose mother was smooth is crossed with a ruffled pigeon. The first chick has smooth feathers. What are the genotypes of the chick, its parents and the grandmother?
- 8) What gametes could the genotype BbRR produce? What gametes could the genotype BbRr produce.

Use a Punnett Square to determine the possible genotypes of their offspring. How many different genotypes are there? How many different phenotypes are there? (the answer here would describe the possibilities in terms of having the dominant or recessive trait for each pair of genes- for example, BbRR would be "dominant/dominant" whereas bbRR would be "recessive/dominant")

- 9) A rooster with grey feathers is mated with a hen of the same phenotype. Among their offspring 15 chicks are grey, 6 are black and 8 are white.
- What is the simplest explanation for the inheritance of these colors in chickens?
 - What offspring would you expect from the mating of a grey rooster and a black hen?
10. Color patterns in a species of duck is determined by one gene with three alleles. Alleles H and I are semidominant (i.e., incomplete dominance), and allele i is recessive to both. How many phenotypes are possible in a flock of ducks that contains all the possible combinations of these three alleles.
11. In corn plants, a dominant allele I inhibits kernel color, while the recessive allele i permits color when homozygous. At a different locus, the dominant gene P causes purple kernel color, while the homozygous recessive genotype pp causes red kernels. If plants heterozygous at both loci are crossed, what will be the phenotypic ratio of the F_1 generation?