

Name: _____

Mendelian Genetics' Packet

Mendelian Genetics: Genotypes

1. For each of these genes, give the **genotype** that would be homozygous dominant (HD), heterozygous (He), and homozygous recessive (hr).

Y → HD: ____ He: ____ hr: ____ Q → HD: ____ He: ____ hr: ____ E → HD: ____ He: ____ hr: ____

M → HD: ____ He: ____ hr: ____ F → HD: ____ He: ____ hr: ____ G → HD: ____ He: ____ hr: ____

2. For each of the **genotypes** below determine what **phenotypes** would be possible.

a. Purple flowers are dominant to white flowers.

b. Curly Hair in cats is recessive to straight hair.

PP _____

BB _____

Pp _____

Bb _____

pp _____

bb _____

Mendelian Genetics: Independent Assortment Probability

3. Read each scenario carefully and give an answer in percent:

a. What is the chance a heterozygous parent passes on a recessive allele? ____

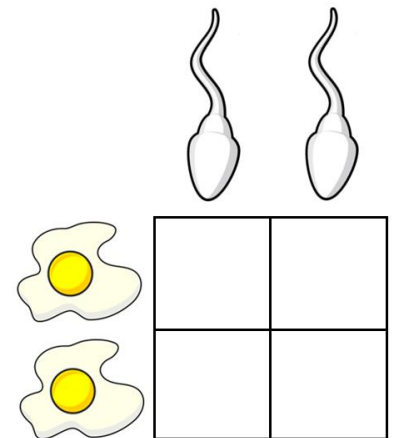
b. What is the change a homozygous recessive parent passes on a dominant allele? ____

c. What is the chance a homozygous dominant parent passes on a dominant allele? ____

Monohybrid Cross Problems

For the following problems, SHOW ALL OF YOUR WORK. For each cross, be sure to give the genotype(s) of the parents and the resulting genotype(s) and phenotype(s) of the offspring. For consistency, all probabilities should be expressed as percentages (e.g. 50% homozygous dominant, 50% heterozygous).

4. The gene for tall (A) is dominant over dwarf (a) in the garden pea plant used by Mendel. A pea plant that comes from a line of true-breeding tall plants is crossed with a dwarf pea plant. What are the phenotype(s) and genotype(s) of the F1 generation?



5. Two plants from the F1 generation of question #4 are crossed. What are the genotype(s) and phenotype(s) ratios of the offspring?

6. The gene for flower color for pea plants codes for two types of flower color, purple and white flowers. You do a test cross between a purple and white flower. All out of the 18 flowers in the next generation are purple. What is the genotype of the purple and white flower in the P generation? What are the genotypes of the purple flowers in the F1 generation?

7. In humans, freckles are a trait that exhibits simple dominance. The two alleles for this trait are freckles (A) and no freckles (a). A freckled man whose mother has no freckles marries a woman with no freckles. What is the probability that their first child will have freckles? Use the Punnett square to the right to show your work.

8. The genes for freckles is dominant over genes for no freckles. A man with freckles marries a woman without freckles. They have 12 children who all have freckles. What are the most likely genotypes of the man, his wife, and all the children?

9. A freckled man marries a woman without freckles. They have four children, two with freckles, and two without freckles. What are the genotypes of all these people?

10. A man with freckles has a mom without freckles. The man marries a woman who has freckles, but has a father without freckles.
 - a. What is the probability that their first child having freckles?

 - b. That the second child will be freckles?

11. A man and a woman have 24 children. Of the children, 17 have freckles and 7 don't have freckles. What are the genotypes of the parents?

Mendelian Genetics: Independent Assortment Problems

12. One gene has alleles A and a. Another has alleles B and b. For each genotype listed, what type(s) of gametes will be produced? (Assume independent assortment occurs before gametes form.)

- AABb _____
- AaBB _____
- Aabb _____
- AaBb _____

13. Assume that you now study a third gene having alleles C and c. For each genotype, what type(s) of gametes will be produced?

- AABbCc _____
- AaBBcc _____
- AaBbCc _____

14. The cell below is currently in Metaphase I. Draw the four resulting cells after the original cell goes through Meiosis. Write down the genotype above each of the new cells. (ignore crossing over)



Mendelian Genetics: Dihybrid Cross

Set up a dihybrid Punnett square using the following information:

- Dominant allele for green peas in pea plants = A
- Recessive allele for yellow peas in pea plants = a
- Dominant allele for smooth surface in pea plants = B
- Recessive allele for wrinkled surface in pea plants = b

Cross a heterozygous parent (AaBb) with a heterozygous parent (AaBb). Answer the following questions about the ratios from the dihybrid Punnett square.

15. What are ALL of the genotypes for each of the following types of pea plants?

- a. Green and Smooth: _____
- b. Yellow and Smooth: _____
- c. Green and Wrinkled: _____
- d. Yellow and Wrinkled: _____

16. What is the ratio and probability for each phenotype below?

- a. Green and Smooth - Ratio: _____ Probability: _____
- b. Yellow and Smooth - Ratio: _____ Probability: _____
- c. Green and Wrinkled - Ratio: _____ Probability: _____
- d. Yellow and Wrinkled - Ratio: _____ Probability: _____

Mendelian Genetics: Product and Sum Rules

Directions: For each of the following problems, calculate the probability of the offspring between the cross using the sum and product rule. For these problems, try not creating a di or trihybrid Punnett squares.

17. The parent generation have genotypes of **Aa** and **Aa**. What is the probability the F1 generation would be **Aa**?

18. The parent generation have genotypes of **Aa Bb** and **Aa bb**. What is the probability the F1 generation would be **aa Bb**?

19. The parent generation have genotypes of **Aa Bb Cc** and **AA Bb CC**. What is the probability the F1 generation would be **AA bb cc**?

20. The parent generation have genotypes of **AA Bb CC Dd** and **Aa bb Cc dd**. What is the probability the F1 generation would be **Aa bb Cc dd** or **AA bb Cc dd**?

21. The parent generation have genotypes of **Aa Bb cc DD** and **Aa Bb cc dd**. What is the probability the F1 generation would be **Aa bb cc Dd**?

22. The parent generation have genotypes of **Aa Bb Cc dd Ee** and **Aa bb Cc Dd ee**. What is the probability the F1 generation would be **aa Bb Cc Dd Ee**?

Genetic Recombination Problems

23. Determine the sequence of genes A, B, and C on a chromosome. Which two genes are most likely going to be inherited together?

Genes	Crossover Frequency
A & B	24%
A & C	11%
B & C	13%

24. The following chart shows the crossover frequencies for some genes on an autosome of organism Y. Construct a chromosome map. Which two genes are most likely going to be inherited together?

Genes	Crossover Frequency
W & S	8%
C & W	3%
C & B	5.5%
C & S	11%
B & S	5.5%

25. The following chart shows the crossover frequencies for some genes on an autosome of organism Z. Construct a chromosome map. Which two genes are most likely going to be inherited together?

Genes	Crossover Frequency
A & W	15%
W & L	35%
A & L	15%
A & D	20%

26. Thomas Morgan collected the following crossover gene frequencies while studying *Drosophila*. Bar-shaped eyes are indicated by the (B) allele, and carnation eyes are indicated by the allele (C). Fused veins on wings (F), leg length (C), and scalloped wings (D) are located on the same chromosomes. Construct a chromosome map. Which two genes are most likely going to be inherited together?

Genes	Crossover Frequency
A & B	24.0%
A & C	8.0%
C & D	2.0%
A & F	16.0%
F & B	8.0%
D & F	6.0%

27. Construct a gene map given the following information. Which two genes are most likely going to be inherited together?

Genes	Crossover Frequency
A & C	8%
A & D	10%
B & D	14%
B & F	8%
C & D	2%
C & F	8%
D & F	6%

Mendelian Genetics: Autosomal Dominant and Recessive Genetics

28. A young man recently learned from a genetics doctor that he had a condition called Friedreich's ataxia. This syndrome affects the arms and the legs with the person usually needing a wheel chair. Neither of his parents have this disorder. However the young man's grandfather was wheelchair bound, but didn't know why because genetic information was very limited when his grandfather grew up. Based on this information, what type of inheritance does Friedreich's ataxia follow? Explain why. What are the genotypes of each of the individuals mentioned in this question?
29. Sickle cell anemia (SCA) is a human genetic disorder known to be caused by a recessive allele. A couple plans to marry and wants to know the probability that they will have an affected child. In the following scenarios, use your knowledge of Mendelian inheritance to give the families the probabilities of having a child with SCA.
- a. The man and woman do not have SCA. However, each has one parent with the disorder.
 - b. The man is affected by the disorder. The woman has no family history of SCA.
30. A 38-year-old man (Hh) recently has been diagnosed with familial hypercholesterolemia which is a dominant disorder. Prior to his diagnosis, he and his wife had 3 children, a boy first and then two girls. The wife was recently tested negative for familial hypercholesterolemia (hh). One of the girls tested positive for the disease while the other two siblings tested negative. What are the genotypes of the children? What is the probability the next child inherits the disease?