Name: _____ Date: ___/___/___ Period: _____

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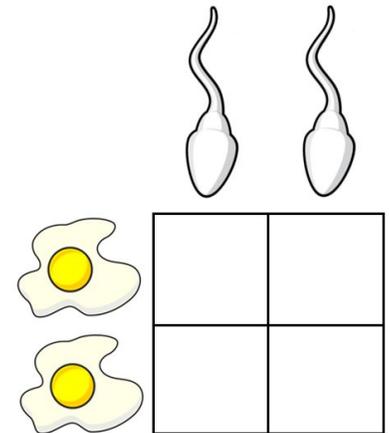
5. Two plants from the F1 generation of question #4 are crossed. What are the genotype(s) and phenotype(s) ratios of the offspring?

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 male whose biological mother has no freckles has a child with a female 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 male with freckles has a child with a female without freckles. They have 12 children who all have freckles. What are the most likely genotypes of the biological parents, and all the offspring?

9. A freckled male has a child with a female without freckles. They have four offspring, two with freckles, and two without freckles. What are the genotypes of all these people?

10. A male with freckles has a biological mother without freckles. The male has a child with a female who has freckles, but has a biological male parent without freckles.
    a. What is the probability that their first offspring having freckles?

    b. That the second offspring will be freckles?

11. A male and a female have 24 biological children!!! Of the offspring, 17 have freckles and 7 don't have freckles. What are the genotypes of the biological 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)
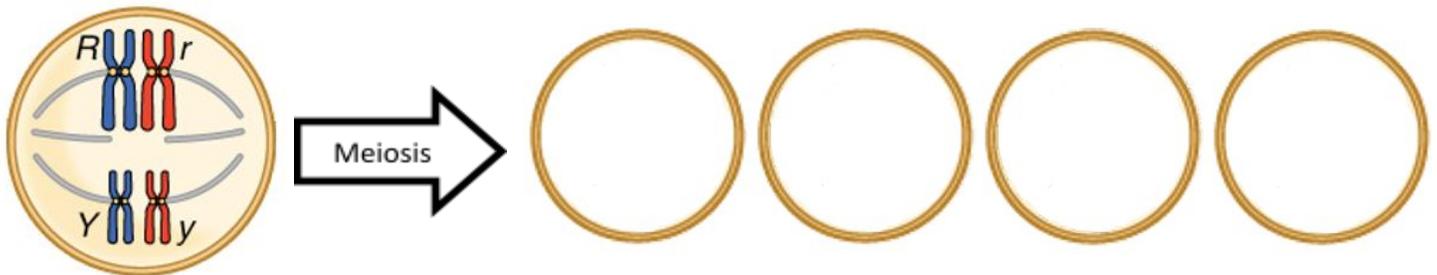
Mendelian Genetics: Dihybrid Cross

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 (Read Section 14.2 in text book)

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**?

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 male recently learned from a genetics doctor that they had a condition called Friedreich's ataxia. This syndrome affects the arms and the legs with the person usually needing a wheelchair. Neither of their biological parents have this disorder. However the young male's biological grandfather was wheelchair bound, but didn't know why because genetic information was very limited when the 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 male (Hh) recently has been diagnosed with familial hypercholesterolemia which is a dominant autosomal disorder. Prior to his diagnosis, he and his spouse had 3 children, a male first and then two females. The spouse was recently tested negative for familial hypercholesterolemia (hh). One of the females 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?

Mendelian Genetics: Two factor Crosses

31. In guinea pigs, dark fur is dominant to light fur and rough coat texture is dominant to smooth coat texture. What are the predicted genotype and phenotype ratios of a cross between a guinea pig that is heterozygous for both traits with another light-furred guinea pig who is heterozygous for texture?

32. In watermelon, the allele for short fruit is dominant to the allele for long fruit, and the allele for green fruit is dominant to the allele for mottled fruit. Each of four short, green plants were crossed with a different long, mottled plant. The phenotypes of the offspring of these crosses are shown below:

*Note: This is considered a **test cross**. The genotypes of phenotypically dominant individuals can be determined through crossing them with homozygous recessive individuals.*

Plant	Short, green	Short, mottled	Long, green	Long, mottled
1	28	30	33	31
2	71	0	60	0
3	109	0	0	0
4	49	56	0	0

What are the genotypes of plants 1-4?

HW: Review chapter 14 in the textbook for class on Monday, March 1st. Come to class with questions on topics on which you require more clarification. Review Page 290: Tips for Genetics Problems!