

Name: _____ David Qiu _____

Date:

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AP Biology Genetics Practice Packet 2023-2024

Alleles and Genotypes

Directions: Assume Mendelian inheritance. Answer the following.

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

Y → HD: __YY__ He: __Yy__ hr: __yy__ Q → HD: __QQ__ He: __Qq__ hr: __qq__ E → HD: __EE__
He: __Ee__ hr: __ee__

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

Purple flowers are dominant to white flowers.

Curly Hair in cats is recessive to straight hair.

PP _____ purple flowers _____

BB _____ curly hair _____

Pp _____ purple flowers _____

Bb _____ curly hair _____

pp _____ white flowers _____

bb _____ straight hair _____

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

- What is the chance a heterozygous parent passes on a recessive allele? __50%__
- What is the chance a heterozygous parent passes on a dominant allele? __50%__
- What is the chance a homozygous recessive parent passes on a dominant allele? __0%__
- What is the chance a homozygous recessive parent passes on a recessive allele? __100%__
- What is the chance a homozygous dominant parent passes on a dominant allele? __100%__
- What is the chance a homozygous dominant parent passes on a recessive allele? __0%__

Monohybrid Cross Problems

Directions: In humans, freckles are a trait that exhibits simple dominance. The two alleles for this trait are freckles (A) and no freckles (a). The gene for freckles is dominant over genes for no freckles. Read each scenario, complete a Punnett square, and answer the question. **SHOW ALL OF YOUR WORK.** For consistency, all probabilities should be expressed as percentages (e.g. 50% homozygous dominant, 50% heterozygous).

8. 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?

	a	a
A	Aa	Aa
A	Aa	Aa

The man has AA genotype and his wife has aa genotype, as a result all their children will be Aa

9. A man without freckles has four children with a woman without freckles. What are the genotypes of the man, the woman, and the children?

	a	a
a	aa	aa
a	aa	aa

since no freckles (a) is recessive, both the man and the woman must both be aa, and as a result all their children can also only be aa genotype

10. The man is heterozygous for the freckle trait. The woman is homozygous recessive for the freckle trait.
 a. What is the probability that their first child having freckles?

	A	a
a	Aa	aa
a	Aa	aa

50%

b. That the second child will be freckles?

50%

11. What are the chances a homozygous dominant male and a homozygous dominant female have a child without freckles? Complete a Punnett square.

	A	A
A	AA	AA
A	AA	AA

0%, all their children will have freckles

12. 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?

	A	a
A	AA	Aa
a	Aa	aa

They both have the Aa genotype

Law of Independent Assortment

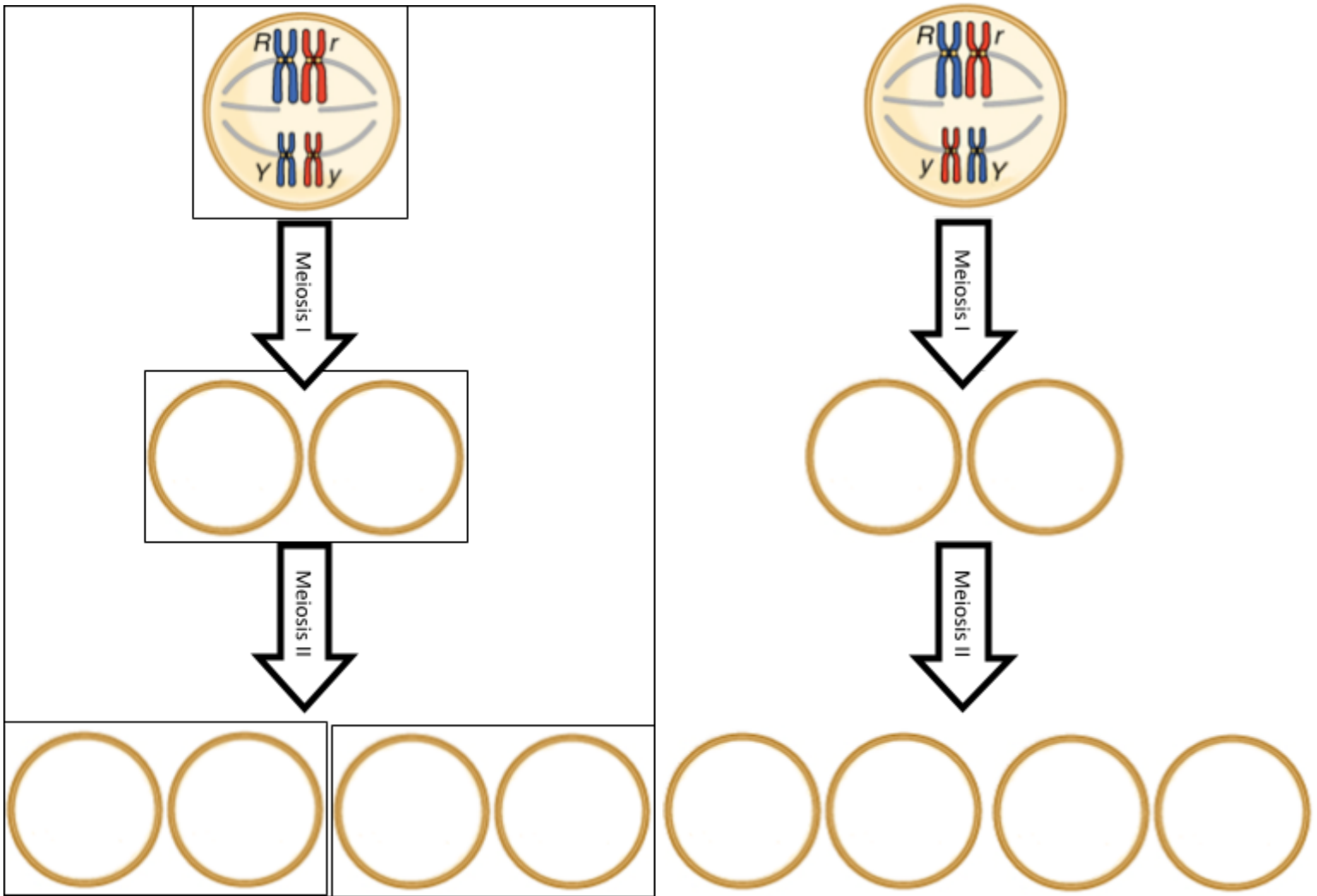
13. For each genotype listed, what type(s) of gametes could be produced? (Assume independent assortment occurs before gametes form.)

- AABB _____ AB _____
- Aabb _____ Ab, ab _____
- AaBB _____ AB, aB _____
- AaBb _____ AB, Ab, aB, ab _____

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

- AABBCC _____ ABC _____
- AaBBcc _____ ABc, aBc _____
- AaBbCc _____ ABC, aBC, AbC, ABc, Abc, aBc, abC, abc _____

15. The cells below are currently in Metaphase I of Meiosis I. Draw the chromosomes splitting during Meiosis I and Meiosis II in each cell. Make sure to use the correct colors.



Dihybrid Cross (Use the Product and Sum Rule)

16. Cross a heterozygous parent (AaBb) with a heterozygous parent (AaBb). Answer the following questions about the ratios from the dihybrid Punnett square. Set up a dihybrid Punnett square using the data below:

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

	AB	Ab	aB	ab
AB	AABB	AABb	AaBB	AaBb
Ab	AABb	AAbb	AaBb	Aabb
aB	AaBB	AaBb	aaBB	aaBb
ab	AaBb	Aabb	aaBb	aabb

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

- a. Yellow and Smooth: _____AABB, AaBB, AABb, AaBb_____
- b. Yellow and Wrinkled: _____AAbb, Aabb_____
- c. Green and Smooth: _____aaBB, aaBb_____
- d. Green and Wrinkled: _____aabb_____

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

- a. Yellow and Smooth - Ratio: 9:16 Probability: 56.25%
- b. Yellow and Wrinkled - Ratio: 3:16 Probability: 18.75%

c. Green and Smooth - Ratio: 3:16 Probability: 18.75%

d. Green and Wrinkled - Ratio: 1:16 Probability: 6.25%

Multiple Trait Crosses

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.

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

$2/16=0.125$ or 12.5%

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

0/640 or 0%

21. The parent generation has 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**?

$$2*1*2*1=4, 1*2*1*2=4, 4*4=16$$

$$2*1*2*1=4, 1*2*1*2=4, 4*4=16$$

$$16+16=32$$

$$32/256=0.125$$
 or 12.5%

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

$$1*1*2*2=4, 1*1*2*2=4, 4*4=16$$

$$16/256=0.063$$
 or 6.3%

23. The parent generation has 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**?

$$1 \cdot 1 \cdot 1 \cdot 0 \cdot 1 = 0, 1 \cdot 2 \cdot 1 \cdot 1 \cdot 1 = 2, 0 \cdot 2 = 0$$

there is no chance of the F1 generation getting this genotype

Autosomal Dominant and Recessive (Simple Mendelian) Genetics Word Problems

24. 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 wheelchair. 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.

- a. Based on this information, what type of inheritance does Friedreich's ataxia follow? Explain why.

Friedreich's ataxia follows autosomal recessive trait, because this type of inheritance is known to skip generations and both of his parents are carriers of the ataxia allele, if the disease is autosomal dominant then one of his parents must have it, on the other hand.

- b. What are the genotypes of each of the individuals mentioned in this question?

both of his parents have Ff gene (F for healthy and f for ataxia), and the man and his grandpa both have ff gene and have the ataxia

25. 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.

SCA is autosomal recessive, meaning that both parents must give the child the recessive s allele for them to be affected. since the parents in this do not have SCA but one of their parents do, they are heterozygous carriers of s allele. The probability of them having a child with SCA is 25%

- b. The man is affected by the disorder. The woman has no family history of SCA.

The woman is homozygous dominant with the SS genotype, and the man is homozygous recessive with the ss genotype, there is 0% chance of having a SCA affected child because all possible genotypes for them are Ss (heterozygous and healthy)

26. 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. One of the girls tested positive for the disease while the other two siblings tested negative.

- a. What are the genotypes of the children?

the children, from oldest to youngest, have hh, hh, and Hh genotypes respectively

- b. What is the probability the next child inherits the disease?

The next child has a 50% chance of inheriting the disease

27. Jason is a boy with no history of familial hypercholesterolemia in his family and has dreams of marrying his neighbor Michelle when they become older. Michelle's mother and father are both affected by familial hypercholesterolemia, but she has been tested and she does not contain the familial hypercholesterolemia gene. Jason has just learned about genetics in school and wants to predict the health of their future children.

- a. What are the genotypes of Jason and Michelle?

Jason and Michelle both are autosomal recessive with hh genotype

b. What are the genotypes of Michelle's parents? What are the genotypes of Jason's parents?

Because Jason has no family history of familial hypercholesterolemia, and he is healthy, his parents are hh; while Michelle's parents are affected but Michelle herself is healthy, suggesting that their genotype of Hh

Non-Mendelian Genetics: Multiple Alleles

28. Human hair color is controlled by one gene with four alleles (with some incomplete dominance):

$$H^{Br} = \text{brown} \quad H^{Bd} = \text{blonde} \quad h^R = \text{red} \quad h^{bk} = \text{black}$$

The possible genotypes and phenotypes:

$$H^{Bd} H^{Bd} \text{ or } H^{Bd} h^{bk} = \text{blonde}$$

$$H^{Br} H^{Br} \text{ or } H^{Br} h^{bk} = \text{brown}$$

$$H^{Bd} H^{Br} = \text{mousy brown}$$

$$H^{Br} h^R = \text{auburn}$$

$$H^{Bd} h^R = \text{strawberry blonde}$$

$$h^R h^R \text{ or } h^R h^{bk} = \text{red}$$

$$h^{bk} h^{bk} = \text{black}$$

a) If someone with auburn hair has children with someone with red hair (but whose mother had black hair), what are the genotype and phenotype probabilities for their children?

$$H^{Br} h^R \times h^R h^{bk}:$$

	H^{Br}	h^R
h^R	HBrhR	HRhR
h^{Bk}	HBrhBk	hRhBk

phenotypes: auburn, red, brown

b) If someone with strawberry blonde hair has a child with someone who has mousy blonde hair, what are the genotype and phenotype probabilities of their children?

c) If someone with brown hair (with a red hair parent) has a child with someone who has blonde hair (who also has a parent with red hair), what are the genotype and phenotype probabilities of their children?

Non-Mendelian Genetics: Codominance

Erminette Chickens: In some chickens, the gene for feather color is controlled by codominance. The allele for black is B and the allele for white is W. The heterozygous phenotype is known as Erminette (black and white spotted).

29. What are the genotypes for the following chickens?

- What is the genotype for black chickens? BB
- What is the genotype for white chickens? WW
- What is the genotype for Erminette chickens? BW

30. If two Erminette chickens were crossed.

- What would the genotypes of the two parents be? BW X BW
- What is the probability that they will have a white chick? 25%
- What is the probability that they will have a black chick? 25%
- What is the probability that they will have Erminette chicks? 50%

31. A black chicken and a white chicken are crossed.

- What would the genotypes of the two parents be? BB X WW
- What is the probability that they will have a white chick? 0%
- What is the probability that they will have a black chick? 0%
- What is the probability that they will have Erminette chicks? 100%



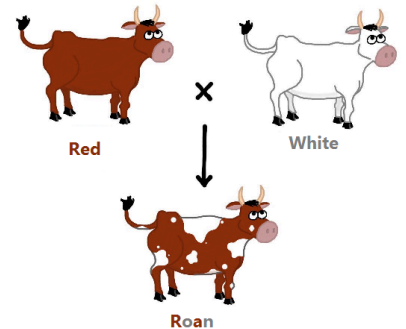
Roan Cattle: Roan cattle are a mix between red and white cattle. Roan cattle have both red and white fur because they are heterozygous for fur color and both alleles are expressed. This is another example of codominance. White cattle is homozygous for the W allele. Red cattle is homozygous for the R allele. Answer the following questions by creating Punnett squares.

32. What offspring are expected from mating a roan bull and a roan cow?

- What would the genotypes of the two parents be? RW X RW
- What is the probability that they will have a red offspring? 25%
- What is the probability that they will have a white offspring? 25%
- What is the probability that they will have roan offspring? 50%

33. What phenotypes would you expect from a cross between a roan bull and a white cow?

- What would the genotypes of the two parents be? RW X WW
- What is the probability that they will have a red offspring? 0%
- What is the probability that they will have a white offspring? 50%
- What is the probability that they will have roan offspring? 50%



Non-Mendelian Genetics: Multiple Alleles, Codominance

34. Both parents have blood type O, but do not know if they are Rh + or -.

- a. What are the chances the offspring is type A blood? 0 %
- b. What are the chances the offspring is type B blood? 0 %
- c. What are the chances the offspring is type AB blood? 0 %
- d. What are the chances the offspring is type O blood? 100 %

35. A parent is heterozygous for the Rh factor while the other parent is negative.

- e. What are the chances the offspring is +? 50 %
- f. What are the chances the offspring is -? 50 %

36. A father is heterozygous for type A blood and is homozygous positive for the Rh factor. A mother is heterozygous for type B blood and is homozygous positive for the Rh factor.

- g. What are the chances the offspring is type A blood? 25 %
- h. What are the chances the offspring is type B blood? 25 %
- i. What are the chances the offspring is type AB blood? 25 %
- j. What are the chances the offspring is type O blood? 25 %
- k. What are the chances the offspring is +? 100 %
- l. What are the chances the offspring is -? 0 %

37. A father has type B- blood who has a mother with type O blood, but doesn't know the father. A woman has type A+ blood who had genetic testing done and knows she is homozygous for both blood traits (ABO/Rh).

- m. What are the chances the offspring is type A blood? 50 %
- n. What are the chances the offspring is type B blood? 0 %
- o. What are the chances the offspring is type AB blood? 50 %
- p. What are the chances the offspring is type O blood? 0 %
- q. What are the chances the offspring is +? 100 %
- r. What are the chances the offspring is -? 0 %

38. A father has type AB+ blood who has a who is heterozygous for the Rh factor. A mother has type O+ blood and is heterozygous for the Rh factor.

- a. What are the chances the offspring is type A blood? 50 %
- b. What are the chances the offspring is type B blood? 50 %
- c. What are the chances the offspring is type AB blood? 0 %
- d. What are the chances the offspring is type O blood? 0 %
- e. What are the chances the offspring is +? 75 %
- f. What are the chances the offspring is -? 25 %

Non-Mendelian Genetics: Incomplete Dominance

In snapdragons, flower color is controlled by incomplete dominance. The two alleles are red (C^R) and white (C^W). The heterozygous genotype is expressed as pink. Red flowers and white flowers are both homozygous.

39. A pink-flowered plant is crossed with a white-flowered snapdragon plant.

- a. What is the probability that they will be red? 0 %
- b. What is the probability that they will be white? 50 %
- c. What is the probability that they will be pink? 50 %



40. A cross between two pink flower snapdragons.

- a. What is the probability that they will be red? 25 %
- b. What is the probability that they will be white? 25 %
- c. What is the probability that they will be pink? 50 %

41. What cross will produce the most pink-flowered plants? Show a Punnett square to support your answer.

	C^R	C^R
C^W	$C^R C^W$	$C^R C^W$
C^W	$C^R C^W$	$C^R C^W$

When a red flower and white flower is bred together, all offsprings will be pink

In Andalusian fowls, black birds (BB) and white birds (B'B') are homozygous. A heterozygous (BB' or B'B) Andalusian fowl will be a bluish-gray color.



42. A black Andalusian fowl is crossed with a white Andalusian fowl.

- a. What is the probability that they will be black? 0 %
- b. What is the probability that they will be white? 0 %
- c. What is the probability that they will be bluish-gray? 100 %

43. What results if a black Andalusian fowl is crossed with a bluish-gray Andalusian fowl?

- a. What is the probability that they will be black? 50 %
- b. What is the probability that they will be white? 0 %
- c. What is the probability that they will be bluish-gray? 50 %

44. A farm has a bluish-gray color Andalusian fowl, but doesn't want anymore of that color of bird. Which color of bird would be best for the farmer to breed the bluish-gray Andalusian fowl with in order to have the lowest chance of having offspring that are bluish-gray? Why?

Non-Mendelian Genetics: Sex-Linked Genetics

In humans, hemophilia is a sex-linked trait. Females can be unaffected, carriers, or have the disease. Males will either have the disease or not (but they won't ever be carriers)

$X^H X^H$ = healthy woman $X^H X^h$ = carrier woman $X^h X^h$ = diseased woman $X^H Y$ = healthy man $X^h Y$ = diseased man

45. Show the cross of a man who has hemophilia with a woman who is a carrier.
- What is the probability that their children will have the disease? 50 %
 - What is the probability that their son will have the disease? 50 %
 - What is the probability that their daughter will have the disease? 50 %
46. A woman who is a carrier marries an unaffected man. Show the cross.
- What is the probability that their children will have the disease? 25 %
 - What is the probability that their son will have the disease? 50 %
 - What is the probability that their daughter will have the disease? 0 %
47. A woman who has hemophilia marries an unaffected man.
- What is the probability that their children will have the disease? 50 %
 - What is the probability that their son will have the disease? 100 %
 - What is the probability that their daughter will have the disease? 0 %

In cats, the gene for calico (multicolored) cats is codominant. Females that receive a B and an R gene have black and orange splotches on white coats. Males can only be black or orange, but never calico. Here's what a calico female's genotype would look like. $X^B X^R$

48. Show the cross of a female calico cat with a black male cat?
- What percentage of the kittens will be black and male? 25 %
 - What percentage of the kittens will be orange and male? 25 %
 - What percentage of the kittens will be calico and male? 0 %
 - What percentage of the kittens will be calico and female? 25 %
 - What percentage of the kittens will be orange and female? 0 %
 - What percentage of the kittens will be black and female? 25 %

49. Show the cross of a female black cat with a male orange cat.
- What percentage of the kittens will be black and male? 100%
 - What percentage of the kittens will be orange and male? 0%
 - What percentage of the kittens will be calico and male? 0%
 - What percentage of the kittens will be calico and female? 100%
 - What percentage of the kittens will be orange and female? 0%
 - What percentage of the kittens will be black and female? 0%

Non-Mendelian Genetics: Polygenic Inheritance

A geneticist studying the inheritance of color in flowers crossed a pure white flower (aabb) with a dark red flower (AABB) and got all pink offspring. Interbreeding the pink flowers produced the following data:

- 43 dark red • 162 red • 245 pink • 166 light pink • 41 white

50. What are the genotypes of...
- The dark red flower AABB
 - The red flower AaBB
 - The pink flower AaBb
 - The light pink flower Aabb
 - The white flower aabb

51. Cross a red flower (AaBB) with a pink flower (AaBb). What are the expected phenotypic ratios of offspring?

	AB	AB	aB	aB
AB	AABB	AABB	AaBB	AaBB
Ab	AABb	AABb	AaBb	AaBb
aB	AaBB	AaBB	aaBB	aaBB
ab	AaBb	AaBb	aaBb	aaBb

- Dark Red: 12.5%
- Red: 12.5%
- Pink: 25%
- aa. Light Pink: %
- bb. White: %

52. Cross a light pink flower (aaBb) with a pink flower (AaBb). What are the expected phenotypic ratios of offspring?

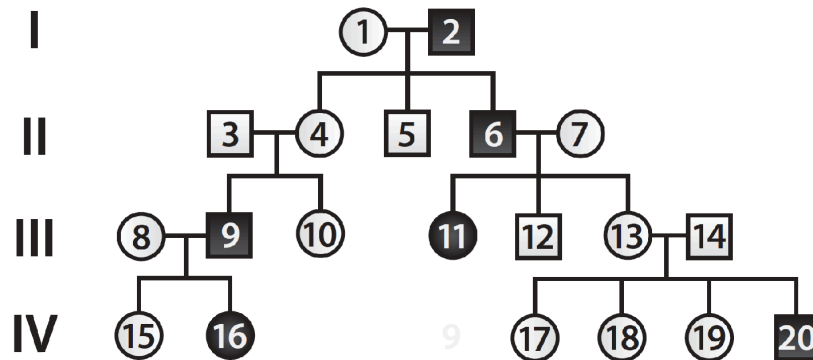
- cc. Dark Red: _____%
- dd. Red: _____%
- ee. Pink: _____%
- ff. Light Pink: _____%
- gg. White: _____%

53. Cross a light pink flower (Aabb) with a white flower (aabb). What are the expected phenotypic ratios of offspring?

- hh. Dark Red: _____%
- ii. Red: _____%
- jj. Pink: _____%
- kk. Light Pink: _____%
- ll. White: _____%

Pedigree Analysis Practice

54. The following pedigree traces sickle cell disease through four generations of a family living in the highlands of eastern Africa. Use the pedigree to answer the following questions.



- a. What are the genotypes of the following individuals? (If more than one genotype pertains, include all possibilities.)

Individual 1 ___Ss___	Individual 10 ___Ss, SS___
Individual 2 ___ss___	Individual 13 ___Ss___
Individual 7 ___Ss___	Individual 17 ___Ss, SS___
- b. If individuals 13 and 14 have another child, what are the chances that the child will have sickle cell disease?
 _____25%_____
- c. If the same couple has three more children, what are the chances that the three children will have sickle cell trait? (Show your work.) _____1.5625%_____

We know that there is a 25% chance of getting the ss genotype and having SCD, so the probability of all three children having that would be $(0.25)(0.25)(0.25)=0.015625$ or 1.5625%

d. Based on where this family lives, is the sickle cell trait genotype a genetic advantage? Explain.

It is a genetic advantage because because people with scd usually suffer from anemia, this condition is compensated by the lower oxygen concentration in high altitudes

e. If individuals 8 and 9 have four more children, what are the chances that two of the children will be homozygous for normal RBCs? Explain why.

We want 2 children to be homozygous dominant for normal rbc, which is impossible because 9 is homozygous recessive ss and 8 is heterozygous Ss (to have an affected 16) so all of their children will either be heterozygous or homozygous recessive, this chance of having two homozygous dominant child is 0%

CHI-SQUARE STATISTICS

55. Multiple couples living in a small village in the eastern African lowlands, all of whom are heterozygous for the *HbS* allele, have 500 children among them. Of these children, 139 are homozygous for *HbA*, 279 are heterozygous for *HbS*, and 82 suffer from sickle cell disease. Are these data statistically significant? Explain using a chi-square statistical analysis test.

Phenotype/Genotype	Observed (o)	Expected (e)	(o - e)	(o - e) ² /e
Homozygous for HbA	139	125	14	1.57
heterozygous for HbS	279	250	29	3.364
SCE	82	125	-43	14.792

- What is the chi-square value (χ^2)? 19.73
- Calculate the degrees of freedom (df). 2
- Using the critical values table, determine the *P* value. 5.99
- Interpret the *P* value as it relates to these data. Explain the significance.

19.73 > 5.99, the null hypothesis is rejected and we can conclude that this data shows no significance

- Which of the children have the greatest chance of survival? Explain why.

heterozygous children because they outnumber the expected number the most

56. Suppose there are 50 couples with the same blood type and hemoglobin genotypes. They live on a small, isolated Pacific island on which very few mosquitoes have been identified. All the individuals are heterozygous for type A blood and have sickle cell trait. The 50 couples had 224 children over the years. The children were all tested for blood type and for the presence of the sickle cell allele. Here are the results.

Testing Results

Blood Test Results	Number of Children
Type A, normal RBCs	48
Type O, normal RBCs	18
Type A, sickle cell trait	92
Type O, sickle cell trait	33
Type A, sickle cell disease	27
Type O, sickle cell disease	6

Are these data significant? Explain using a chi-square statistical analysis test. (Use the table below if you need assistance.)

Phenotype	Observed (<i>o</i>)	Expected (<i>e</i>)	(<i>o</i> - <i>e</i>)	(<i>o</i> - <i>e</i>) ² / <i>e</i>
Type A normal RBC	48	42	6	0.86
Type O normal RBC	18	14	4	1.14
Type A SC trait	92	84	8	0.76
Type O SC trait	33	28	5	0.89
Type A SCD	27	42	-15	5.36
Type O SCD	6	14	-8	4.57
Total	224	224		13.58

- What is χ^2 ? 13.58 Calculate *df*. 5
- Using the critical values table, determine the *P* value. 11.07
- Interpret the *P* value as it relates to these data. Explain the significance.

13.58 > 11.07, the null hypothesis is rejected and the data bears no statistical significance

- d. From what you know about hemoglobin, sickle cell disease, and blood type, what selection pressure is acting on this population of children and causing the null hypothesis to be rejected? Explain your answer. (Hint: Look at the actual differences between the observed and expected numbers.)

Many are fearful that they will be punished if they say they have SCD, so they lied to be normal RBCs and carriers

- e. Due to the increase in global travel and the prevalence of invasive species, the *Anopheles* mosquito carrying the malaria parasite was inadvertently introduced to this isolated Pacific island. A researcher, 100 years from the present day, decides to complete a follow-up study and monitors another 50 couples who are all heterozygous for type A blood and have sickle cell trait. These couples had 136 children. Based on the introduction of the *Anopheles* mosquito carrying the malaria parasite, *predict scientifically logical* observed numbers of children for each genotype possibility and complete a chi-square statistical analysis test.

Phenotype	Predicted Observed (o)	Expected (e)	(o - e)	(o - e) ² /e
Type A normal RBC				
Type O normal RBC				
Type A SC trait				
Type O SC trait				
Type A SCD				
Type O SCD				

- What is your *predicted* chi-square value (χ^2)? _____
- From your predicted numbers, do you accept or reject the null hypothesis? _____
- Based on what you know about hemoglobin, sickle cell disease, blood type, and malaria, what selection pressures are acting on this population of children? Explain your answer.

Genetic Recombination Problems

57. The following chart shows the crossover frequencies for some genes on an autosome of organism W. Construct a chromosome map. Map out the genes on a chromosome.

- What two genes are most likely going to be inherited together? C & W
- What two genes are most likely going to be recombined? C & S

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

58. The following chart shows the crossover frequencies for some genes on an autosome of organism Z. Construct a chromosome map. Map out the genes on a chromosome.

- a. What two genes are most likely going to be inherited together? D & W
- b. What two genes are most likely going to be recombined? W & L

Genes	Crossover Frequency
A & W	15%
W & L	30%
A & L	15%
A & D	20%
D & W	5%

59. Thomas Morgan collected the following crossover gene frequencies while studying *Drosophila*. Map out the genes on a chromosome.

- a. What two genes are most likely going to be inherited together? C & D
- b. What two genes are most likely going to be recombined? A & B

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%