

Name _____ Period _____

Monohybrid Cross Inheritance Problems

1. For each genotype, indicate whether it is heterozygous (HE) or homozygous (HO)

Aa _____ BB _____ Cc _____ dd _____ Ee _____ Ff _____ gg _____

2. On the basis of Mendel's hypothesis and observations, use Punnett squares to predict the results from the following crosses in garden peas. Show the Punnett square for each cross, and give both the phenotype and genotype ratios for each.

A tall (dominant and homozygous) plant crossed with a short one.

Key: tall= _____ short= _____

A. P₁ cross= _____ x _____

Punnett Square:

Phenotypic ratio: _____

Genotypic ratio: _____

B. the offspring of "A" (your first punnett square) crossed with each other.

Cross = _____ x _____

Punnett Square:

Phenotypic ratio: _____

Genotypic ratio: _____

C. an offspring of punnett "A" crossed with the original tall parent.

Cross = _____ x _____

Punnett Square:

Phenotypic ratio: _____

Genotypic ratio: _____



D. an offspring of Punnett "A" crossed with the original short parent.

Cross = _____ x _____

Punnett Square:

Phenotypic ratio: _____

Genotypic ratio: _____

Time for some practice

1. In mice, Gray color is considered to be dominant over white. Show the parent genotypes, the Punnett squares and give the phenotype and genotype ratios of the P1 generation: a homozygous gray mouse and a white mouse, show the F1.

2. Two laboratory mice are mated several times over many years. Data collected on their offspring indicate that 84 were gray and 27 were white. What were the genotypes and phenotypes of the two parent mice?

Genotypes: _____ (x) _____
 Phenotypes: _____ (x) _____

3. A certain male gray mouse is mated to several female mice. The first female was white and all their offspring were gray. The second female was gray and all the offspring were gray. The third female was gray and the offspring were both gray and white. The fourth female was white and offspring were both gray and white. Determine the genotypes of as many of the mice as possible.

Male: _____ 1st Female: _____ - offspring: _____
 2nd Female: _____ - offspring: _____
 3rd Female: _____ - offspring: _____ and _____
 4th Female: _____ - offspring: _____ and _____



4. A woman has a rare abnormality of the eyelids called Ptosis, which makes it impossible for her to open her eyes completely. It is controlled by a dominant gene (E). The woman's father had Ptosis, but her mother had normal eyelids. Her father's mother had normal eyelids. What are the probable genotypes of the woman, her father, and her mother?

Woman: _____ her Father: _____ her Mother: _____

What portion (or %) of her children would you predict would be expected to have Ptosis, if she marries a man with normal eyelids? _____ %

5. Two short-haired rabbits produce offspring that have long hair. Which trait is dominant? What are the genotypes of the parents and the offspring?
6. Sickle cell anemia occurs in two forms, mild and severe. Severely affected individuals are homozygous recessive, mildly affected individuals are heterozygous, and persons free of the disease (normal) are homozygous dominant.
- a. If both the mother and father in a family have the mild form of the disease, what is the chance that their baby will be severely affected? Mildly affected? Normal?
- b. A man with the mild form of sickle cell anemia marries a normal woman. What are the possible genotypes and phenotypes of their children?
7. In sheep, white is due to a dominant allele and black is its recessive allele. Two white sheep produce a black lamb. If next season another lamb is born to these same parents, could it be white? If yes, give the probability (chance that it will be white).



Let's take a closer look at how this applies to real world genetics:

Cystic fibrosis is a genetic disease that affects many different parts of the body. There are approximately 30,000 Americans with cystic fibrosis. The most serious problem is the production of extremely thick, sticky mucus that clogs up the bronchial tubes in the lungs and the passageways in the pancreas (recall that the pancreas makes enzymes that help break down food). This causes malnutrition, diabetes, lung infections, and difficulty getting enough oxygen to the body. Sadly, most people with cystic fibrosis die in their 20s or 30s from lung failure. Cystic fibrosis is caused by a mutation in the cystic fibrosis gene. This gene provides the code to produce a protein that helps produce digestive enzymes and mucus.

Cystic fibrosis is a recessive genetic disease, meaning that in order for someone to inherit the disease, they must have two copies of the recessive allele. The normal allele can be represented by "G" and the mutant recessive allele can be represented by "g".

1. Using what you know about DNA, what does it mean for there to be "a mutation in the cystic fibrosis gene"?
2. If you have cystic fibrosis, what is your genotype? _____
3. Approximately one in 25 Americans has a mutation in the cystic fibrosis gene. Does this mean that all of those people will have the cystic fibrosis disease? Explain your answer.

Cindy and Jonathan were married one year ago and are thinking of starting a family. Neither has cystic fibrosis. However, Cindy's younger sister is very sick with cystic fibrosis. This has made Cindy and Jonathan worried that a baby they have together may be born with cystic fibrosis.

4. Cindy's parents DO NOT have cystic fibrosis. Knowing that Cindy's sister has the disease, what must Cindy's parents' genotypes be? _____ How do you know their genotype?
5. What kinds of kids could Cindy's parents have? Fill in the Punnett square below.

- o What are the chances that one of their kid's genotype for this gene is GG? _____%
- o What are the chances that one of their kid's genotype for this gene is Gg? _____%
- o What are the chances that one of their kid's genotype for this gene is gg? _____%

Cindy and Jonathan decide to get genetic testing to see whether either of them carries a mutant cystic fibrosis gene. Remember, **Cindy and Jonathan do not have cystic fibrosis.**

- 6. The results come back saying that Cindy is heterozygous. What is her genotype? _____
- 7. Jonathan's results say that he is homozygous. What is his genotype? _____
- 8. What is the chance that Cindy and Jonathan's kids will have cystic fibrosis?

Check for Understanding:

- 9. Using the background information, explain how two people with different genotypes can have the same phenotype:

- 10. Huntington's disease is a dominant disease, meaning that if one copy of the dominant allele (H) is present, the person will have the disease. What is the probability that a couple will have a child that will develop Huntington's disease if the husband is heterozygous for Huntington's (Hh) and the wife is homozygous recessive (hh)?

- 11. In humans, freckles are dominant over not having freckles. If two people are both heterozygous for freckles get married and have children, what is the probability that they will have a child with freckles?

- 12. Dimples are a recessive trait. Two parents without dimples have 3 children, one with dimples and 2 with no dimples. Determine the genotypes of all the members of this family.

mom = _____ child with dimples=_____
- dad = _____ 2 children without dimples = _____

Monohybrid Cross Inheritance Problems **KEY**

1. For each genotype, indicate whether it is heterozygous (HE) or homozygous (HO)

Aa HE BB HO Cc HE dd HO Ee HE Ff HE gg HO

2. On the basis of Mendel's hypothesis and observations, use Punnett squares to predict the results from the following crosses in garden peas. Show the Punnett square for each cross, and give both the phenotype and genotype ratios for each.

A tall (dominant and homozygous) plant crossed with a short one.

Key: tall = T short = t

A. P₁ cross = TT x tt

Punnett Square:

	T	T
t	Tt	Tt
t	Tt	Tt

Phenotypic ratio: 4 : 0 (or 1 : 0)

Genotypic ratio: 0 : 1 : 0

B. the offspring of "A" (your first Punnet square) crossed with each other.

Cross = Tt x Tt

Punnett Square:

	T	t
T	TT	Tt
t	Tt	tt

Phenotypic ratio: 3 : 1

Genotypic ratio: 1 : 2 : 1

C. an offspring of Punnet "A" crossed with the original tall parent.

Cross = Tt x TT

Punnett Square:

	T	t
T	TT	Tt
T	TT	Tt

Phenotypic ratio: 4 : 0

Genotypic ratio: 2 : 2 : 0



D. an offspring of Punnett "A" crossed with the original short parent.

Cross = Tt x tt

Punnett Square:

	T	t
t	Tt	tt
t	Tt	tt

Phenotypic ratio: 2 : 2

Genotypic ratio: 0 : 2 : 2

Time for some practice

3. In mice, Gray color is considered to be dominant over white. Show the parent genotypes, the Punnett squares and give the phenotype and genotype ratios of the F1 generation: a homozygous gray mouse and a white mouse, show the F1.

P1: GG x gg

Phenotypic Ratio: 4 : 0

Genotypic Ratio: 0 : 4 : 0

	G	G
g	Gg	Gg
g	Gg	Gg

4. Two laboratory mice are mated several times over many years. Data collected on their offspring indicate that 84 were gray and 27 were white. What were the genotypes and phenotypes of the two parent mice?

Genotypes: Gg (x) Gg

Phenotypes: Gray (x) Gray

5. A certain male gray mouse is mated to several female mice. The first female was white and all their offspring were gray. The second female was gray and all the offspring were gray. The third female was gray and the offspring were both gray and white. The fourth female was white and offspring were both gray and white. Determine the genotypes of as many of the mice as possible.

Male: Gg

1st Female: gg

- offspring: Gg

2nd Female: GG

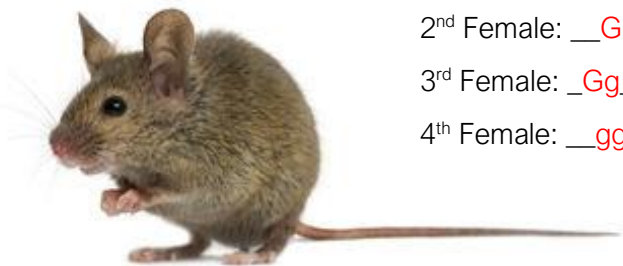
- offspring: GG, Gg

3rd Female: Gg

- offspring: GG, Gg and gg

4th Female: gg

- offspring: Gg and gg



6. A woman has a rare abnormality of the eyelids called Ptosis, which makes it impossible for her to open her eyes completely. It is controlled by a dominant gene (E). The woman's father had Ptosis, but her mother had normal eyelids. Her father's mother had normal eyelids. What are the probable genotypes of the woman, her father, and her mother?

Woman: Ee her Father: Ee her Mother: ee

What portion (or %) of her children would you predict would be expected to have Ptosis, if she marries a man with normal eyelids? 50 %

	E	e
e	Ee	ee
e	Ee	ee

8. Two short-haired rabbits produce offspring that have long hair. Which trait is dominant? What are the genotypes of the parents and the offspring?

Short hair is dominant

P1: Ss x Ss

F1: 1 : 2 : 1

9. Sickle cell anemia occurs in two forms, mild and severe. Severely affected individuals are homozygous recessive, mildly affected individuals are heterozygous, and persons free of the disease (normal) are homozygous dominant.

- b. If both the mother and father in a family have the mild form of the disease, what is the chance that their baby will be severely affected? Mildly affected? Normal?

P1: Aa x Aa

F1: 1 : 2 : 1

Normal : Mild : Severe

- c. A man with the mild form of sickle cell anemia marries a normal woman. What are the possible genotypes and phenotypes of their children?

P1: Aa x AA

F1: 2 : 2 : 0

Normal : Mild : Severe

10. In sheep, white is due to a dominant allele and black is its recessive allele. Two white sheep produce a black lamb. If next season another lamb is born to these same parents, could it be white? If yes, give the probability (chance that it will be white).

Yes, it could be white. Each of these events is independent of the other, so the probability that they will have another black sheet is 25%.



Let's take a closer look at how this applies to real world genetics:

Cystic fibrosis is a genetic disease that affects many different parts of the body. There are approximately 30,000 Americans with cystic fibrosis. The most serious problem is the production of extremely thick, sticky mucus that clogs up the bronchial tubes in the lungs and the passageways in the pancreas (recall that the pancreas makes enzymes that help break down food). This causes malnutrition, diabetes, lung infections, and difficulty getting enough oxygen to the body. Sadly, most people with cystic fibrosis die in their 20s or 30s from lung failure. Cystic fibrosis is caused by a mutation in the cystic fibrosis gene. This gene provides the code to produce a protein that helps produce digestive enzymes and mucus.

Cystic fibrosis is a recessive genetic disease, meaning that in order for someone to inherit the disease, they must have two copies of the recessive allele. The normal allele can be represented by "G" and the mutant recessive allele can be represented by "g".

13. Using what you know about DNA, what does it mean for there to be "a mutation in the cystic fibrosis gene"?

One or more of the nitrogenous bases has been inserted, deleted, or replaced.

14. If you have cystic fibrosis, what is your genotype? gg

15. Approximately one in 25 Americans has a mutation in the cystic fibrosis gene. Does this mean that all of those people will have the cystic fibrosis disease? Explain your answer.

No, because the gene is recessive, so they need to have both alleles.

Cindy and Jonathan were married one year ago and are thinking of starting a family. Neither has cystic fibrosis. However, Cindy's younger sister is very sick with cystic fibrosis. This has made Cindy and Jonathan worried that a baby they have together may be born with cystic fibrosis.

16. Cindy's parents DO NOT have cystic fibrosis. Knowing that Cindy's sister has the disease, what must Cindy's parents' genotypes be? Gg How do you know their genotype?

The only way they can have a baby with cystic fibrosis is if they are both carriers for the gene.

17. What kinds of kids could Cindy's parents have? Fill in the Punnett square below.

	G	g
G	GG	Gg
g	Gg	gg

- What are the chances that one of their kid's genotype for this gene is GG? 25%
- What are the chances that one of their kid's genotype for this gene is Gg? 50%
- What are the chances that one of their kid's genotype for this gene is gg? 25%

Cindy and Jonathan decide to get genetic testing to see whether either of them carries a mutant cystic fibrosis gene. Remember, **Cindy and Jonathan do not have cystic fibrosis.**

18. The results come back saying that Cindy is heterozygous. What is her genotype? **__Gg**

19. Jonathan's results say that he is homozygous. What is his genotype? **__GG__**

20. What is the chance that Cindy and Jonathan's kids will have cystic fibrosis?

They have a 0% chance of their children having cystic fibrosis, but there is a 50% chance that each child will be a carrier for the gene.

Check for Understanding:

21. Using the background information, explain how two people with different genotypes can have the same phenotype:

One person can be homozygous dominant (HH) and the other can be heterozygous (Hh), meaning they will both have the same phenotype, even though they have different genotypes.

22. Huntington's disease is a dominant disease, meaning that if one copy of the dominant allele (H) is present, the person will have the disease. What is the probability that a couple will have a child that will develop Huntington's disease if the husband is heterozygous for Huntington's (Hh) and the wife is homozygous recessive (hh)?

Hh x hh

There is a 50% chance that the H allele will be passed along, leading to Huntington's disease

23. In humans, freckles are dominant over not having freckles. If two people are both heterozygous for freckles get married and have children, what is the probability that they will have a child with freckles?

Ff x Ff

F1: 1 : 2 : 1

The probability they will have a child with freckles is 75%

24. Dimples are a recessive trait. Two parents without dimples have 3 children, one with dimples and 2 with no dimples. Determine the genotypes of all the members of this family.

mom = **__Dd__** child with dimples = **__dd__**

dad = **__Dd__** 2 children without dimples = **__DD or Dd__**