**Bikini Bottom Genetics** Name KEY

**Scientists at Bikini Bottoms have been investigating the genetic makeup of the organisms in this community. Use the information provided and your knowledge of genetics to answer each question.**

**1. For each genotype below, indicate whether it is a heterozygous (He) OR homozygous (Ho).**

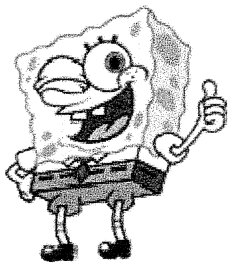
TT Ho Bb He DD Ho Ff He tt Ho dd Ho

Dd He ff Ho Tt He bb Ho BB Ho FF Ho

Which of the genotypes in #1 would be considered purebred? TT, ff, DD, bb, tt, BB, dd, FF

Which of the genotypes in #1 would be hybrids? Dd, Bb, Tt, Fe

**2. Determine the phenotype for each genotype using the information provided about SpongeBob.**



Yellow body color is dominant to blue.

YY yellow Yy yellow yy blue

Square shape is dominant to round.

SS square Ss square ss round

**3. For each phenotype, give the genotypes that are possible for Patrick.**

A tall head (T) is dominant to short (t).

Tall = TT, Tt Short = tt

Pink body color (P) is dominant to yellow (p).

Pink body = PP, Pp Yellow body = pp

**4. SpongeBob SquarePants recently met SpongeSusie Roundpants at a dance. SpongeBob is heterozygous for his square shape, but SpongeSusie is round. Create a Punnett square to show the possibilities that would result if SpongeBob and SpongeSusie had children. HINT: Read question #2!**

| | s | s |
|---|---|---|
| S | Ss | Ss |
| s | ss | ss |

A. List the possible genotypes and phenotypes for their children.

Ss, ss

B. What are the chances of a child with a square shape? 2 out of 4 or 50%

C. What are the chances of a child with a round shape? 2 out of 4 or 50%

**5. Patrick met Patti at the dance. Both of them are heterozygous for their pink body color, which is dominant over a yellow body color. Create a Punnett square to show the possibilities that would result if Patrick and Patti had children. HINT: Read question #3!**

| | P | p |
|---|---|---|
| P | PP | Pp |
| p | Pp | pp |

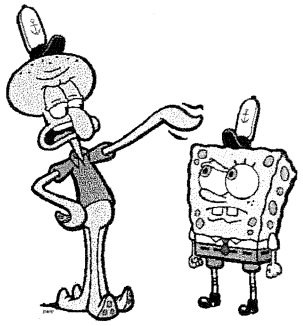
A. List the possible genotypes and phenotypes for their children.

PP, Pp, pp

B. What are the chances of a child with a pink body? 3 out of 4 or 75%

C. What are the chances of a child with a yellow body? 1 out of 4 or 25%

**6. Everyone in Squidward's family has light blue skin, which is the dominant trait for body color in his hometown of Squid Valley. His family brags that they are a "purebred" line. He recently married a nice girl who has light green skin, which is a recessive trait. Create a Punnett square to show the possibilities that would result if Squidward and his new bride had children. Use B to represent the dominant gene and b to represent the recessive gene.**



| | B | B |
|---|---|---|
| b | Bb | Bb |
| b | Bb | Bb |

A. List the possible genotypes and phenotypes for their children.

Bb

B. What are the chances of a child with light blue skin? 100 %

C. What are the chances of a child with light green skin? 0 %

D. Would Squidward's children still be considered purebreds? Explain!

No- they are "hybrids" or heterozygous because they have 2 different alleles-green from mom and blue from dad

**7. Assume that one of Squidward's sons, who is heterozygous for the light blue body color, married a girl that was also heterozygous. Create a Punnett square to show the possibilities that would result if they had children.**

| | B | b |
|---|---|---|
| B | BB | Bb |
| b | Bb | bb |

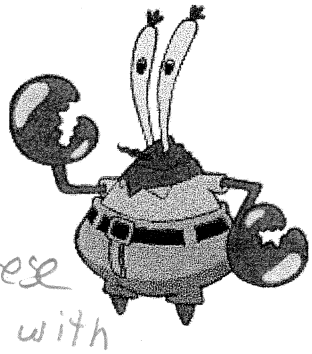
A. List the possible genotypes and phenotypes for their children.

BB, Bb, bb

B. What are the chances of a child with light blue skin? 75 %

C. What are the chances of a child with light green skin? 25 %

**8. Mr. Krabbs and his wife recently had a Lil' Krabby, but it has not been a happy occasion for them. Mrs. Krabbs has been upset since she first saw her new baby who had short eyeballs. She claims that the hospital goofed and mixed up her baby with someone else's baby. Mr. Krabbs is homozygous for his tall eyeballs, while his wife is heterozygous for her tall eyeballs. Some members of her family have short eyes, which is the recessive trait. Create a Punnett square using T for the dominant gene and t for the recessive one.**



| | T | T |
|---|---|---|
| T | TT | TT |
| t | Tt | Tt |

A. List the possible genotypes and phenotypes for their children.

100% tall eyes (TT or Tt)

B. Did the hospital make a mistake? Explain your answer.

yes - it is impossible for these two to have any offspring with 2 recessive alleles

KEY

# Genetics Practice Problems (single trait crosses)

**Courtesy of The Biology Binder**

Pictured here is an alien who displays all of the dominant characteristics of its species. Below is a chart listing various traits found in this alien race. Use the information in the chart to solve the genetics problems that follow.

| Trait | Dominant Phenotype | Recessive Phenotype |
|---|---|---|
| Body color | **(Y)** Yellow | **(y)** Orange |
| Number of Antennae | **(A)** 2 | **(a)** 1 |
| Eye color | **(P)** Purple | **(p)** White |
| Eyesight | **(E)** Glasses needed | **(e)** Glasses not worn |
| Number of Body Rings | **(R)** 3 | **(r)** 5 |

1. A heterozygous male mates with a pure yellow female. What is the chance this couple will produce an orange baby? Check your answer

♀ = YY

♂ = Yy

| | Y | Y |
|---|---|---|
| Y | YY | YY |
| y | Yy | Yy |

0%

2. Two purple-eyed aliens mate. Both aliens are hybrid for the eye color trait. What is the chance this couple will produce a baby with a homozygous recessive genotype? Check your answer

| | P | p |
|---|---|---|
| P | PP | Pp |
| p | Pp | pp |

← 25% chance "pp"

3. A heterozygous female with 3 body rings mates with a 5-ringed male. What is the chance that this couple will have a baby that looks like its mother? Check your answer

♀ = Rr

♂ = rr

| | R | r |
|---|---|---|
| r | Rr | rr |
| r | Rr | rr |

50% chance to look like mom

4. A pure male alien displaying the dominant body color mates with a female that is homozygous recessive for this

N/A

4. A pure male alien displaying the dominant body color mates with a female that is homozygous recessive for this characteristic. What is the chance that this couple will have a baby with a hybrid genotype? Check your answer

♀ = yy

♂ = YY

| | y | y |
|---|---|---|
| Y | Yy | Yy |
| Y | Yy | Yy |

100% Yy genotype

5. A male alien with 1 antenna mates with a female alien who has 2 antennae. The female is heterozygous for the antenna trait. What is the chance that this couple will produce a baby with the recessive phenotype? Check your answer

♀ = Aa

♂ = aa

| | A | a |
|---|---|---|
| a | Aa | aa |
| a | Aa | aa |

50% chance of 1 antenna phenotype

6. An alien couple, both of which wear glasses, are having a baby. The male's genotype is heterozygous. The female is phenotypically dominant but does carry the recessive allele. What is the chance that this couple's baby will have to wear glasses? Check your answer

| | E | e |
|---|---|---|
| E | EE | Ee |
| e | Ee | ee |

75% Dominant (will need glasses)

7. A 3-ringed female mates with a homozygous male. The female has been genetically tested and is carrying both the dominant and the recessive allele for this trait. The male displays the recessive phenotype. What is the chance that this couple will have a genetically pure baby? Check your answer

♀ = Rr

♂ = rr

| | R | r |
|---|---|---|
| r | Rr | rr |
| r | Rr | rr |

50% chance of being homozygous or "purebred"

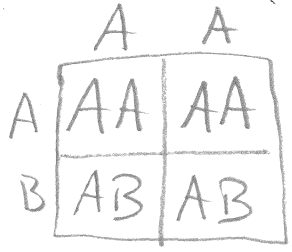
Biology CP

Name KEY

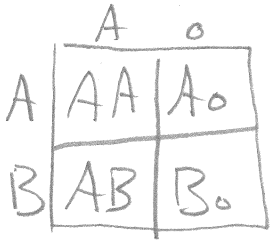
Date _____ Period _____

Genetics of Blood Types

1. Mom has type A blood. Dad has type AB blood. What possible blood types could their children inherit? (Show all possibilities).

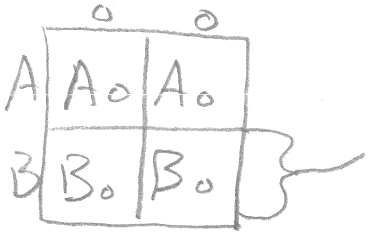



or



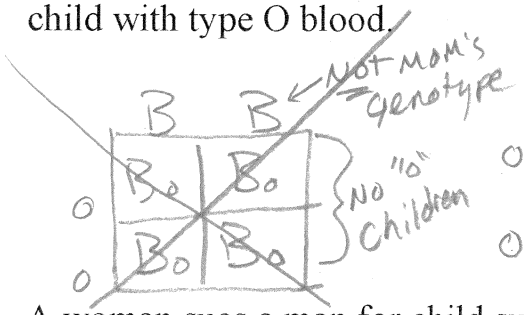

AA, Ao, Bo, AB

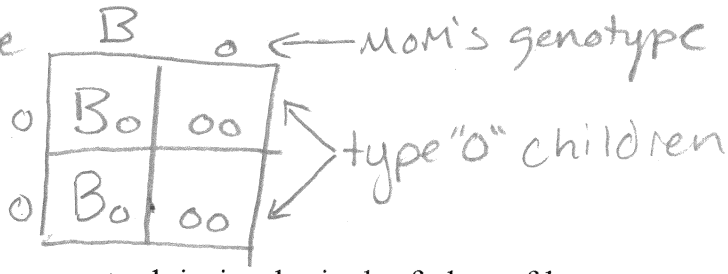
2. Mom has type O blood. Dad has type AB blood. What percentage of their kids will inherit type B blood?



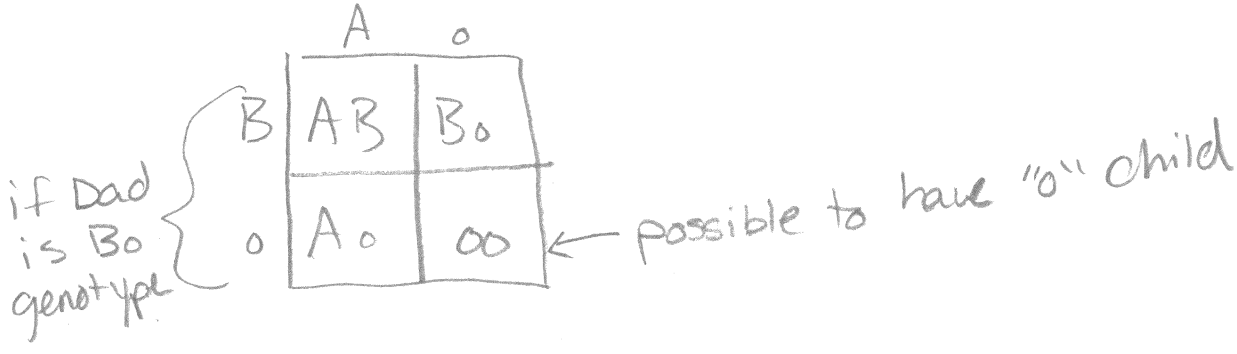

50% chance to have type "B" blood

3. Mom has type B blood. Dad has type O blood. They have a child with type O blood. Make a punnett square to show what Mom's genotype must be to have a child with type O blood.




4. A woman sues a man for child support, claiming he is the father of her illegitimate child. The woman is type A blood, the man is type B blood, and the child is type O blood. Show how it is possible for this man to be the father of this child.



5. A woman sues a man for child support, claiming that he is the father of her illegitimate child. The woman is type A, the child is type O, and the man is type AB. Could he be the father of her child? Show why or why not.

| | A | O |
|---|---|---|
| A | AA | Ao |
| B | AB | Bo |

Type "O" would have to inherit an "O" allele from each parent An AB dad does not have an O allele

6. A wealthy elderly couple dies together in an accident. A man comes forward, claiming that he is their long lost son and is entitled to their fortune. The couple were of blood types AB and O. The man has type O blood. Could he be the heir to the fortune? Show why or why not.

| | O | O |
|---|---|---|
| A | Ao | Ao |
| B | Bo | Bo |

Impossible to have type "O" offspring

7. John has type O blood. He knows his mother had type B blood. He does not know the identity of his father, however. What possible blood types could his father have had? Show your work.

① 

| | B | O |
|---|---|---|
| B | BB | Bo |
| O | Bo | oo |

② 

| | A | O |
|---|---|---|
| A | Ao | Ao |
| O | Ao | oo |

③ 

| | A | O |
|---|---|---|
| O | Ao | oo |
| O | Ao | oo |

Dad could be... Bo, Ao, oo

8. Mike has type AB blood. Paul has type O blood. Mike knows that his Mom had type B blood. Show how it could be possible for Mike and Paul to be brothers.

| | A | O |
|---|---|---|
| B | AB (Mike) | Bo |
| O | Ao | oo (Paul) |

Parents: Ao and Bo

9. Alice has type O blood. Jessica has type B blood. Jessica's mom had type O blood. Show how it is possible that Jessica and Alice are <u>not</u> sisters.

| | O | O |
|---|---|---|
| A | Ao | Ao |
| O | oo | oo |

no type B

| | O | O |
|---|---|---|
| O | oo | oo |
| O | oo | oo |

no type B

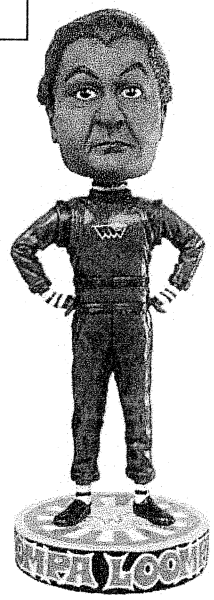
Dad must be either Ao or oo

Monohybrid Crosses

# OOMPA LOOMPA GENETICS

Name KEY

SHOW WORK HERE!



KEY

GG = gray face

Gg = gray face

gg = orange face

1. OOmpas generally have gray faces, which is caused by a dominant gene. The recessive condition results in an orange face. Develop a "key" to show the possible genotypes and phenotypes for the OOmpah's face colors.

2. Two heterozygous OOmpahs are crossed. What proportion of the offspring will have orange faces? 25%.

| ② | G | g |
|---|---|---|
| G | GG | Gg |
| g | Gg | gg |

3. A gray faced OOmpah (homozygous) is married to an orange faced Oompah. They have 8 Oompah children.
How many of those children will have gray faces? 100%

| ③ | G | G |
|---|---|---|
| g | Gg | Gg |
| g | Gg | Gg |

4. Otis Oompah has an orange face is is married to Ona OOmpah who has a gray face. They have 60 Oompah children, 30 of those children have orange faces. What is Ona and Otis OOmpah's genotype? _____ Show the cross. Otis = gg Ona = Gg

| ④ | G | g |
|---|---|---|
| g | Gg | gg |
| g | Gg | gg |

5. Odie Oompah has a gray face, in fact everyone in Odie's family has a gray face, and the family likes to brag that they are a "pure" line. Much to his family's horror, he married Ondi Oomah, who ***gasp*** has an orange face.
What will be the phenotypes of their children? gray

What are the genotypes of the children? Gg

| ⑤ | G | G |
|---|---|---|
| g | Gg | Gg |
| g | Gg | Gg |

6. Ona Oompah (from #4) divorces Otis and marries Otto. Otto has an orange face.
What is the probability that Ona and Otto's children will have an orange face? 50%

| ⑥ | G | g |
|---|---|---|
| g | Gg | gg |
| g | Gg | gg |

## Monohybrid Crosses

## Incomplete Dominance

7. OOmpahs can have red, blue, or purple hair. The allele that controls this trait is INCOMPLETELY DOMINANT, where purple hair is caused by the heterozygous condition. Show a "key" for the genotypes and phenotypes of hair color.

KEY

BB = blue

RR = red

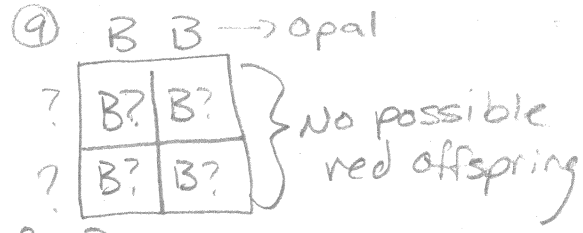
BR = purple

8. Orville Oompah has purple hair and is married to Opal Oompah who brags that she has the bluest blue hair in the valley. How many of Opal's children will be able to brag about their blue hair also. 50%
How many will take after their father? 50%

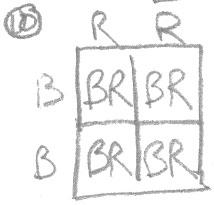
| | B | B |
|---|---|---|
| B | BB | BB |
| R | BR | BR |

## Incomplete Dominance

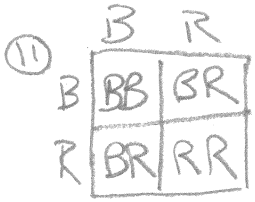
9. One of Opal's children is born with shocking red hair. Is Orville Oompah the father of this child? N
But wait, Opal swears that she has been faithful, she claims the hospital goofed and got her baby mixed with someone else's. Is Opal the mother of the red haired child?
No



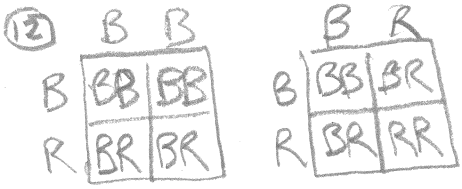

10. Olga Oompah has red hair and marries Oliver Oompah who has blue hair. They have 32 children. What is the color of these children's hair? purple



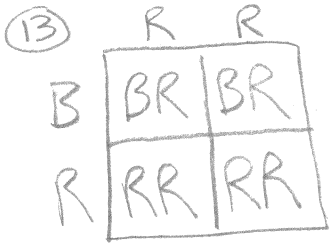

11. Olivia Oompah is married to Odo Oompah. Both of them have purple hair. They have 100 children. What is the hair color of their children and in what proportion?
Red 25% Blue 25% Purple 50%




12. In the land of OOmpah, blue hair is highly valued. Blue haired OOmpahs get special benefits. Oscar Oompah has purple hair but he wants a wife that will give him children with blue hair.
What color hair should he look for in a wife? BLUE
If he can't find this type of Oompah what should be his second choice? PURPLE




13. Ophelia Oompah is not married but she wants to have children. She goes to a fertility clinic where she is fertilized by an anonymous sperm donor. Ophelia has red hair. 5 months later, a litter of oompahs is born, of the eight babies in the litter, 4 of them have red hair, and 4 of them have purple hair. What color hair did the babies' father have? BR (Show the cross)




14. Ophelia repeats the process a year later. This time she has a litter of 5 oompahs, all of which have purple hair. What was the father's hair color in this case? most likely BB
(Show the cross)


## Dihybrid Crosses

15. A homozygous gray faced, blue haired oompah named Ortimer marries an orange faced (homozygous) red haired oompah named Odette. GGBB x ggRR What will Ortimer and Odette's children look like? gray face + purple hair

GgBR

16. Two oompahs, both heterozygous for both traits are married. Out of 16 children, how many of each type would you expect?

| | GB | GR | gB | gR |
|---|---|---|---|---|
| GB | GGBB | GGBR | GgBB | GgBR |
| GR | GgBR | GGRR | GgBR | GgRR |
| gB | GgBB | GgBR | ggBB | ggBR |
| gR | GgBR | GgRR | ggBR | ggRR |

Gray/Blue 3/16
Gray/Red 3/16
Gray/Purple 6/16
Orange/Blue 1/16
Orange/Red 1/16
orange/purple 2/16

Name KEY

# GENETICS: X LINKED GENES

****In fruit flies, eye color is a sex linked trait. Red is dominant to white ****

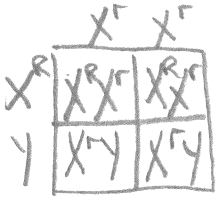
1. What are the sexes and eye colors of flies with the following genotypes:

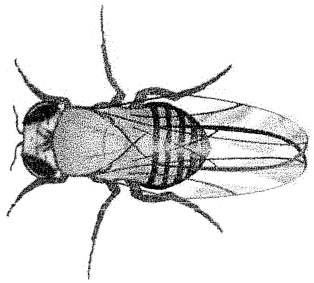
$X^RX^r$ female red $X^RY$ male red $X^rX^r$ female white
$X^RX^R$ female red $X^rY$ male white

2. What are the genotypes of these flies:

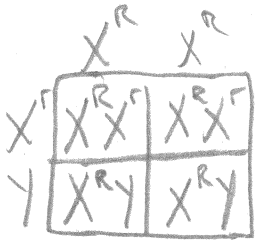
white eyed, male $X^rY$ red eyed female (heterozygous) $X^RX^r$
white eyed, female $X^rX^r$ red eyed, male $X^RY$

3. Show the cross of a white eyed female $X^rX^r$ with a red-eyed male $X^RY$.



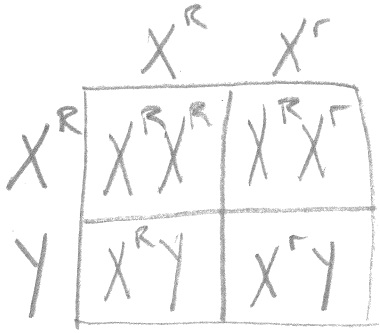



4. Show a cross between a pure red eyed female and a white eyed male.
What are the genotypes of the parents: $X^RX^R$ & $X^rY$




How many are:
white eyed, male 0%
white eyed, female 0%
red eyed, male 50%
red eyed, female 50%

5. Show the cross of a red eyed female (heterozygous) and a red eyed male. What are the genotypes of the parents?
$X^RX^r$ & $X^RY$




How many are:
white eyed, male 25%
white eyed, female 0%
red eyed, male 25%
red eyed, female 50%

Math: What if in the above cross, 100 males were produced and 200 females. How many total red-eyed flies would there be?
~150

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

$X^H X^H$ = female, normal

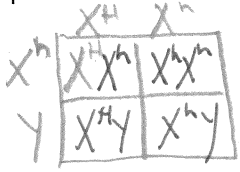
$X^H X^h$ = female, carrier

$X^h X^h$ = female, hemophiliac

$X^H Y$ = male, normal

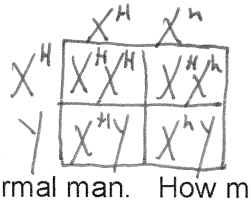
$X^h Y$ = male, hemophiliac

Show the cross of a man who has hemophilia with a woman who is a carrier.



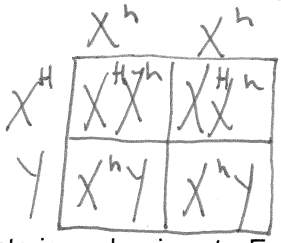
What is the probability that their children will have the disease? 50%

7. A woman who is a carrier marries a normal man. Show the cross. What is the probability that their children will have hemophilia? What sex will a child in the family with hemophilia be?



- 25% chance of hemophilia (50% if you are male)
- only males can get the condition in this case

8. A woman who has hemophilia marries a normal man. How many of their children will have hemophilia, and what is their sex?

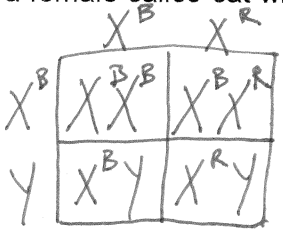


- 50% children (100% of males) have hemophilia
- only boys will get it - no girls

9. 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.

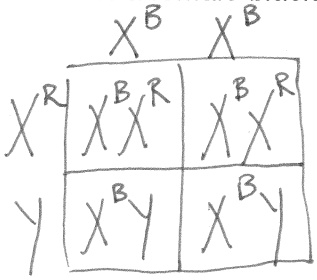
Here's what a calico female's genotype would look like. $X^B X^R$

Show the cross of a female calico cat with a black male?

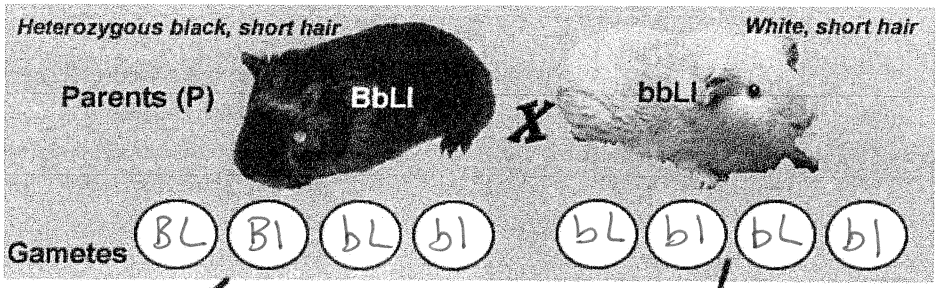


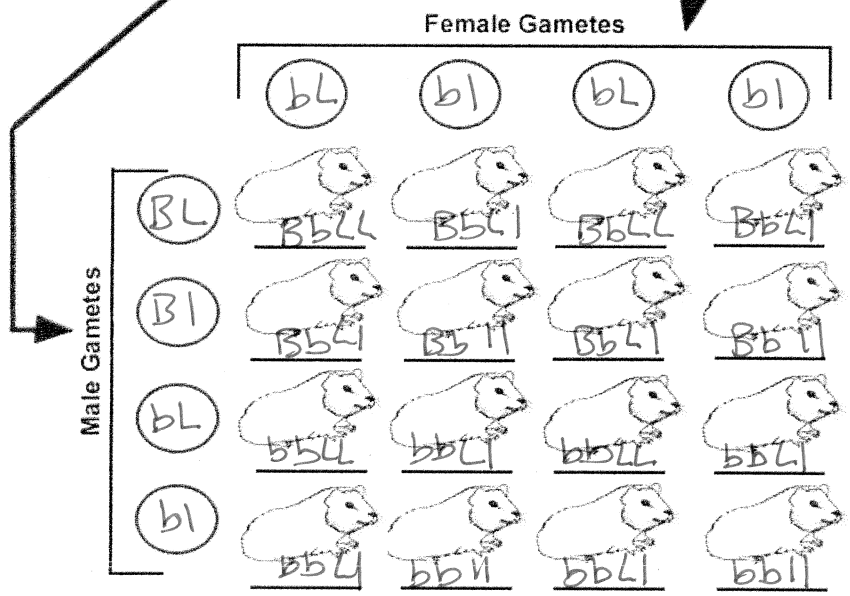
What percentage of the kittens will be black and male? 25%
What percentage of the kittens will be calico and male? 0%
What percentage of the kittens will be calico and female? 25%

10. Show the cross of a female black cat, with a male orange cat.



What percentage of the kittens will be calico and female? 50%
What color will all the male cats be? black




How many of the offspring are:

Black, Short 4

Black, Long 4

White, Short 4

White, Long 4

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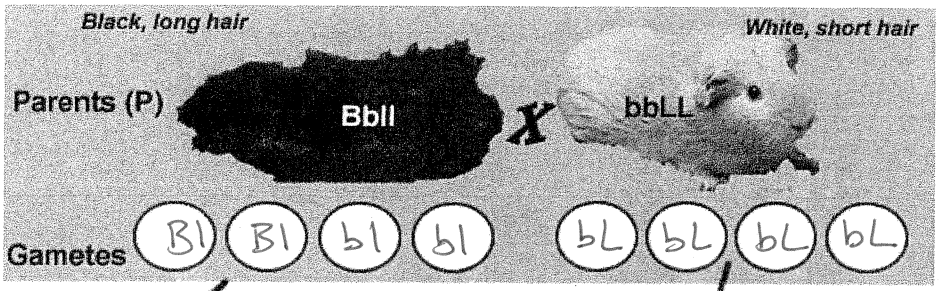
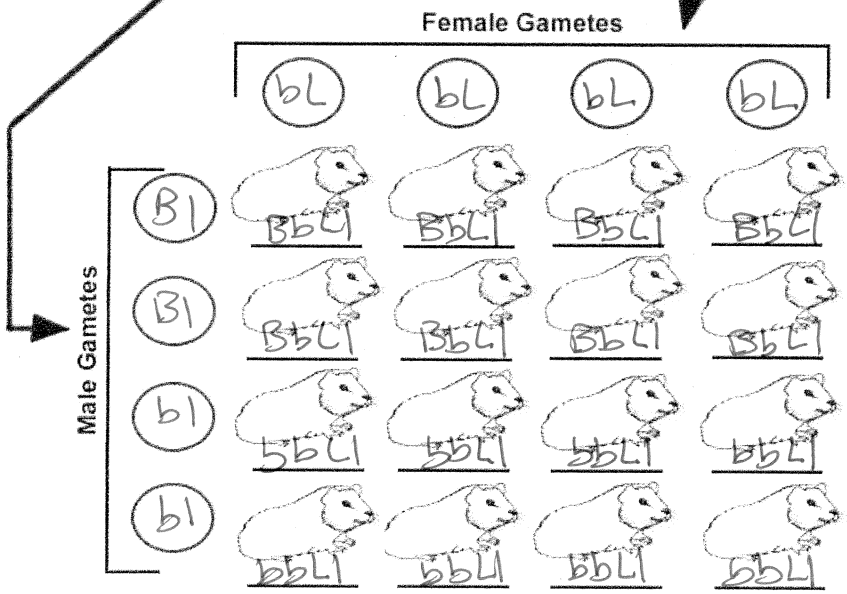



How many of the offspring are:

Black, Short 0

Black, Long 8

White, Short 0

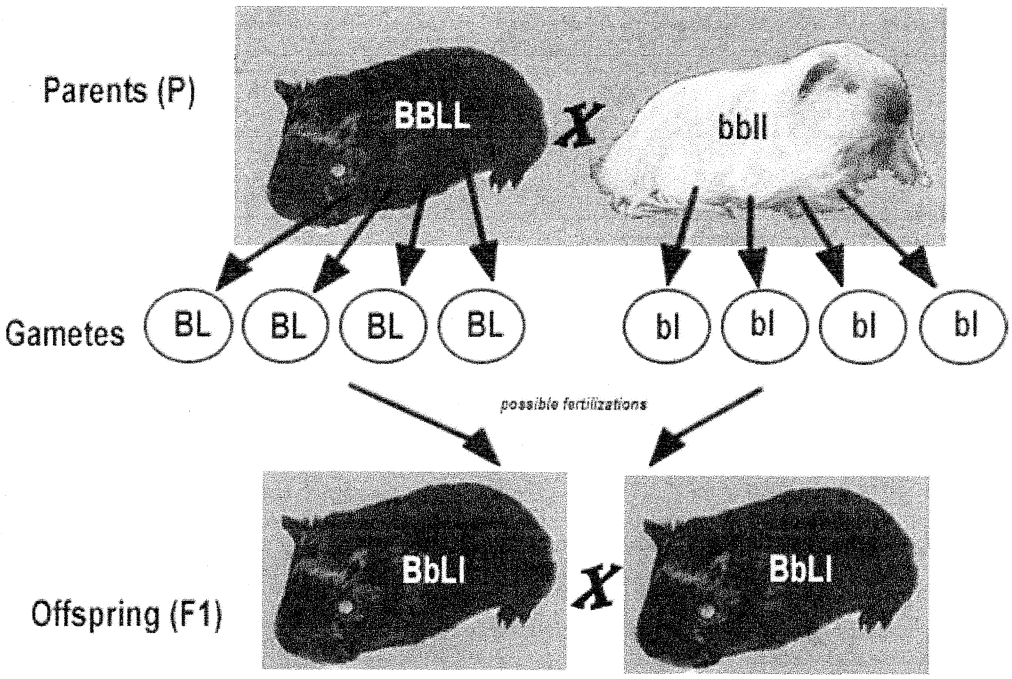
White, Long 8

# DIHYBRID CROSS

Name KEY

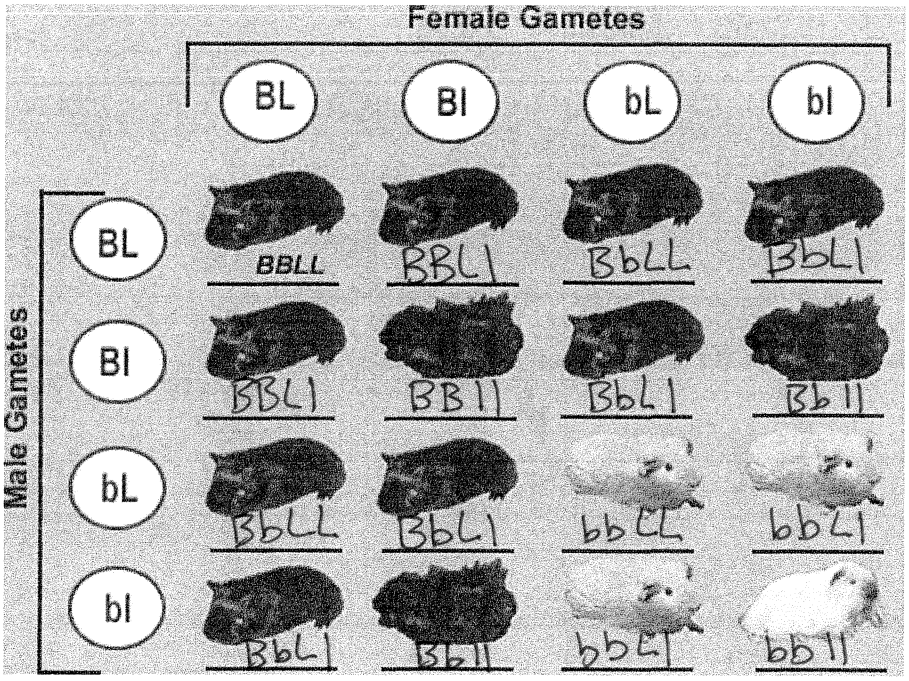
A cross (or mating) between two organisms where two genes are studied is called a DIHYBRID cross.

The genes are located on separate chromosomes, so the traits themselves are unrelated.



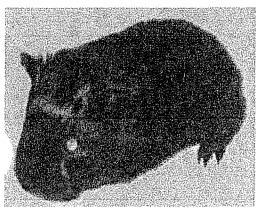

BB = black
Bb = black
bb = white

LL = short hair
Ll = short hair
ll = long hair

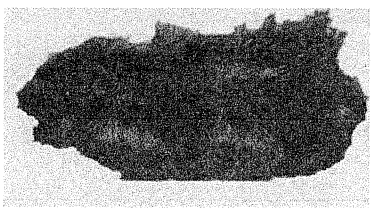



Fill out the genotypes of each of the offspring to determine how many of each type of offspring are produced.

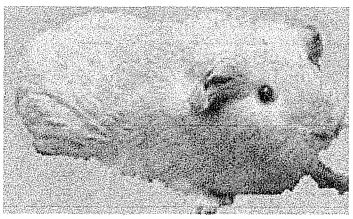
Phenotypic ratios - How many, out of 16 are:



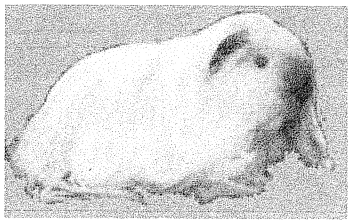
Black, Short
9 of 16



Black, Long
3 of 16



White, Short
3 of 16



White, Long
1 of 16