Formation of gametes

A a genotype before sex cells are made. (Full set of chromosomes)

Separate during meiosis

½ set of chromosome

Monohybrid cross – a one-trait cross = a ONE GENE cross with any alleles that are present.

Cross: AA x aa (P-generation)

	a	a
A	Aa	Aa
A	Aa	Aa

F1 Generation

4/4 x100 = 100% green flwr.

Cross: Aa x Aa

	A	a
A	AA	Aa
a	Aa	aa

3/4 x100 = 75% green
1/4 x100 = 25% white

Genotypic ratio: ratio of potential genotypes of the offspring, from Dominant to recessive.

homozygous dominant : heterozygous : homozygous recessive

0 : 4 : 0
AA : Aa : aa

1 : 2 : 1
AA : Aa : aa

Phenotypic ratio: ratio of dominant to recessive appearances (expressions of genes) of potential offspr.

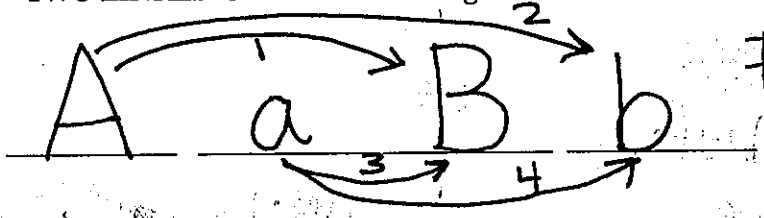
dominant phenotype : recessive phenotype

4 : 0
AA/Aa : aa
green : white

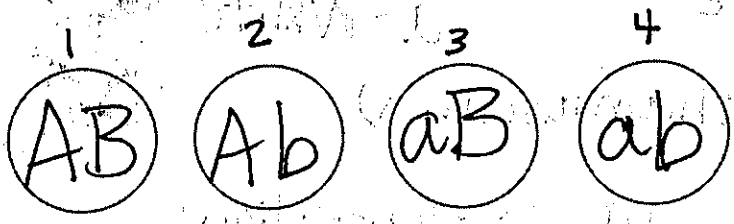
3 : 1
AA/Aa : aa
green : white

Dihybrid cross – a two-trait cross = TWO LINKED GENES close enough on a chromosome that they can be predicted through Punnett squares.

How the gametes are formed...



F.O.I.L.



Cross: Aa Bb x Aa Bb

AB Ab aB ab AB Ab aB ab

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

Phenotypic ratio only! Dom – Dom : Dom – Rec : Rec – Dom : Rec – Rec

Genotypes to look for... 9 : 3 : 3 : 1

A_B_ : A-bb : aaB- : aabb

KEY

Monohybrid & Dihybrid Minions

Define the following terms:

Genotype the genetic make-up of an organism.

Phenotype the physical appearance of a trait.

Homozygous "same", either dominant or recessive alleles.

Heterozygous "different" alleles of a genotype. Aa.

Dominant always expressed if allele is present

Recessive only expressed if paired with another recessive copy.

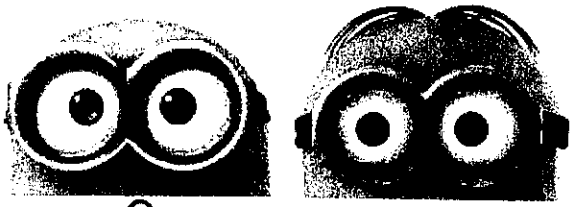
Heritable passed down from one generation to the next.

1. In minions, **sleek hair (S) is dominant to smooth hair (s).** If a female minion who was **heterozygous** married a minion with **smooth hair**, what would the potential genotypic and phenotypic ratios of their offspring be? Use the space below to draw a Punnett square and correctly write out the two ratios.

Genotypic Ratio – SS : Ss : ss
0 : 2 : 2

Phenotypic Ratio - sleek : smooth
2 : 2

Smooth Sleek



	S	s
s	Ss	ss
s	Ss	ss

2. Hair thickness is controlled by the "T" gene in minions. Answer the questions below based on this.

a. If thick hair is dominant to thin hair, the genotypes for hair thickness is:

homozygous dominant (thick hair) - TT

heterozygous (thick hair) - Tt

homozygous recessive (thin hair) - tt

b. Explain how each of the three genotypes in part "a" come to be by using the concept of dominance to describe it.

T" dominant over "t" so when present, its expressed

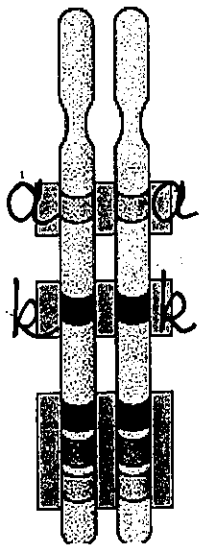
TT tt

c. Should a **homozygous dominant** and **homozygous recessive** minion have offspring, what is the probability of having a **thin haired offspring**? Draw a Punnett square to help you explain.

0 : 4 : 0

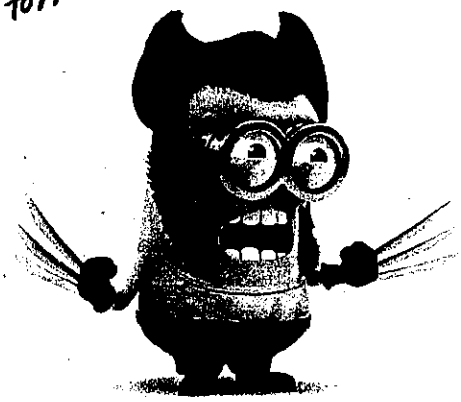
0% chance of thin hair (tt)

	T	T
t	Tt	Tt
t	Tt	Tt



A/a - tolerate K/k - form knives

3. In Wolver-minion, the ability to **tolerate adamantium** (a metal) and the ability to **form hand-knives** are located on two different genes found on chromosome #9. The **ability to tolerate adamantium is a recessive characteristic, as is the ability to form hand-knives.**



a. Draw Wolver-minion's **genotype on the homologous chromosomes #9 located to the left.** Choose which genes the traits (alleles) are found on and write his genotype on the picture. You can use any letter you wish to represent the alleles for each gene.

b. There are two wolver-minions that meet and have an offspring. If **Logan is homozygous recessive for both adamantium tolerance and ability to form hand-knives**; and he has an offspring with **Talus, a heterozygote for both traits**, what will be the probability that their offspring will be able to tolerate adamantium and form hand-knives? Draw a Punnett square to help you.

Talus AaKk

AK Ak aK ak

	AK	Ak	aK	ak
ak	AaKk	Aakk	aaKk	aakk
ak				
ak				
ak				

c. Write the genotypic and phenotypic ratios for Logan and Talus' potential offspring.

Genotypic ratio – too many to show!

Phenotypic ratio - A-K- ; A-kk ; aaK- ; aakk

4 : 4 : 4 : 4

Name KEY Date _____ Period _____

Worksheet: Mendel and Genetic Crosses

BIOLOGY: CHAPTER 6

Directions: Answer the following questions using your notes and textbook (pages 166-197)

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

AA Ho	Ee He	Ii He	Mm He
Bb He	ff Ho	Jj He	nn Ho
Cc He	Gg He	kk Ho	oo Ho
DD Ho	HH Ho	LL Ho	Pp He

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

Purple flowers are dominant to white flowers.

PP purple

Pp purple

pp white

Bobtails in cats are recessive.

TT normal tail } no bobtail

Tt normal tail }

tt bobtails

Brown eyes are dominant to blue eyes

BB Brown

Bb Brown

bb blue

Round seeds are dominant to wrinkled seeds

RR round

Rr round

rr wrinkled

3. For each **phenotype** below, list the **genotypes** (remember to use the letter of the dominant trait)

Straight hair is dominant to curly.

SS/Ss straight

ss curly

Pointed heads are dominant to round heads.

PP/Pp pointed

pp round

Long tails are dominant over short tails.

LL/Ll long tail

ll short tail

Long hair is dominant over short hair.

HH/Hh long hair

hh short hair

4. Set up the Punnet squares for each of the crosses listed below.

Round seeds are dominant to wrinkled seeds. **RR x rr**
What percentage of the offspring will be round?

	R	R
r	Rr	Rr
r	Rr	Rr

4/4 x 100 = 100% round

GR: 0:4:0
PR: 4:0

Rr x rr
What percent of the offspring will be round?

	R	r
r	Rr	rr
r	Rr	rr

2/4 x 100 = 50% round

GR: 0:2:2
PR: 2:2

RR x Rr
What percent of the offspring will be round?

	R	R
R	RR	RR
r	Rr	Rr

4/4 x 100 = 100%

GR: 2:2:0
PR: 4:0

Rr x Rr
What percent of the offspring will be round?

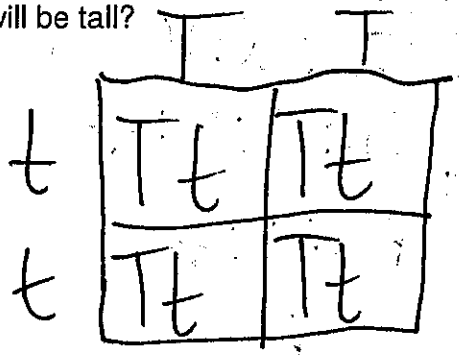
	R	r
R	RR	Rr
r	Rr	rr

3/4 x 100 = 75%

GR: 1:2:1
PR: 3:1

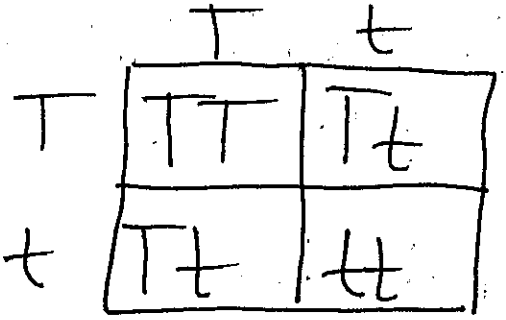
Practice with Crosses. Show all work! SHOW ALL WORK!

5. A **TT** (tall) plant is crossed with a **tt** (short plant). What percentage of the offspring will be tall?



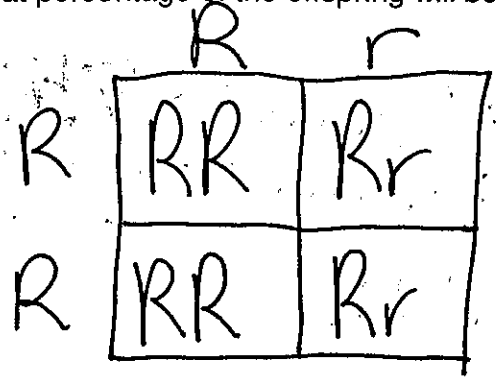
4/4 x 100 = 100%
GR: 0:4:0
PR: 4:0

6. A **Tt** plant is crossed with a **Tt** plant.
What percentage of the offspring will be short?



1/4 x 100 = 25%
GR: 1:2:1
PR: 3:1

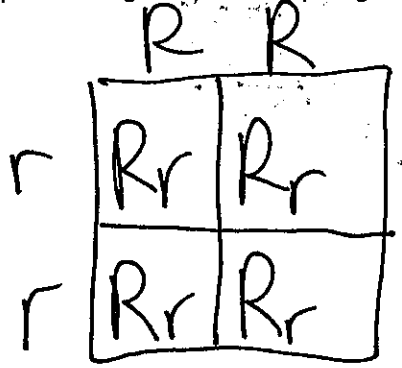
7. A heterozygous round seeded plant (**Rr**) is crossed with ahomozygous round seeded plant (**RR**). What percentage of the offspring will be homozygous (RR)?



2/4 x 100 = 50%
GR: 2:2:0
PR: 4:0

8. A **homozygous round seeded plant** is crossed with a **homozygous wrinkled seeded plant.**

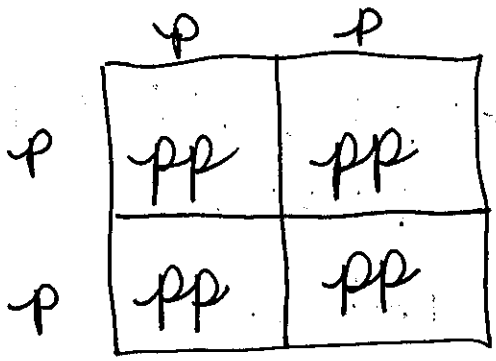
What are the genotypes of the parents? RR x rr
What percentage of the offspring will also be homozygous?



0/4 x 100 = 0%
GR: 0:4:0
PR: 4:0

pp x pp

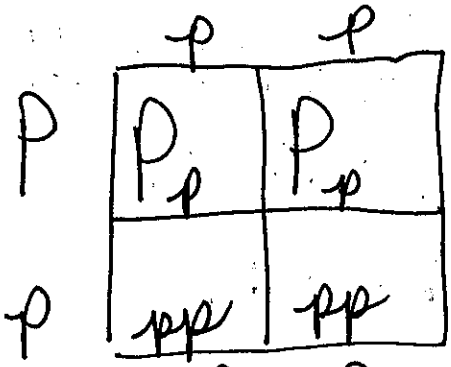
9. **In pea plants purple flowers are dominant to white flowers.**
If two **white flowered** plants are cross, what percentage of their offspring will be **white flowered?**



4/4 x 100 = 100%
GR: 0:0:4
PR: 0:4

pp Pp

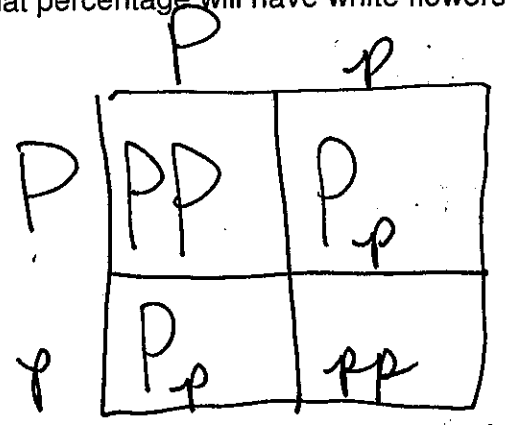
10. A **white flowered** plant is crossed with a plant that is **heterozygous** for the trait.
What percentage of the offspring will have purple flowers?



2/4 x 100 = 100%
GR: 0: 2: 2
PR: 2:2

Pp x Pp

11. Two plants, both **heterozygous** for the gene that controls flower color are crossed.
What percentage of their offspring will have purple flowers?
What percentage will have white flowers?

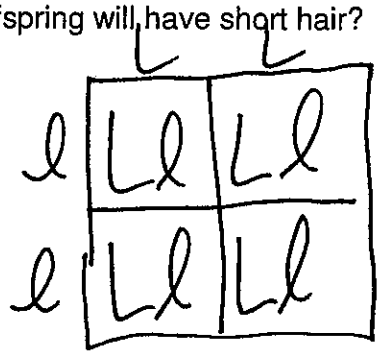


purple: 3/4 x 100 = 75%
white: 1/4 x 100 = 25%
GR: 1:2:1
PR: 3:1

12. In guinea pigs, the **allele for short hair is dominant.** L
What genotype would a heterozygous short haired guinea pig have? → Ll
What genotype would a purebreeding short haired guinea pig have? → LL
What genotype would a long haired guinea pig have? → ll

LL ll

13. Show the cross for a **pure breeding short haired** guinea pig and a **long haired** guinea pig.
What percentage of the offspring will have short hair?

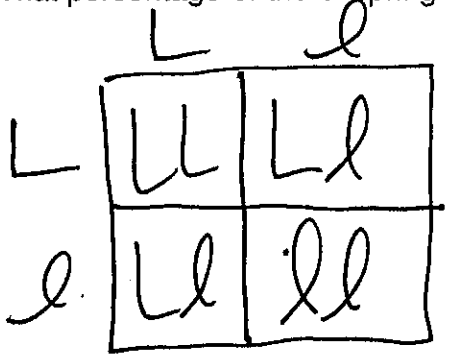


4/4 x 100 = 100%
GR: 0:4:0
PR: 4:0

14. Show the cross for two **heterozygous** guinea pigs.

What percentage of the offspring will have short hair? 3/4 x 100 = 75%

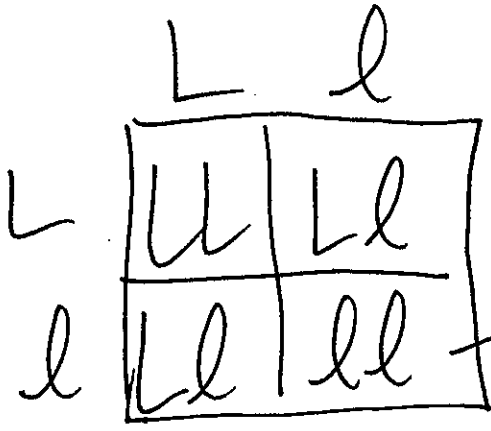
What percentage of the offspring will have long hair? 1/4 x 100 = 25%



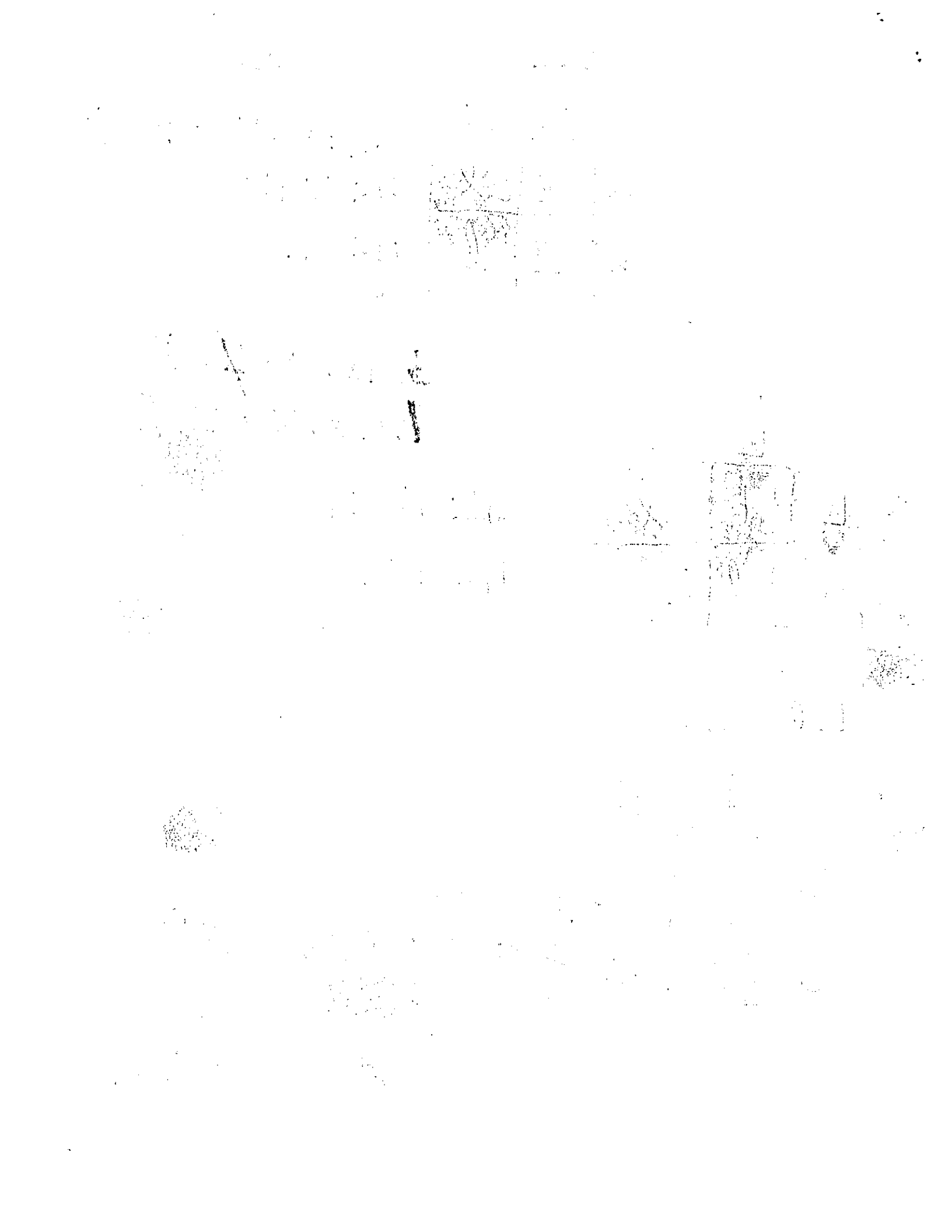
GR: 1:2:1
PR: 3:1

15. Two **short haired** guinea pigs are mated several times.
Out of 100 offspring, 25 of them have long hair. What are the probable genotypes of the parents?

Ll x Ll **Show the cross to prove it!**



→ 1/4 x 100 = 25%
long haired



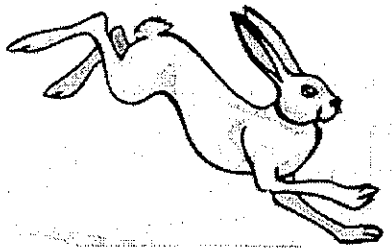
Date_____ Name KEY

Dihybrid Crosses and Polygenic Inheritance

In rabbits, grey hair is completely dominant to white hair and black eyes are completely dominant to red eyes.

GG = gray hair
Gg = gray hair
gg = white hair

BB=black eyes
Bb=black eyes
bb=red eyes



1. What are the phenotypes (descriptions) of rabbits that have the following genotypes:

Ggbb Grey, red eyes ggBB white, black eyes
ggbb white, red eyes GgBb Grey, Black eyes

2. A male rabbit with the genotype GGbb is crossed with a female rabbit with the genotype ggBb The dihybrid cross is set up below. Fill it out and determine the phenotypes and proportions in the offspring.

	Gb	Gb	Gb	Gb
gB	GgBb	GgBb	GgBb	GgBb
gB	GgBb	GgBb	GgBb	GgBb
gb	Ggbb	Ggbb	Ggbb	Ggbb
gb	Ggbb	Ggbb	Ggbb	Ggbb

How many out of 16 have grey fur and black eyes? 8 G-B-

How many out of 16 have grey fur and red eyes? 8 G-bb

How many out of 16 have white fur and black eyes? 0 ggB-

How many out of 16 have white fur and red eyes? 0 ggbb

What is the probability of having an offspring that is grey with red eyes?

8/16 x 100 = 50% chance

3. A male rabbit has the genotype GgBb . Determine the gametes produced by this rabbit (the sperm would have these combinations of alleles) Hint there are 4 combinations.

GB, Gb, gB, gb

4. A female rabbit has the genotype ggBB. Determine the gametes produced by this rabbit (the eggs would have these combinations of alleles) Hint there are 4 combinations.

gB, gB, gB, gB (all identical)

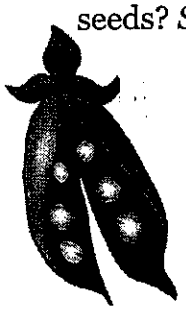
5. Use the gametes from #3 and #4 to set up the dihybrid cross below. Put the male's gametes on the top and the female's gametes down the side. Then fill out the square and determine what kind of offspring would be produced from this cross and in what proportion. What is the likelihood this pair of rabbits would produce a baby with the genotype ggBb? *Show your work!*

cross: GgBb x ggBB

ggBb
4/16 = 25%

	gB	gB	gB	gB
GB	GgBB	GgBB	GgBB	GgBB
Gb	GgBb	GgBb	GgBb	GgBb
gB	ggBB	ggBB	ggBB	ggBB
gb	ggBb	ggBb	ggBb	ggBb

6. A tall, yellow-seeded pea plant heterozygous for height and seed color (TtYy) is crossed with a tall, green-seeded pea plant that is heterozygous for height but homozygous recessive for seed color (Ttyy). If 80 offspring are produced, how many are expected to be tall and have yellow seeds? *Show your work!*



TtYy x Ttyy

(T-Y-)°

6/16 will have T-Yy/Y genotype

38%

	Ty	Ty	ty	ty
TY	TTYy°	TTYy°	TtYy°	TtYy°
Ty	TTyy	TTyy	Ttyy	Ttyy
tY	TtYy°	TtYy°	ttYy	ttYy°
ty	Ttyy	Ttyy	ttyy	ttyy

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.

Parents (P)

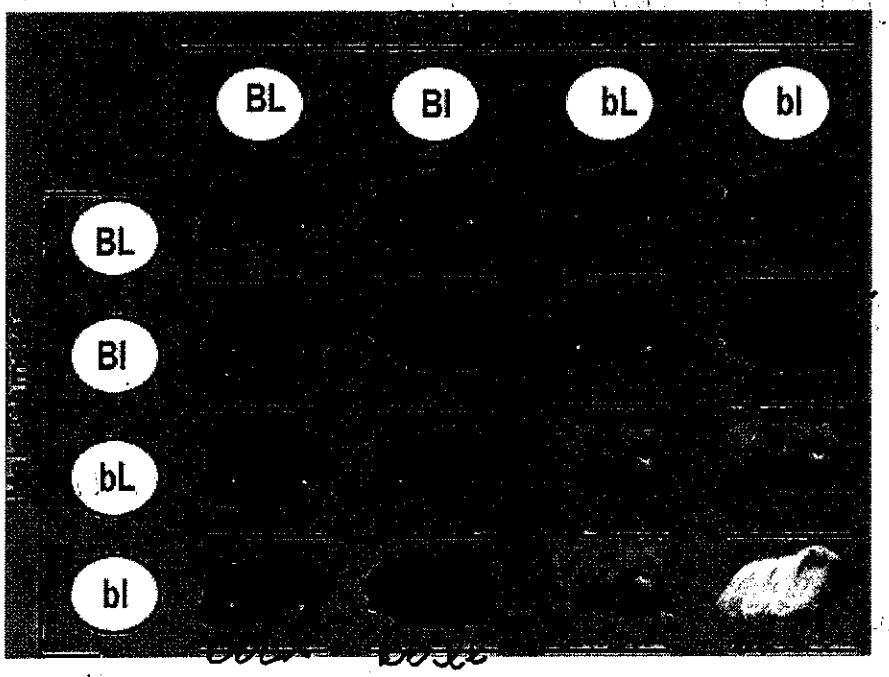
Gametes: BL BL BL BL | bl bl bl bl

possible fertilizations

Offspring (F1): BbLl X BbLl

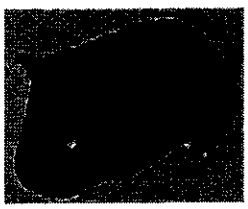
BB = black
Bb = black
bb = white

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

B_L_

Black, Long 3

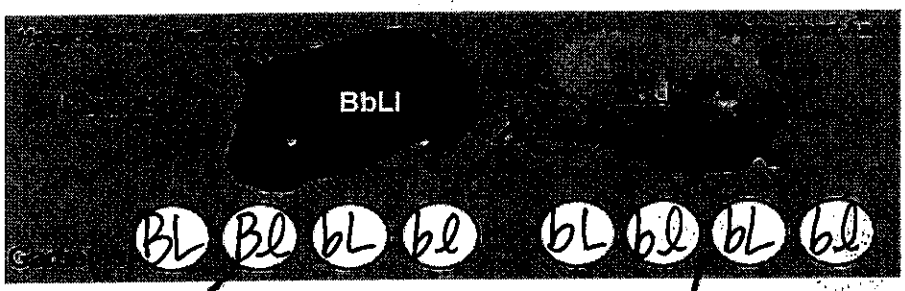
B_ll

White, Short 3

bbL_

White, Long 1

bbll



Female Gametes

Male Gametes	bL	bl	bL	bl
BL	BbLL	BbLl	BbLL	BbLl
Bl	BbLl	Bbll	BbLl	Bbll
bL	bbLL	bbLl	bbLL	bbLl
bl	bbLl	bbll	bbLl	bbll

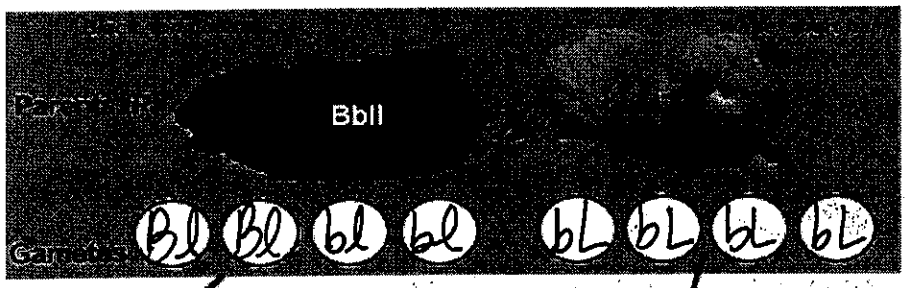
How many of the offspring are:

Black, Short 6 B_L_

Black, Long 2 B_ll

White, Short 6 bbL_

White, Long 2 bbll



Female Gametes

Male Gametes	bL			
Bl	BbLl			
Bl	BbLl			
bl	bbLl			
bl	bbLl			

same for other 3 columns

How many of the offspring are:

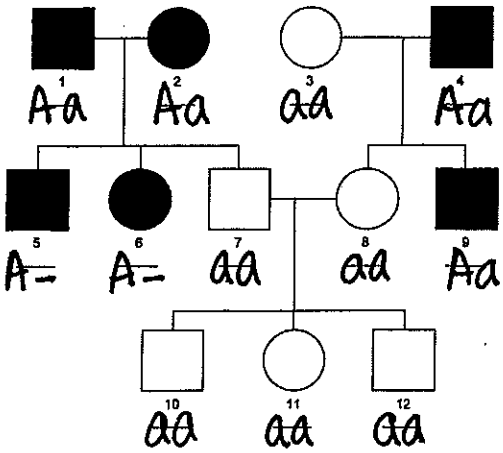
Black, Short 8

Black, Long 0

White, Short 8

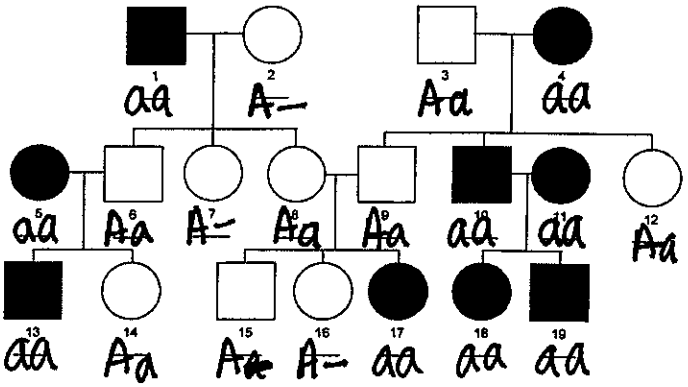
White, Long 0

Autosomal Dominant



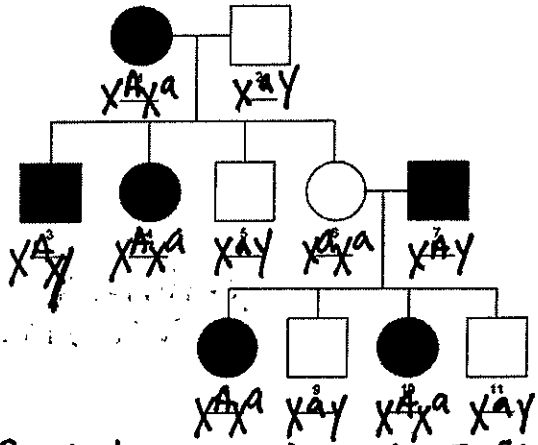
- 2 affected parents have healthy child.
- 50% affected from healthy and affected (carrier) parents.
- all affected people have affected parent.

AUTOSOMAL RECESSIVE

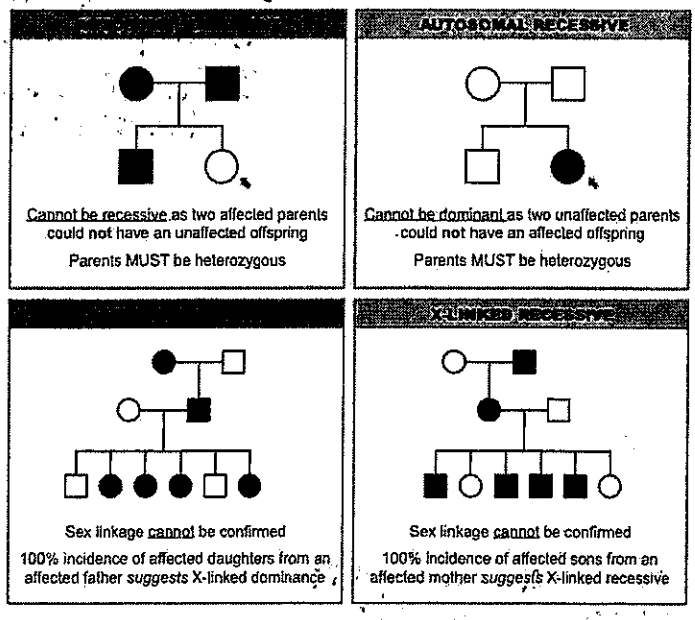


- child of healthy parents can be affected
- 2 affected parents have affected child 100% of time.

X-linked Dominant

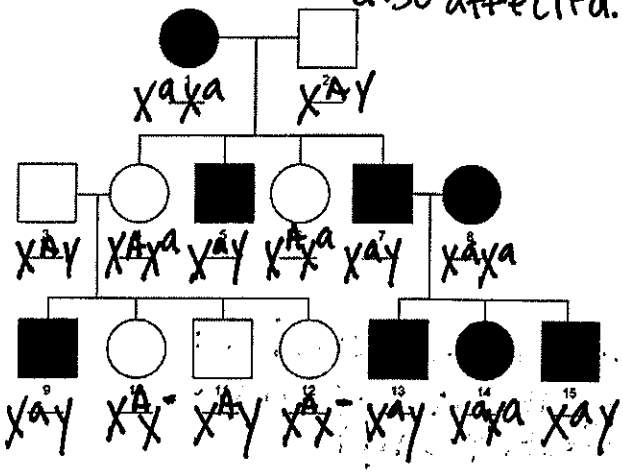


- affected mom gives to 50% of ♀ & ♂.
- affected dad gives to all ♀.



- no father to son inheritance
- mother affected gives to all ♂.
- 2 affected parents 100% offspring are also affected.

X-linked Recessive



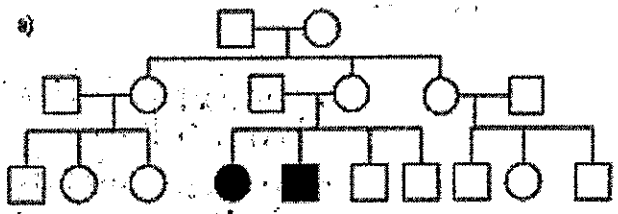
Human Pedigree Analysis Problem Sheet

There are a number of different types of human pedigrees that you may encounter, however, there are only a few different modes of inheritance that you will need to be familiar. The following pedigrees show you different examples of human traits that can be traced through generations. See if you can identify the modes of inheritance, and answer any questions directly related to each pedigree. While you are working on this, keep the following clues in mind:

Clues for Autosomal Inheritance	
Recessive • individual expressing trait has 2 normal parents • two affected parents can not have an unaffected child	Dominant • every affected person has at least one affected parent • each generation will have affected individuals
Clues for Sex-linked Inheritance	
Recessive • no father-to-son transmission • predominantly males affected • trait may skip generations	

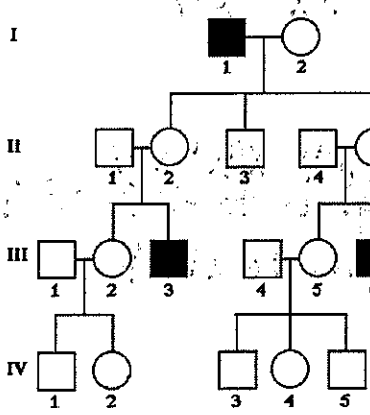
1. For each of the pedigrees below, identify the mode of inheritance and provide at least 2 reasons for your choice.

a)



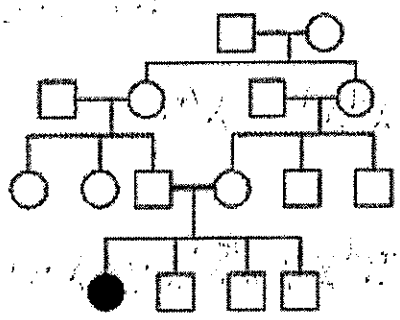
Autosomal recessive:
1. Healthy parents have affected kids
2. "A" masks "a" in parents. 3. skips.

c)



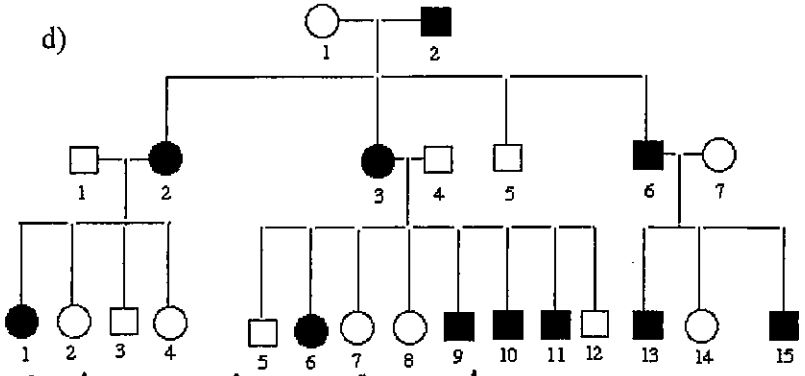
X-linked recessive:
1. only ♂ affecte
2. fathers cannot give to sons.

b)



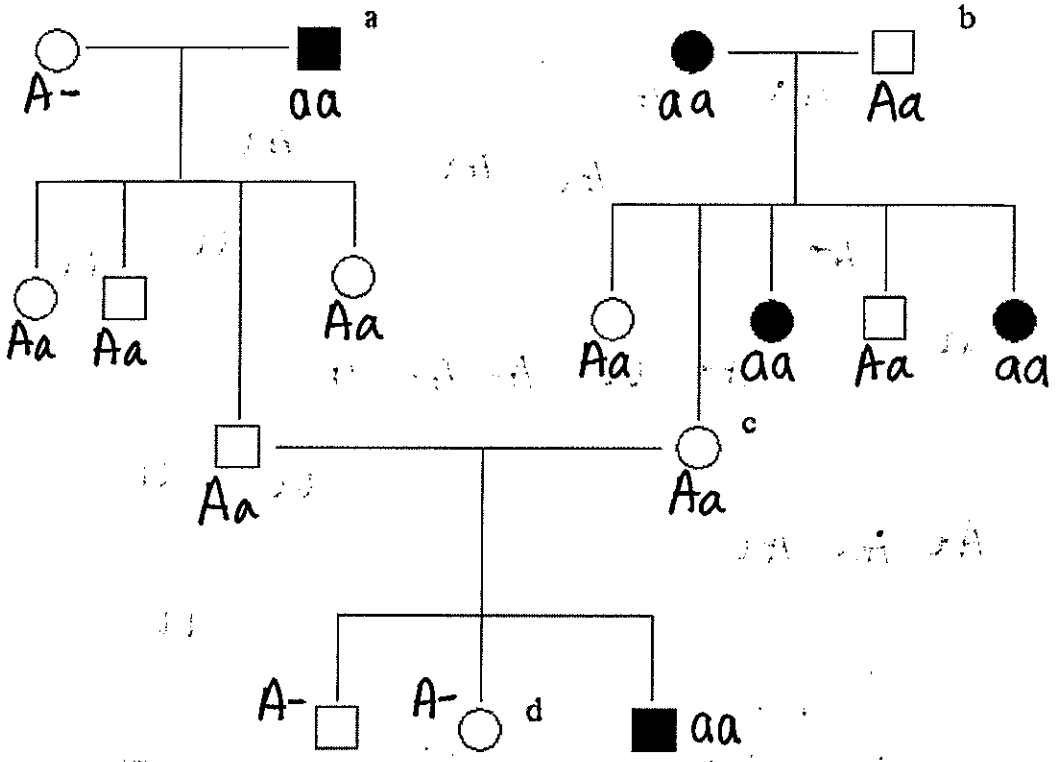
Autosomal recessive:
1. Healthy parents have affected child
2. skips generations

d)



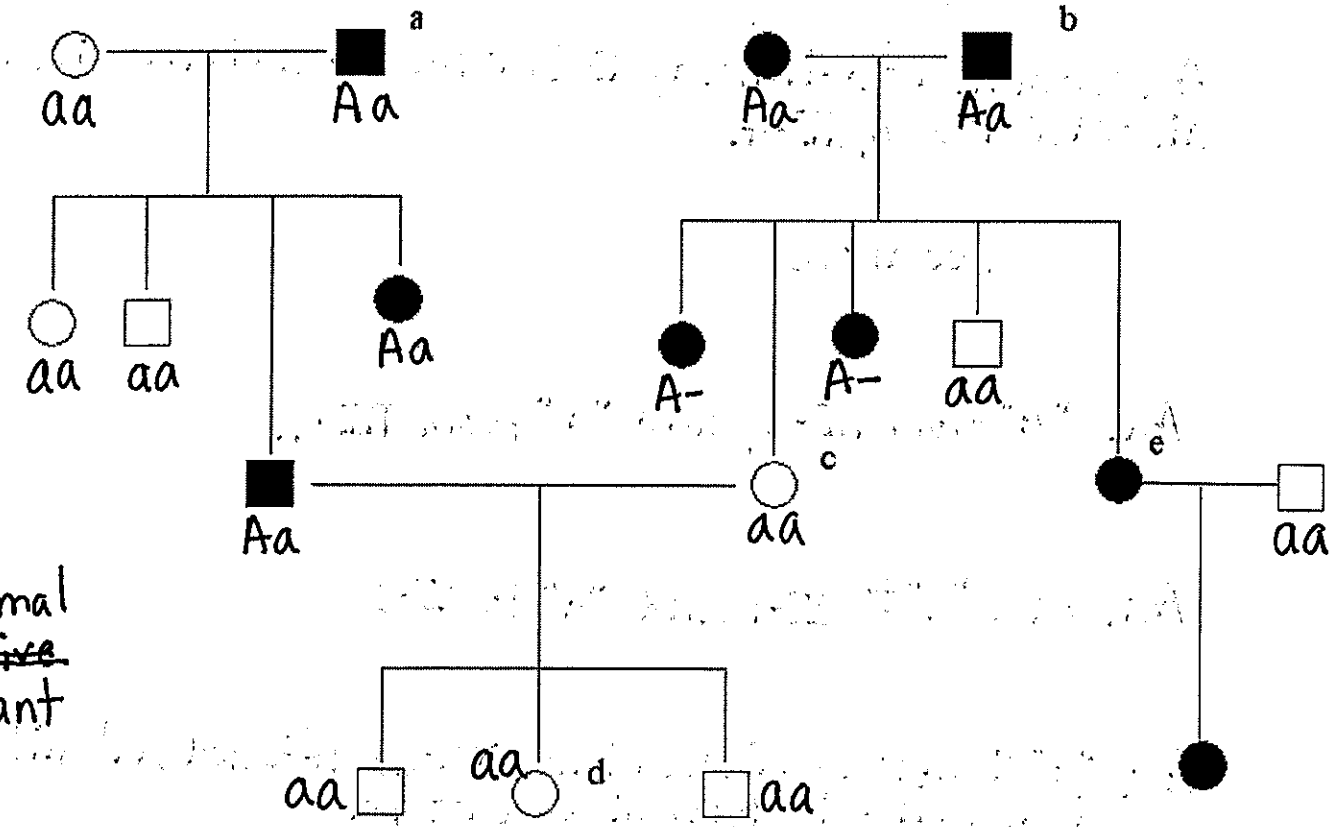
Autosomal dominant:
1. in every generation
2. every affected child has affected parent

2. Below is a pedigree for an inherited lung disease. Provide the genotypes of each of the individuals marked with lower case letters.



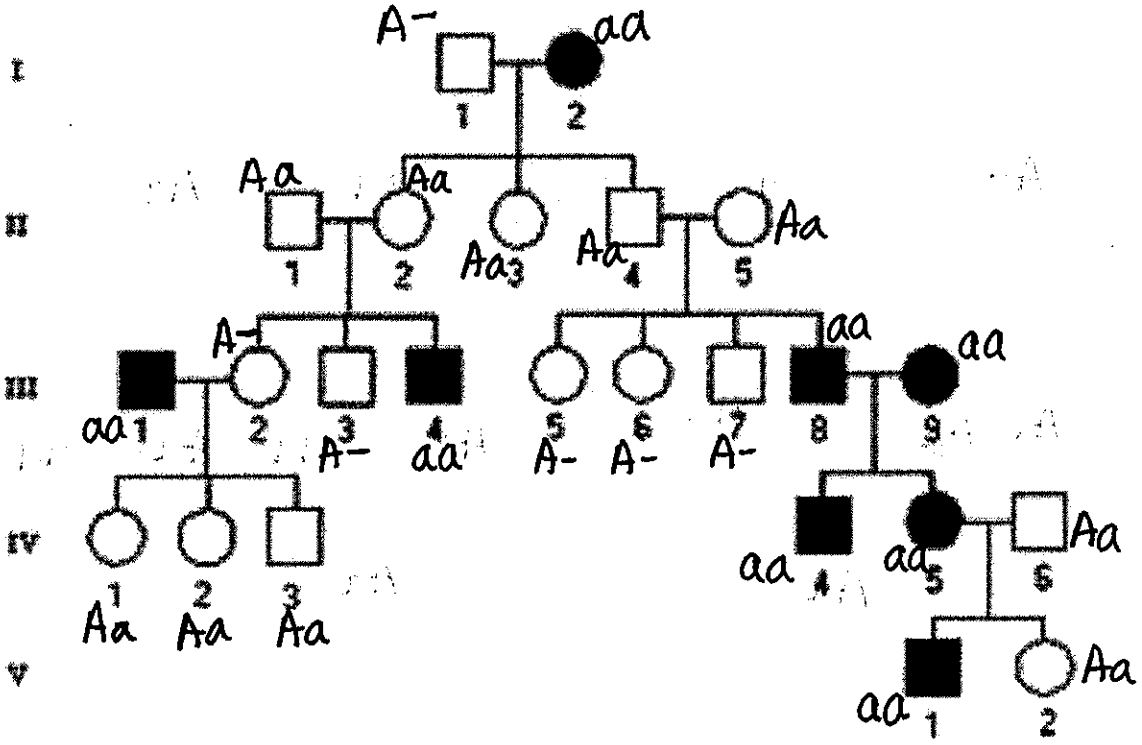
Autosomal recessive

3. Below is a pedigree for an inherited brain disease. Provide the genotypes of each of the individuals marked with lower case letters.



Autosomal ~~recessive~~ dominant

4. Use the Pedigree for Trait A to determine the genetic basis of this trait.



a. Does a dominant or recessive allele produce the trait? Explain.

Recessive. Skips generations and II-1 and II-2 are healthy and have an affected child, III-4.

b. Is it autosomal or sex-linked? Explain.

Autosomal. If x-linked, I-2 mother would have given disorder to son, II-4.

c. What are the genotypes of all the individuals in the pedigree? (Write them on the pedigree.) see above

d. What is the genotype of individual IV-2? Explain.

Aa. "A" from III-2, and "a" from III-1.

e. What is the genotype of individual IV-6? Explain.

Aa. Gave "a" to V-1 and "A" to V-2

f. What is the genotype of individual I-1? Explain

A-. "A" given to all children but without affected (aa) child, impossible to determine genotype.

5. Use the information provided below to create a pedigree. Then answer the question at

the end of each description.

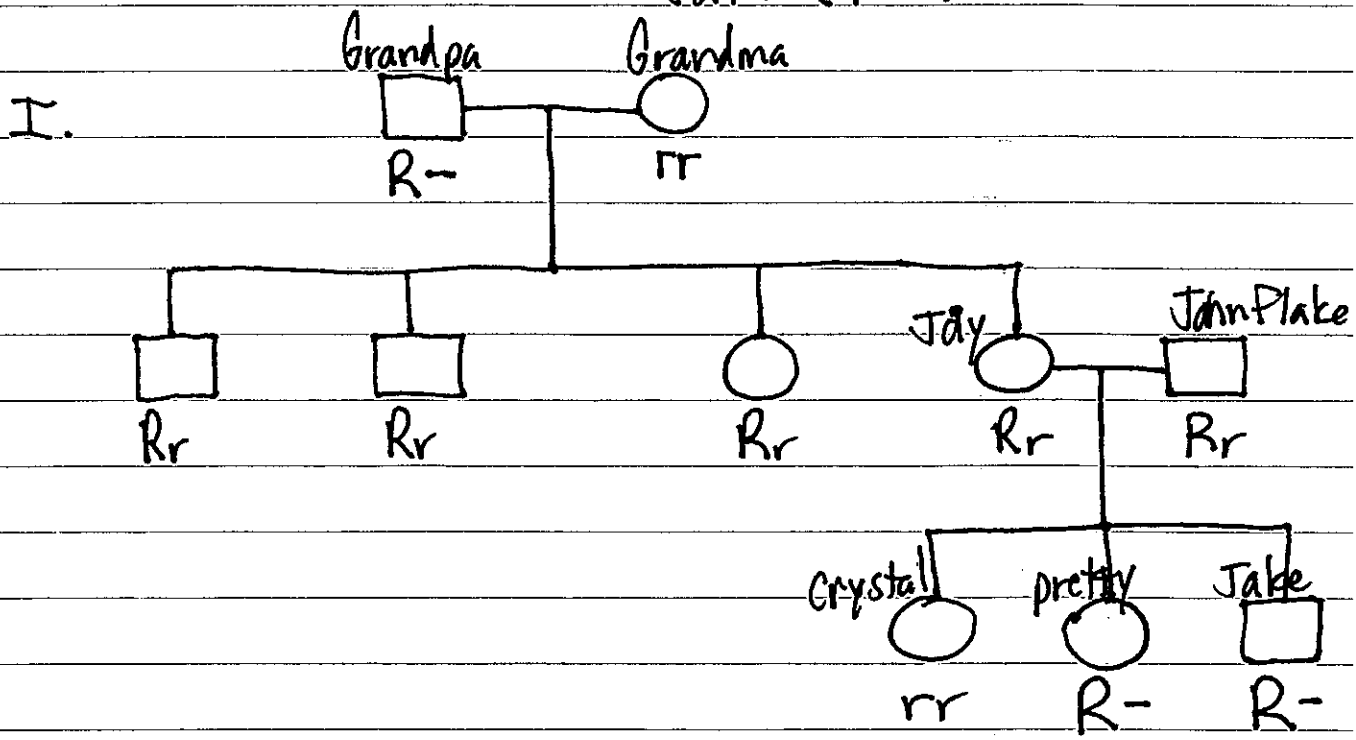
a. The ability to roll your tongue is dominant to not being able to roll your tongue. Draw a pedigree to show the inheritance of this trait, given the following family history:

   Grandpa Snow is a tongue roller but Grandma Snow is not. They have four children (2 sons and 2 daughters) who are all rollers. Their last daughter, Judy, married John Flake. John's parents are both rollers, but John's two sisters are non-rollers. John is a roller. John and Judy Snow-Flake have three children named Crystal Snow-Flake (a non-roller), Pretty Snow-Flake (a roller) and Jake Snow-Flake (a roller).

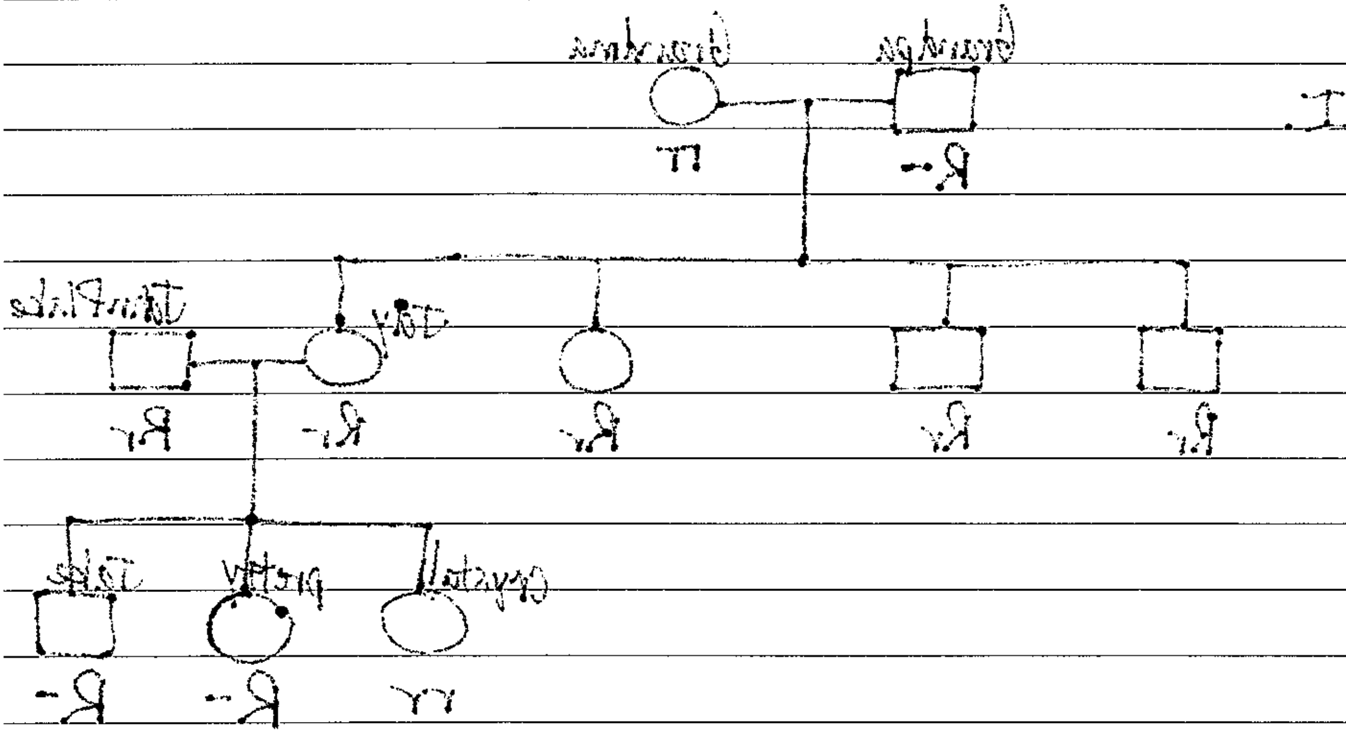
b. A man and woman marry. They have five children, 2 girls and 3 boys. The mother is a carrier of hemophilia, an X-linked disorder. She passes the gene on to two of the boys who died in childhood and one of the daughters is also a carrier. Both daughters marry men without hemophilia and have 3 children (2 boys and a girl). The carrier daughter has one son with hemophilia. One of the non-carrier daughter's sons marries a woman who is a carrier and they have twin daughters. What is the percent chance that each daughter will also be a carrier?

c. The great-great maternal grandmother of a boy was a carrier for colour-blindness, an X-linked disorder. His great uncle on his mother's side was colourblind but his great uncle's father was unaffected. The boy's mother has 2 brothers (1 colourblind, 1 unaffected) and 1 sister (unaffected). The boy's grandmother on his mother's side had 1 brother who was colourblind and 3 sisters. Two of these sisters were unaffected and one was a carrier. The boy's great grandmother on his mother's side had 4 sisters. The boy has one unaffected sister and he is colourblind. What is the probability of the boy's sons being colourblind if he marries a non-carrier?

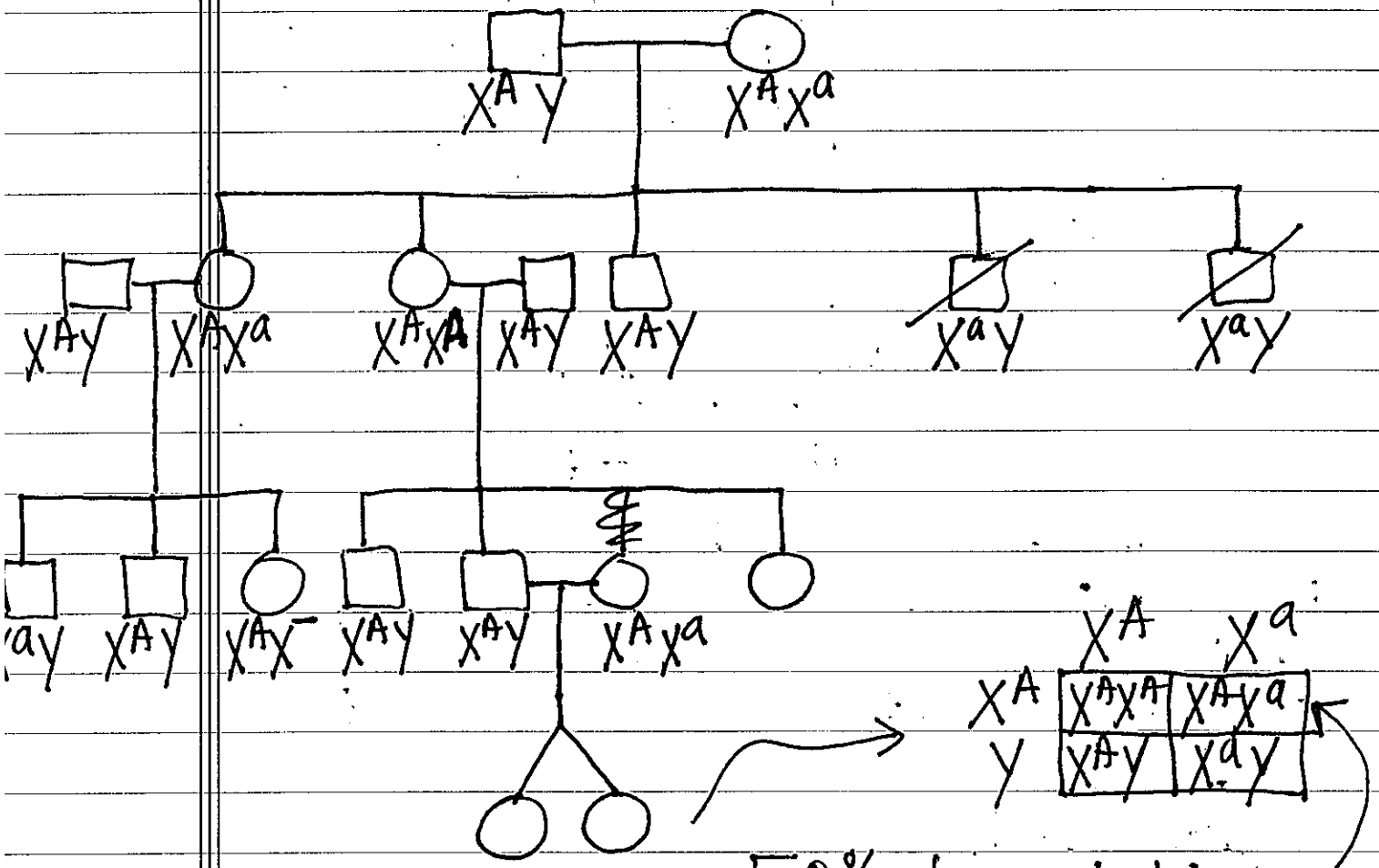
a. Grandpa Snow - roller (R)
Grandma Snow - non-roller (rr)
4 Children - rollers (Rr)
John Flake - roller (Rr)
Flake parents (Rr) rollers
John - Judy children - crystal - non (rr)
pretty (R-)
Jake (R-)



a. Grandpa Snow - roller (R)
Grandma Snow - non-roller (rr)
4 children - rollers (Rr)
John Flake - roller (Rr)
Flake parents (Rr) rollers
John-Judy children - Crystal - non (rr)
pretty (R-)
Jake (R-)

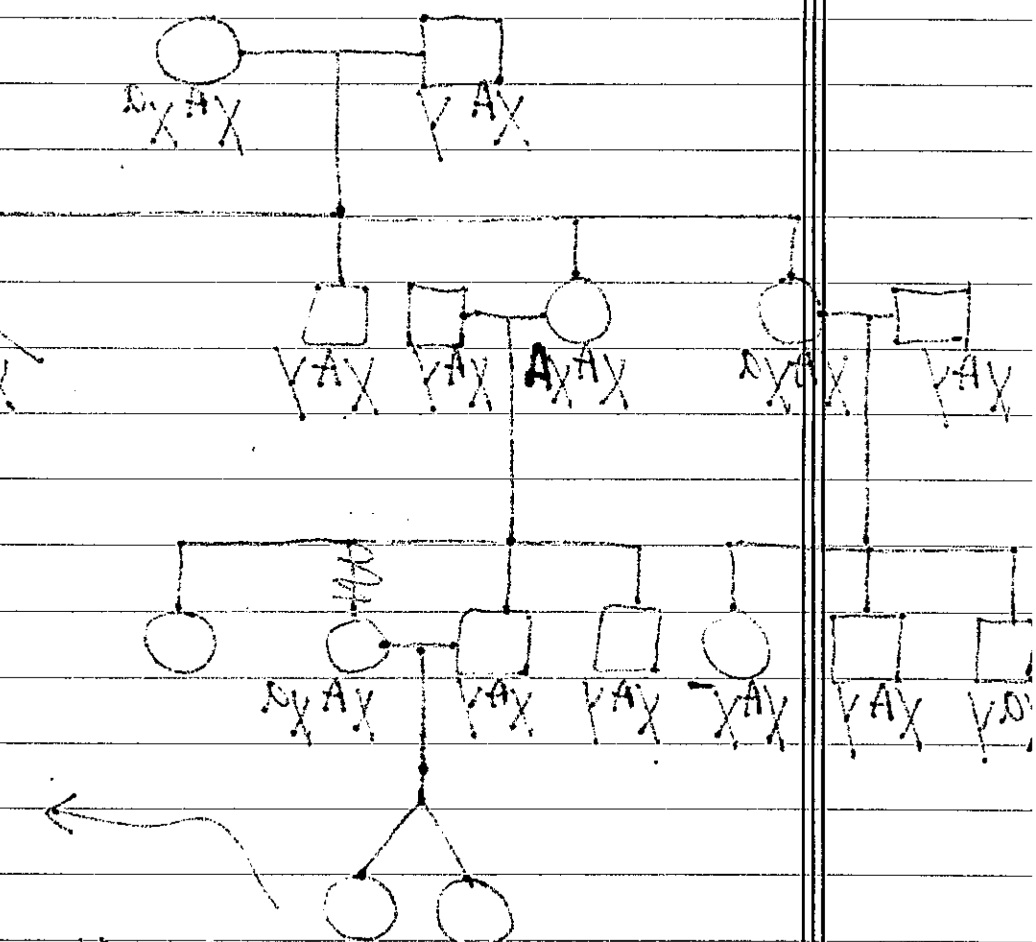


Couple - Mom (X^AX^a)
5 kids (2♀, 3♂) 2♂ - X^aY - die.
1♀ - X^AX^a carrier



50% chance to be a carrier

Couple - Mom (X^AX^a)
5 kids (2♀, 3♂) 2♂ - X^aY - die.
1♀ - X^AX^a carrier



	X^a	X^A
X^A	X^AX^a	X^AX^A
Y	X^aY	X^AY

50% chance to be a carrier

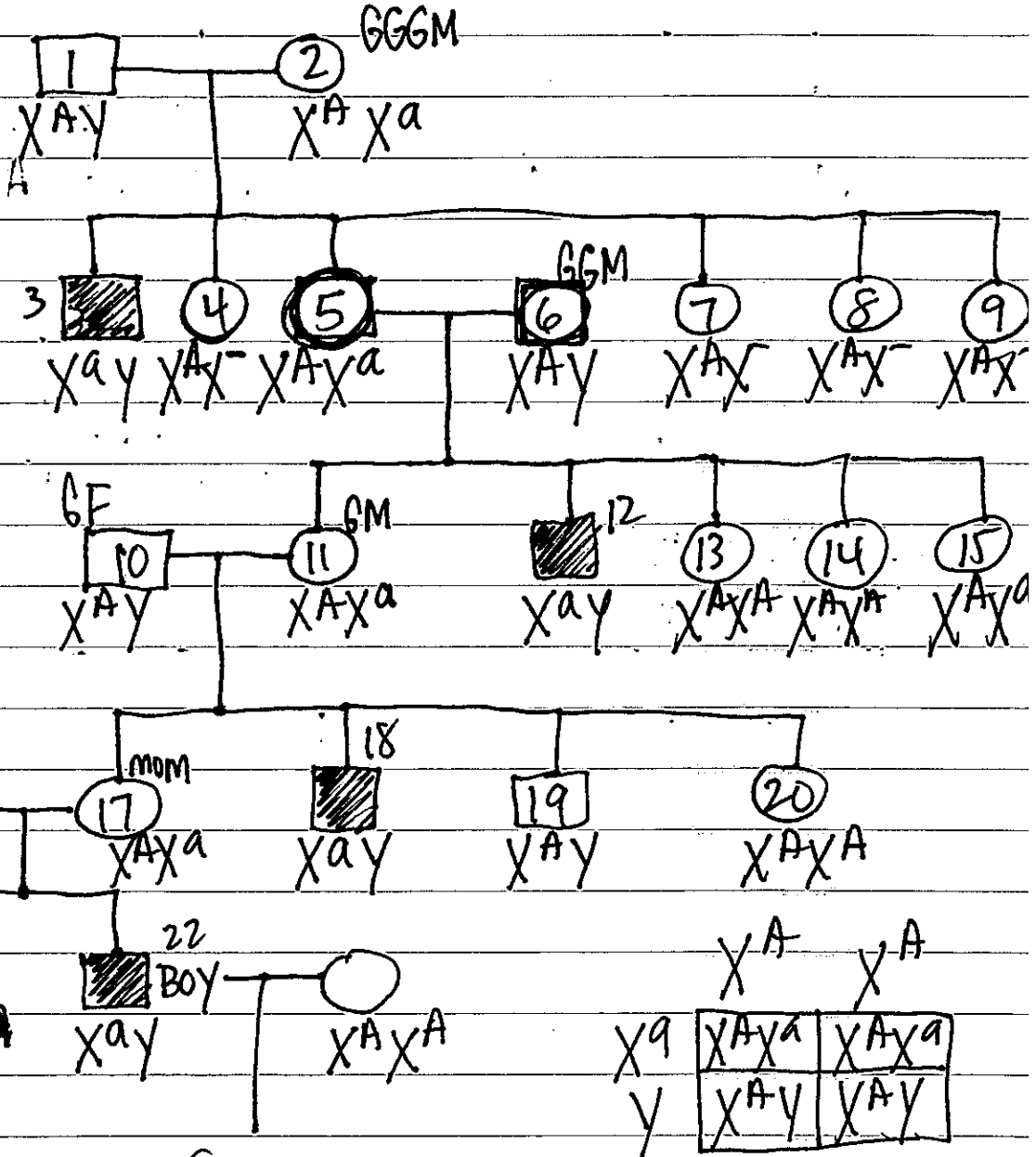
GGGM - X^AX^a x GGGF - X^AY

GU - X^aY (son)

Mom - Bro - X^aY Bro - X^AY

GM GM brother - X^aY 3 sis. → 2 X^AX^A, → 1 X^AX^a

GM sisters (4)



	X^A	X^A
X^a	X^AX^a	X^AX^a
Y	X^AY	X^AY

0% chance of Colorblindness.

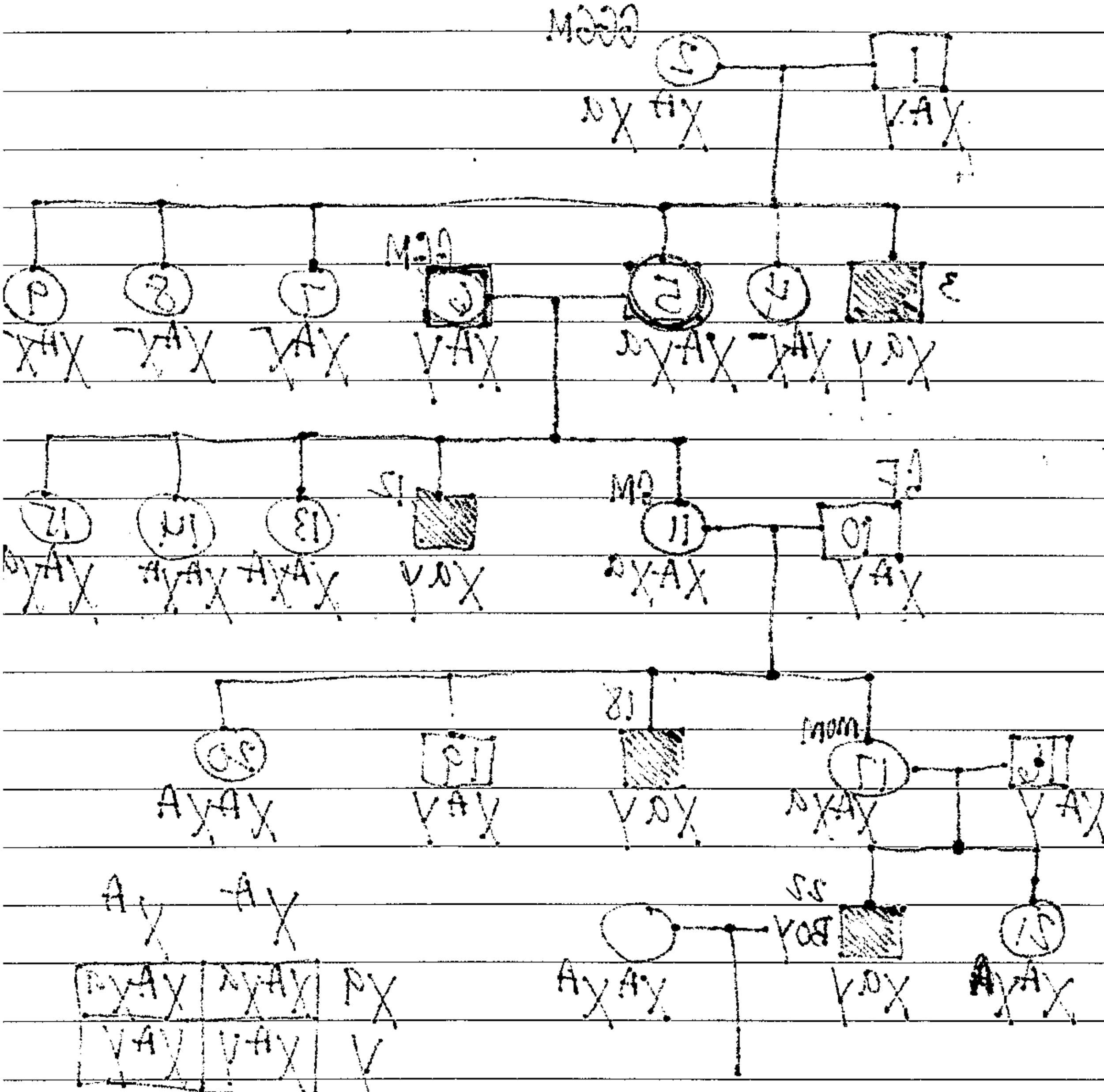
GGGM - $X^A X^a$ x GGGF - $X^A Y$

GU - $X^a Y$ (son)

Mom - Bro - $X^a Y$ Bro - $X^A Y$

GM GM brother - $X^a Y$ 3 sis. 2 $X^A X^A$, 1 $X^A X^a$

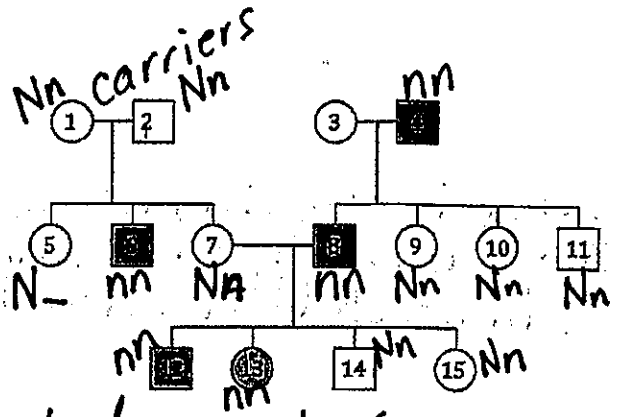
GM sisters (4)



Sons
0% chance of
colorblindness.

Name: KEY Per: Date:

Pedigree & Genotyping



Pedigree A

1. *Which type* of inheritance pattern is likely based on the pedigree of Neurofibromatosis (NF), a genetic skin condition? *Based on what reasoning?*

- o Autosomal Recessive
- o Autosomal Dominant
- o X-linked recessive

Two unaffected parents (1 & 2) produce an affected son (6). Both carriers.

2. For the following genotypes, what would be the appropriate phenotypes?

Genotype:	Phenotype: Affected with NF, Healthy, Incompatible with life
NN	Healthy
Nn	carrier, unaffected
nn	Affected with NF

3. Write the genotypes for at least 7 individuals next to the symbol. see pedigree above.

4. Calculate the risk for persons 7 & 8 to have *another affected child.*

	N	n
n	Nn	nn
n	Nn	nn

2/4 x 100 = 50% chance.

5. Extension: How did individual #6 become affected with NF? Hint: This actually occurs in 50% of cases!

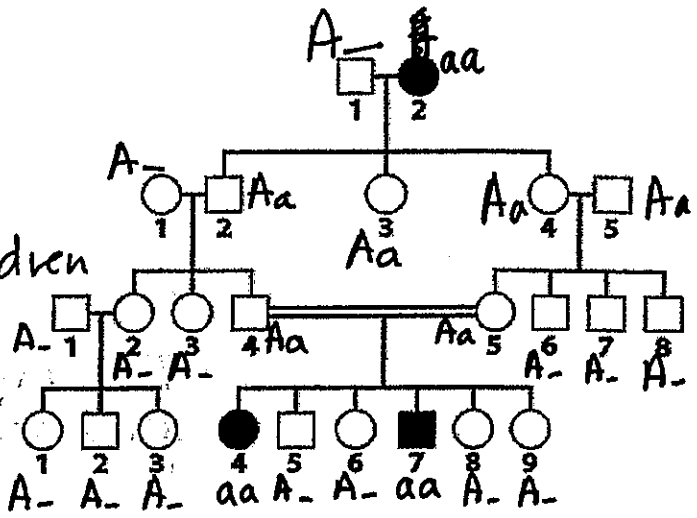
mom and dad (1 & 2) were heterozygous and carried the trait, but were, themselves, healthy.

Pedigree B

1. *Which type* of inheritance pattern is likely based on the pedigree of CIP (Congenital Insensitivity to Pain), a genetic condition? *Based on what reasoning?*

- o Autosomal Recessive
- o Autosomal Dominant
- o X-linked recessive

parent I is dominant and healthy, as is all children. 1:5 (unaffected) have affected children



2. For the following genotypes, what would be the appropriate phenotypes?

Genotype:	Phenotype: Affected with CIP, Healthy (no CIP gene), Healthy CIP Carrier
NN	Healthy
Nn	Carrier, unaffected
nn	Affected with CIP

3. Write the genotypes for at least 7 individuals next to their symbols. see pedigree.

4. Calculate the risk for persons III-4 & III-5 to have *another affected child*.

	A	a
A	AA	Aa
a	Aa	aa

1/4 x 100 = 25% chance

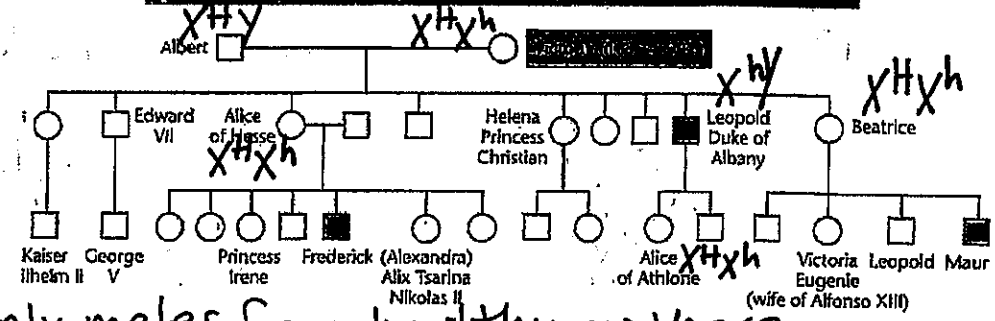
---

5. Extension: What is the chance that IV-5 is a carrier of the disease? Assume IV-5 is healthy and shows no symptoms of the disorder. Hint: the punnett square above can be used for interpretation.

Using #4's punnett square there is a 2/4, or 50% chance of having a carrier.

Pedigree C

1. *Which type* of inheritance pattern is likely based on the pedigree of Hemophilia, a genetic condition? *Based on what reasoning?*



- Autosomal Recessive
- Autosomal Dominant
- X-linked recessive

only males from healthy mothers.

2. For the following genotypes, what would be the appropriate phenotypes?

Genotype:	Phenotype: Hemophiliac, Healthy (non-carrier), Healthy Hemophilia Carrier
X^HX^H	healthy
X^HX^h	healthy, carrier
X^HY	healthy
X^hY	hemophiliac

X^HX^h X^HY X^HX^h X^hY X^HX^h

3. Write the genotypes for the following persons: Victoria, Albert, Alice of Hesse, Duke Leopold, Beatrice and Alice of Athlone. X^HX^h

4. Calculate the risk for persons Victoria and Albert to have *another affected child (gender not known).*

	X^H	X^h
X^H	X^HX^H	X^HX^h
Y	X^HY	X^hY

1/4 X 100 = 25% chance overall.

→ 1/2 chance or 50% of males

5. Extension: Which two relatives could have affected females if crossed? Show the punnett square as evidence.

	X^H	X^h
X^h	X^HX^h	X^hX^h
Y	X^HY	X^hY

Duke Leopold X^hY
Beatrice X^HX^h
Alice of Hesse X^HX^h

Name: _____ Per: _____ Date: _____

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 red X^RY red X^rX^r wht X^RX^R red X^rY wht

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.

	X^r	X^r
X^R	X^RX^r	X^RX^r
Y	X^rY	X^rY

white eyed females only and/or heterozygous red eyed females.

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 and X^rY

	X^R	X^R
X^r	X^RX^r	X^RX^r
Y	X^RY	X^RY

How many are:
white eyed, male 0
white eyed, female 0
red eyed, male 2
red eyed, female 2

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

	X^R	X^r
X^R	X^RX^R	X^RX^r
Y	X^RY	X^rY

How many are:
white eyed, male 1 25%
white eyed, female 0 0%
red eyed, male 1 25%
red eyed, female 2 50%

Math: What if in the above cross, 100 males were produced and 200 females. How many total red-eyed flies would there be? 50 + 200 = 250

100 ♂ → equal red : wht → 50 : 50

200 ♀ → All females are red eyed

KEY

Monohybrid cross practice

20. In humans, being a tongue roller (R) is dominant over non-roller (r). A man who is a non-roller marries a woman who is heterozygous for tongue rolling.

Father's phenotype non-roller Mother's phenotype roller

Father's genotype rr Mother's genotype Rr

	R	r
r	Rr	rr
r	Rr	rr

What is the probability of this couple having a child who is a tongue roller? 2/4 ≈ 50%

21. Brown eyes in humans are dominant to blue eyes. A brown-eyed man, whose mother was blue-eyed, marries a brown-eyed woman whose father had blue eyes. What is the probability that this couple will have a blue-eyed child? 1/4 ≈ 25%

Bb x Bb

	B	b
B	BB	Bb
b	Bb	bb

Dihybrid cross practice

11. Set up a punnett square using the following information:
Dominant allele for black fur in guinea pigs = B
Recessive allele for white fur in guinea pigs =b
Dominant allele for rough fur in guinea pigs =R
Recessive allele for smooth fur in guinea pigs = r

BbRr: BR Br bR br

Bb rr: Br Br br br

Cross: BbRr with a heterozygous parent Bbrr

12. Answer the following questions using the Punnett square you completed.

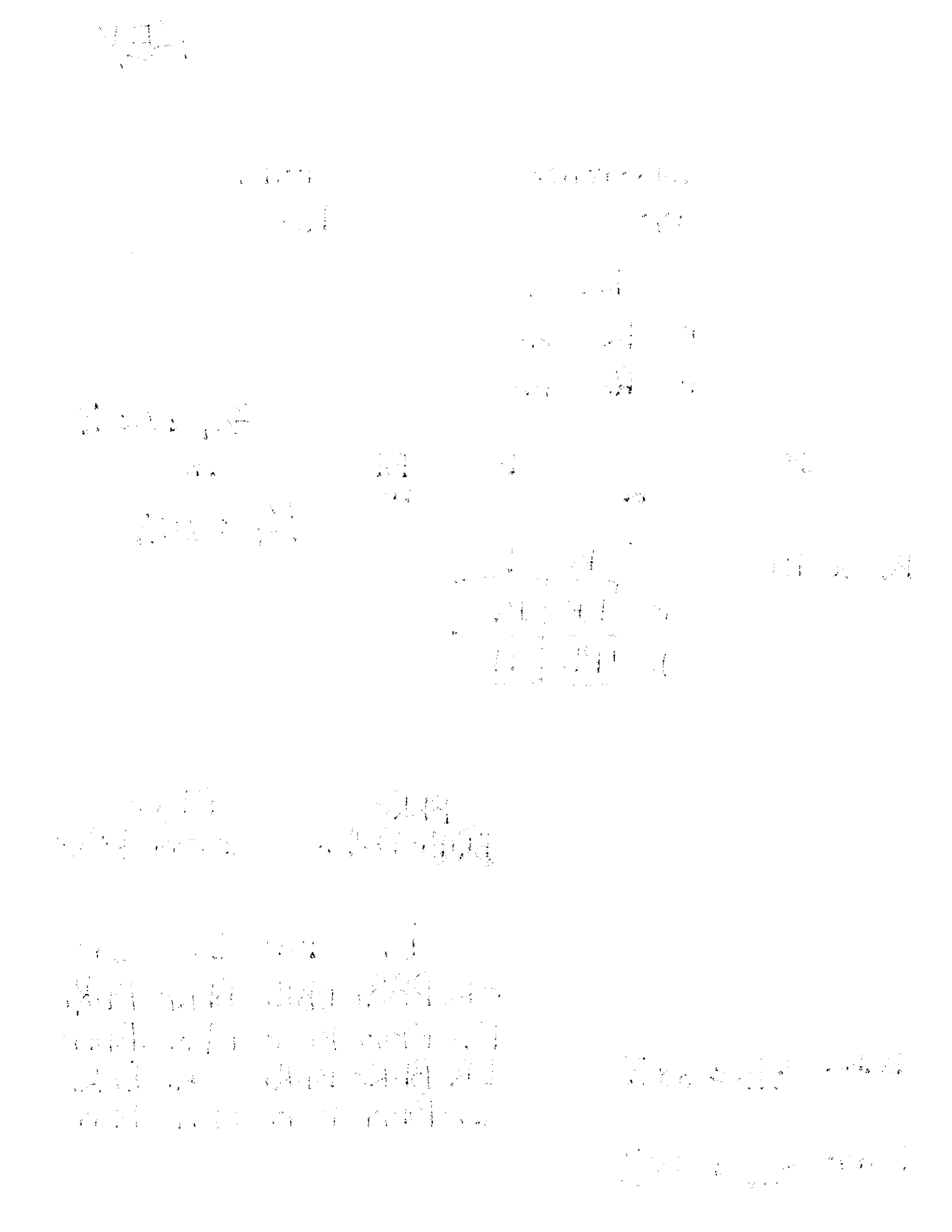
	Br	Br	br	br
BR	BBRr	BBRr	BbRr	BbRr
Br	BBrr	BBrr	Bbrr	Bbrr
bR	BbRr	BbRr	bbRr	bbRr
br	Bbrr	Bbrr	bbrr	bbrr

a. What is the probability of producing guinea pigs with black, rough fur? Possible genotype(s)?

B_R_ 6/16 ≈ 38%

b. What is the probability of producing guinea pigs with black, smooth fur? Possible genotype(s)?

B_rr 6/16 ≈ 38%



c. What is the probability of producing guinea pigs with white, rough fur? Possible genotype(s)?

bbR_ 2/16 ≈ 13%

d. What is the probability of producing guinea pigs with white, smooth fur? Possible genotype(s)?

bbrr 2/16 ≈ 13%

multiply B_R_ x BBRR

e. Challenge! What is the probability of producing guinea pigs that have BOTH black, rough fur AND are homozygous for both traits.

B_R_ x BBRR

6/16 x 0/16 ≈ 0/16 → 0% chance.

8. In mice, the ability to run normally is a dominant trait. Mice with this trait are called running mice (R). The recessive trait causes mice to run in circles only. Mice with this trait are called waltzing mice (r). Hair color is also inherited in mice. Black hair (B) is dominant over brown hair (b). For the following problem, determine the parent genotypes, determine possible gametes, then construct a Punnett square to solve.

RR Bb rr bb

Cross a homozygous running, heterozygous black mouse with a waltzing brown mouse

Parental genotypes – mom: RRBb

dad: rr bb

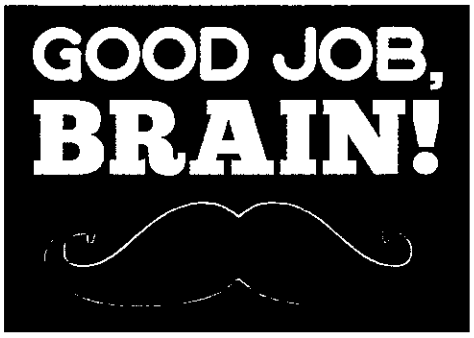
Possible gametes - mom: RB Rb RB Rb

dad: rb rb rb rb

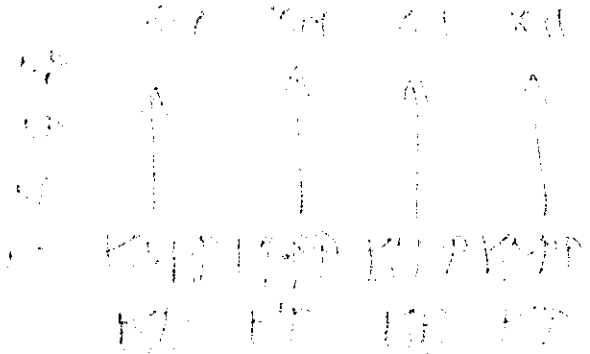
Offspring phenotypic ratio 8 : 8 : 0 : 0

R_B_ : R_bb : rrB_ : rrbb

	RB	Rb	RB	Rb
rb	RrBb	Rrbb	RrBb	Rrbb
rb				
rb				
rb				
	x4	x4	x4	x4



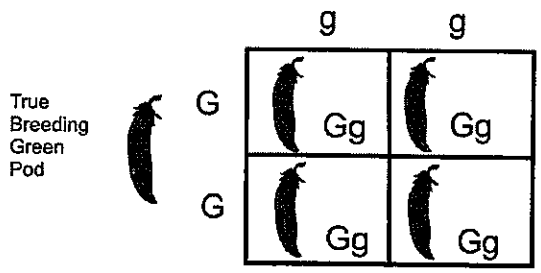
CHECK ANSWERS AGAINST KEY WHEN FINISHED!



Anatomy of a Punnett Square (H)

Breeding Yellow Pod

Directions: for the Punnett squares below, answer the questions about the genetic analysis to better understand the terms for the unit.



1. What type of **cross** is seen in the diagram? monohybrid
2. The **parental (P) generation** cross is: GG x gg
3. **Genotypes** for **homozygous** conditions in the parents: GG & gg
4. **Phenotype** of the homozygous **dominant** genotype is green
5. Phenotype of the homozygous **recessive** genotype is yellow
6. The genotypic ratio of the **F1 generation** is 0 : 4 : 0
7. Phenotype of the offspring in the F1 generation is green
8. The phenotypic ratio of the F1 generation is 4 : 0
9. What are two words we use to describe the offspring in the F1 generation: heterozygotes & hybrids
10. The result of a cross between two F1 offspring would give what **genotypic and phenotypic ratio**? Show work below.

	G	g
G	GG	Gg
g	Gg	gg

g : 1 : 2 : 1

p : 3 : 1

$3/4 \cdot 2/4 = 6/16 \rightarrow 3/8$

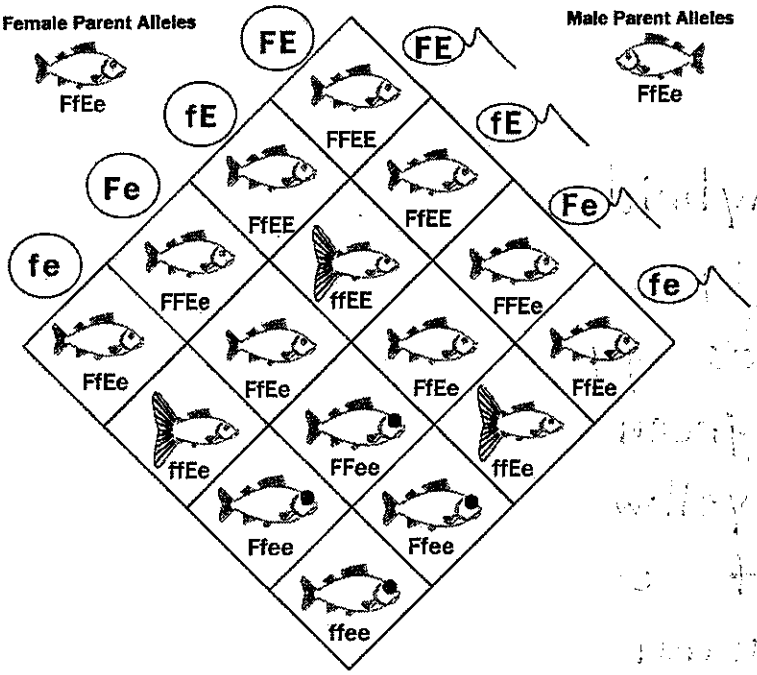
11. What is the probability that an F2 offspring will be BOTH green and **heterozygous**?
12. What is the **probability** that an F2 offspring will not be green? 1/4
13. What potential **gametes** will an F1 offspring give to the F2 offspring? G or g
14. Differentiate between the following pairs of terms:

(a) **gene** and an **allele** gene codes for a protein to be made, or a trait. allele is a variation of a gene.

(b) number of chromosomes in a **body cell** and a **gamete** full set in body cells - 46 gamete: 1/2 set, 23

(c) **phenotype** and **genotype**

physical appearance vs. the genetic make up.



15. What type of cross is seen in the diagram to the left? dihybrid

16. Indicate the trait that each allele below represents

(a) F: normal tail

(b) f: large tail

(c) E: normal eyes

(d) e: large eyes

17. Why do so few potential offspring have the "ff" coded phenotype?

it's recessive and is masked by dominant "F".

18. Can you think of any advantage, or disadvantage it would give fishes to receive one "f" allele from each parent?

D: more easily seen, more drag in water.

A: swim faster.

F-E- ffE- F-ee ffee

19. The phenotypic ratio of the F1 generation above would be 9 : 3 : 3 : 1

20. Why do we only provide the phenotypic ratio from dihybrid crosses?

too many genotypes for a realistic ratio.

21. What would the probability be of producing offspring with a smaller caudal fin (aka tail fin)? *Be sure to indicate the different genotypes that would code for this trait (give both alleles of the genotype).*

13/16 FFEe FFEE FfEe FFee Ffee

22. If 50 offspring were produced in the F1 generation, how many would have a large, showy tail?

$3/16 \times 50 = 150/16 = 9$

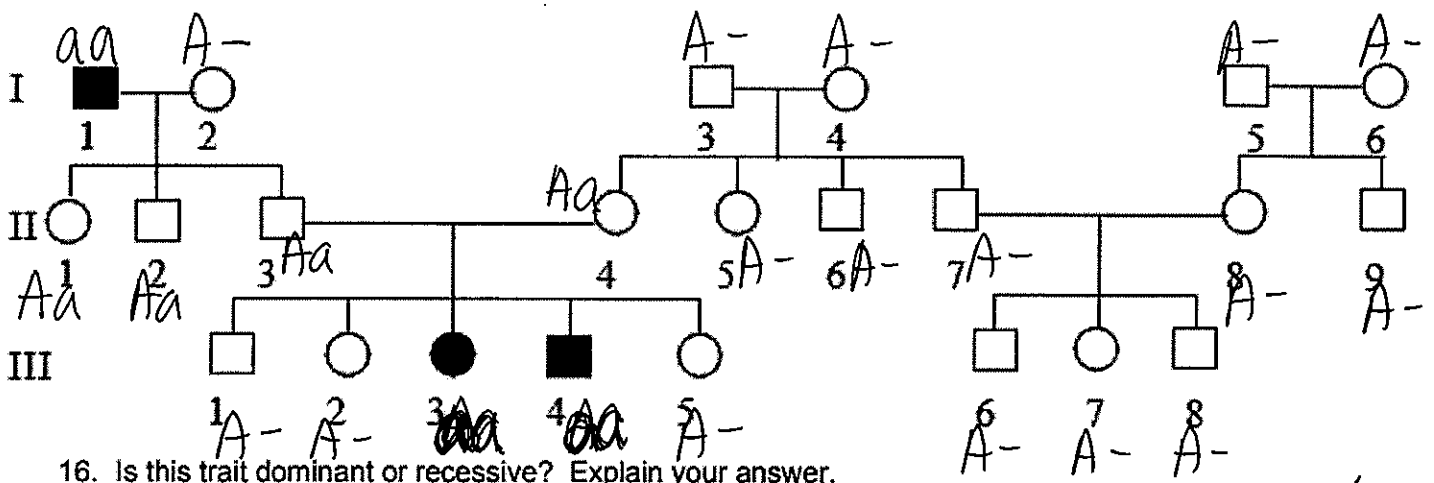
23. *Challenge question (and yes, you must do it!).* What is the probability of having an offspring in the F1 generation with only homozygous genotypes for both traits?

all genotypes FFEE 1/16
FFee 1/16
ffEE 1/16
ffee 1/16

$1/16 + 1/16 + 1/16 + 1/16 = 4/16$

$= 1/4$

25%



16. Is this trait dominant or recessive? Explain your answer.

Autosomal recessive. Healthy parents II-3 and III-4 have affected children, III-4 and III-5. Pattern skips generations.

17. What gave you the essential information to decide that II-3 and II-4 were heterozygous?

I-1 father gave ~~II~~-3 "a". III-3 and III-4 children had to get one "a" from each parent.

18. Set up a two-trait Punnett square using the following information:

- **Dominant** allele for **purple corn kernels = R**
- **Recessive** allele for **yellow corn kernels = r**
- **Dominant** allele for **starchy kernels = T**
- **Recessive** allele for **sweet kernels = t**
- Cross a **homozygous yellow, heterozygous starchy** parent with a **heterozygous purple, sweet** parent

Cross: rrTt x Rrtt

Gametes: rT, rt, rT, rt / Rt, Rt, rt, rt

	Rt	Rt	rt	rt
rT	RrTt°	RrTt°	rrTt■	rrTt■
rt	Rrtt▲	Rrtt▲	rrtt°	rrtt°
rT	RrTt°	RrTt°	rrTt■	rrTt■
rt	Rrtt▲	Rrtt▲	rrtt°	rrtt°

Using the information in the Punnett square, answer the following:

a. What is the probability of producing purple, starchy corn kernels? Possible genotype(s)?

R_T_ • = 4/16 = 25%

b. What is the probability of producing yellow, starchy corn kernels? Possible genotype(s)?

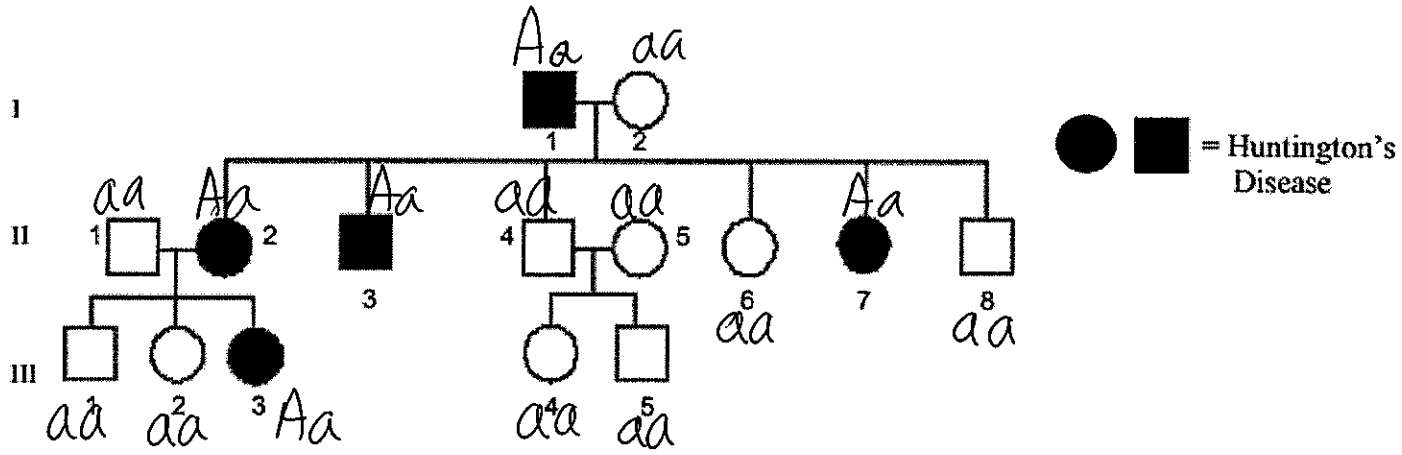
rrT_ = 4/16 = 25%.

c. What is the probability of producing purple, sweet corn kernels? Possible genotype(s)?

R_tt▲ = 4/16 = 25%

d. What is the probability of producing yellow, sweet corn kernels? Possible genotype(s)?

rrtt° = 4/16 = 25%.



1. Which members of the family above are afflicted by Huntington's Disease?

I-1, II-2,3,7, III-3

2. There are no carriers for Huntington's Disease- you either have it or you don't.
With this in mind, is Huntington's disease caused by a dominant or recessive trait?

Dominant

3. How many children did individuals I-1 and I-2 have?

6 children, II-2,3,4,6,7,8

4. How many girls did II-1 and II-2 have?

2 girls, III-2,3

5. How are individuals III-2 and II-4 related?

III-2 is the daughter (healthy) of II-2, II-4's sister, so III-2 is the neice of II-4.

6. In garden peas, tall vine (T) is dominant and short vine (t) is recessive.

If a heterozygous tall pea plant is crossed with a short pea plant.

a. Heterozygous tall pea plant genotype: Tt

b. Short pea plant genotype: tt

c. Complete the Punnett square for the cross and provide a genotypic and phenotypic ratios.

	t	t
T	Tt	Tt
t	tt	tt

Genotypic ratio - 0 : 2 : 2
TT Tt tt

Phenotypic ratio - 2 : 2
tall short

Inheritance Patterns Worksheet #1 Name KEY Per.
Complete Dominance: Monohybrid/Dihybrid Crosses

YOU MUST USE THE PUNNETTE SQUARES TO SHOW YOUR WORK!

Complete Dominance: Monohybrid Cross

1. A homozygous tall plant (TT) is crossed with a heterozygous plant (Tt). What are the genotypes and phenotypes of the offspring? What is the probability of tall plants? Short plants?

	T	t
T	TT	Tt
T	TT	Tt

Genotypes: 2 : 2 : 0 (TT : Tt : tt)
Phenotypes: 4 : 0 (tall : short)
Probabilities: Tall 4/4 - 100%
Short 0/4 - 0%

2. A homozygous red flowered plant (RR) is crossed with a homozygous white plant (rr). What are the genotypes and phenotypes of the offspring? What is the probability of having white flowers & why?

	r	r
R	Rr	Rr
R	Rr	Rr

Genotypes: 0 : 4 : 0
Phenotypes: 4 : 0
Answer: 0/4 = 0% chance, no chance for double recessive genotype.

3. A man with hitchhiker's thumb (Hh) and his wife who also has hitchhiker's thumb (Hh) are expecting a child. What is the probability that the child will also have hitchhiker's thumb? No hitchhiker's thumb?

maternal \ paternal	H	h
H	HH	Hh
h	Hh	hh

Genotypes: 1 : 2 : 1
Phenotypes: 3 : 1
Answer: 3/4 = 75% chance of hitchhiker's thumb. 25% of non.

4. In people, brown eyes (B) is dominant over blue eyes (b). Could a marriage between two blue-eyed people produce a brown-eyed child? Why or why not?

	b	b
b	bb	bb
b	bb	bb

Answer: Never. No dominant alleles are present.

5. A chicken with black feathers is crossed with another chicken with black feathers. Most of their offspring have black feathers and some have white feathers. How is this possible?

	B	b
B	BB	Bb
b	Bb	bb

Parents' Genotypes: Bb x Bb
Offspring's Genotypes: 1 : 2 : 1
Answer: recessive allele is masked by dominant one.

Complete Dominance: Dihybrid Cross

1. a. A man has the genotype BbEE. He has brown hair and free earlobes. What are the different combinations of these alleles in his gametes? BE, BE, bE, bE

   b. This man met a woman with the genotype BBee, what are the different combinations of the alleles in her gametes? Be x 4

   If the man and woman mated, what would be the genotypes and phenotypes of their offspring?

		paternal BE	BE	bE	bE
maternal	Be	BBEe	BBEe	BbEe	BbEe
	Be	BBEe	BBEe	BbEe	BbEe
	Be	BBEe	BBEe	BbEe	BbEe
	Be	BBEe	BBEe	BbEe	BbEe

   c. Offspring's Genotype(s): only 2 - BBEe = 8, BbEe = 8

   d. Offspring's Phenotype(s): Brown-Free (B-E- : B-ee : bbE- : bbee) = 16:0:0:0

   e. Probability of brown & free: 16 brown & attached: 0 blonde & free: 0 blonde & attached: 0

2. Diagram the Punnett square for the offspring between the genotypes GgMM (paternal) and ggmm (maternal). G is dominant for having a widow's peak and g is recessive for not having a widow's peak. M is dominant for having the ability to roll the tongue and m is recessive for not having the ability to roll the tongue.

		paternal GM	GM	gM	gM
maternal	gm	GgMm	GgMm	ggMm	ggMm
	gm	GgMm	GgMm	ggMm	ggMm
	gm	GgMm	GgMm	ggMm	ggMm
	gm	GgMm	GgMm	ggMm	ggMm

   a. Man's allele combinations in his gametes: GM and gM

   b. Woman's allele combinations in her gametes: only gm

   c. Offspring's Genotype(s): GgMm x 8, ggMm x 8

   d. Offspring's Phenotype(s): G-M- : G-mm : ggM- : ggmm → 8:0:8:0

   e. Probability of widow's peak & roll: 8 widow's peak & no roll: 0

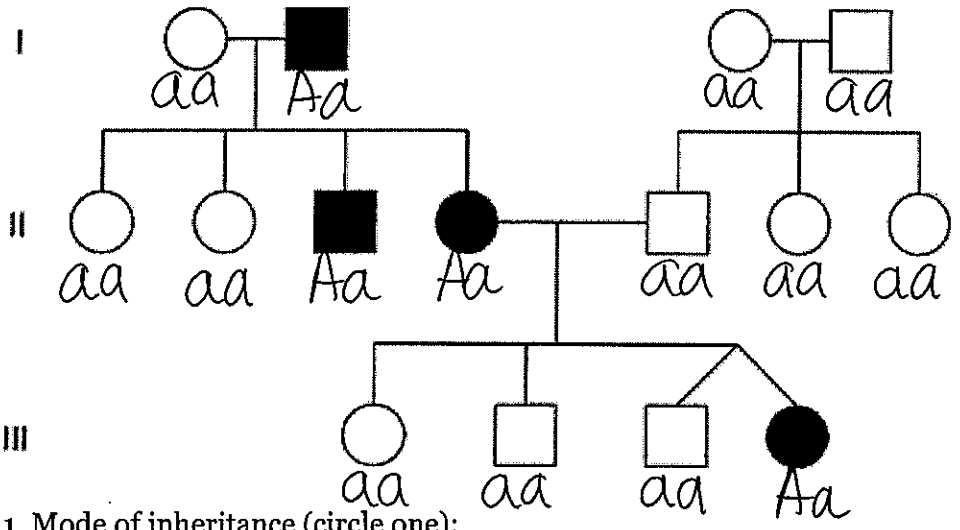
   no widow's peak & roll: 8 no widow's peak & no roll: 0

3. What does it mean when an inheritance pattern shows complete dominance?

   If present, it shows

Pedigree Review

(AA) or (Aa)
A-affected
a-healthy
(aa)

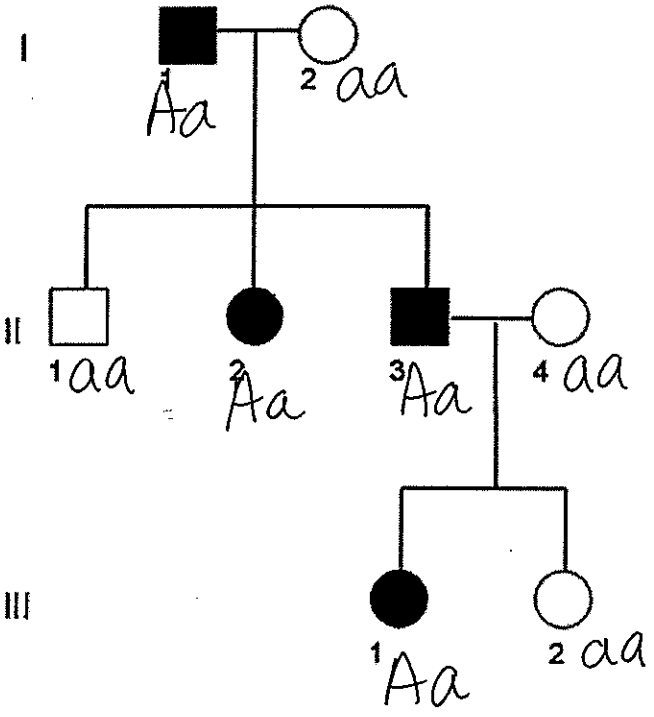


1. Mode of inheritance (circle one):

(autosomal dominant) autosomal recessive x-linked recessive

2. What was your evidence for choosing the mode of inheritance above: every affected child has an affected parent. Every generation has affected people.

3. Using the letter "A" for the dominant allele, and "a" for the recessive, label all individuals in the pedigree above. For those you are uncertain of, label them "A-". If x-linked, use X & Y format with "A" and "a" alleles.

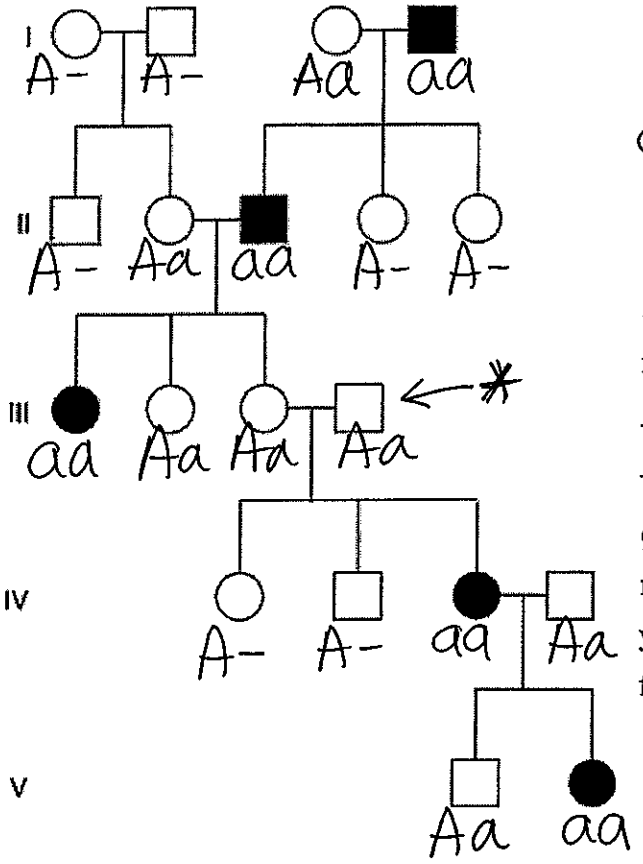


4. Mode of inheritance (circle one):

(autosomal dominant) same alleles as 1st pedigree
autosomal recessive
x-linked recessive

5. What was your evidence for choosing the mode of inheritance above: same answer as 1st pedigree.

6. Using the letter "A" for the dominant allele, and "a" for the recessive, label all individuals in the pedigree above. For those you are uncertain of, label them "A-".



7. Mode of inheritance (circle one): (AA) or (Aa)

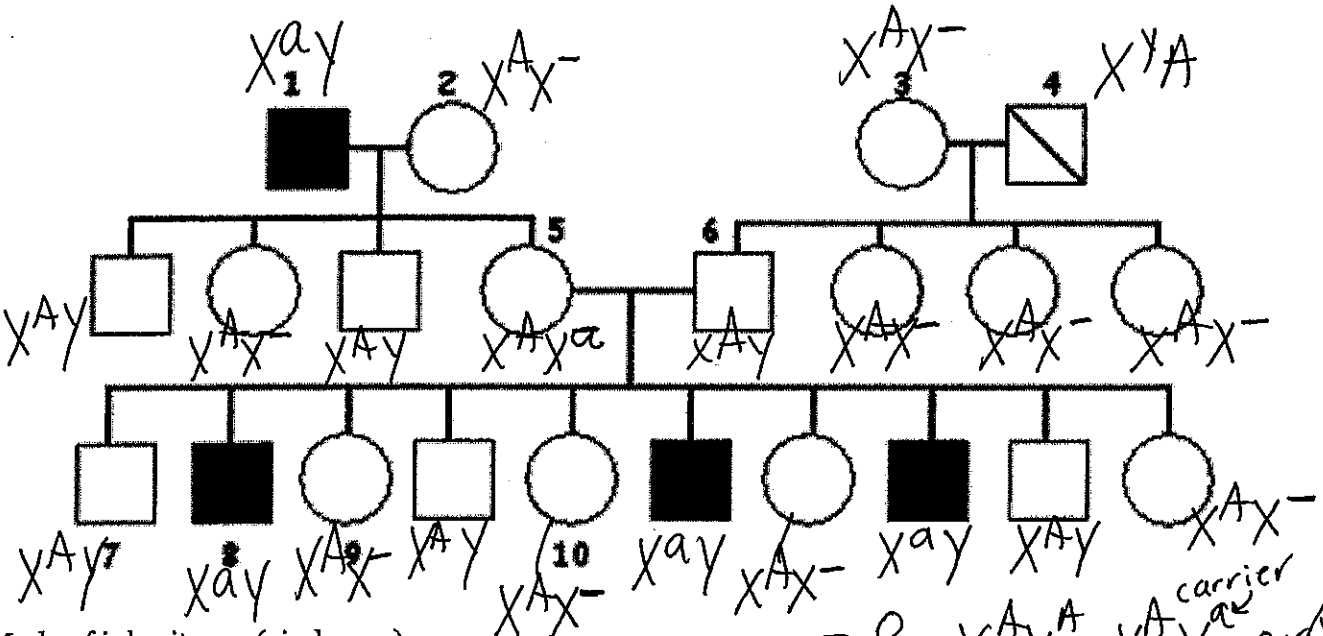
autosomal dominant

(autosomal recessive) → A = healthy

x-linked recessive → a = affected (aa)

8. What was your evidence for choosing the mode of inheritance above: * below shows 2 unaffected parents have an affected child. Masks disorder.

9. Using the letter "A" for the dominant allele, and "a" for the recessive, label all individuals in the pedigree above. For those you are uncertain of, label them "A-". If x-linked, use X & Y format with "A" and "a" alleles.



10. Mode of inheritance (circle one):

autosomal dominant autosomal recessive (x-linked recessive)

→ ♀ - X^AX^A, X^AX^a (carrier), or (X^aX^a) affected

→ ♂ X^AY, (X^aY) affected

11. What was your evidence for choosing the mode of inheritance above: only males are affected. Skips generation. All mothers of affected males are carriers (X^AX^a).

12. Using the letter "A" for the dominant allele, and "a" for the recessive, label all individuals in the pedigree above. For those you are uncertain of, label them "A-". If x-linked, use X & Y format with "A" and "a" alleles.