

Pedigrees

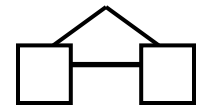
Pedigrees: show how traits are passed on in a family

○ = Female □ = Male

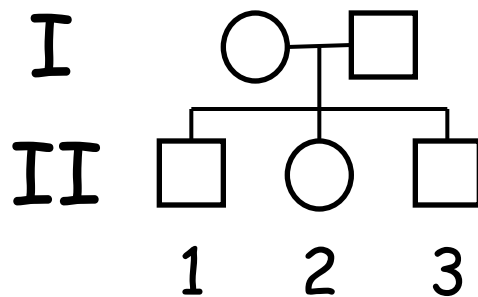
○—□ = mating

○=□ = Inbreeding (mating between relatives)

 = Fraternal twins



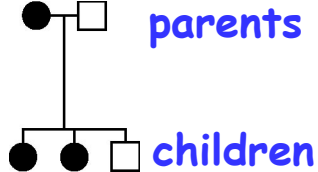

 = Identical twins

● ■ = Affected individuals



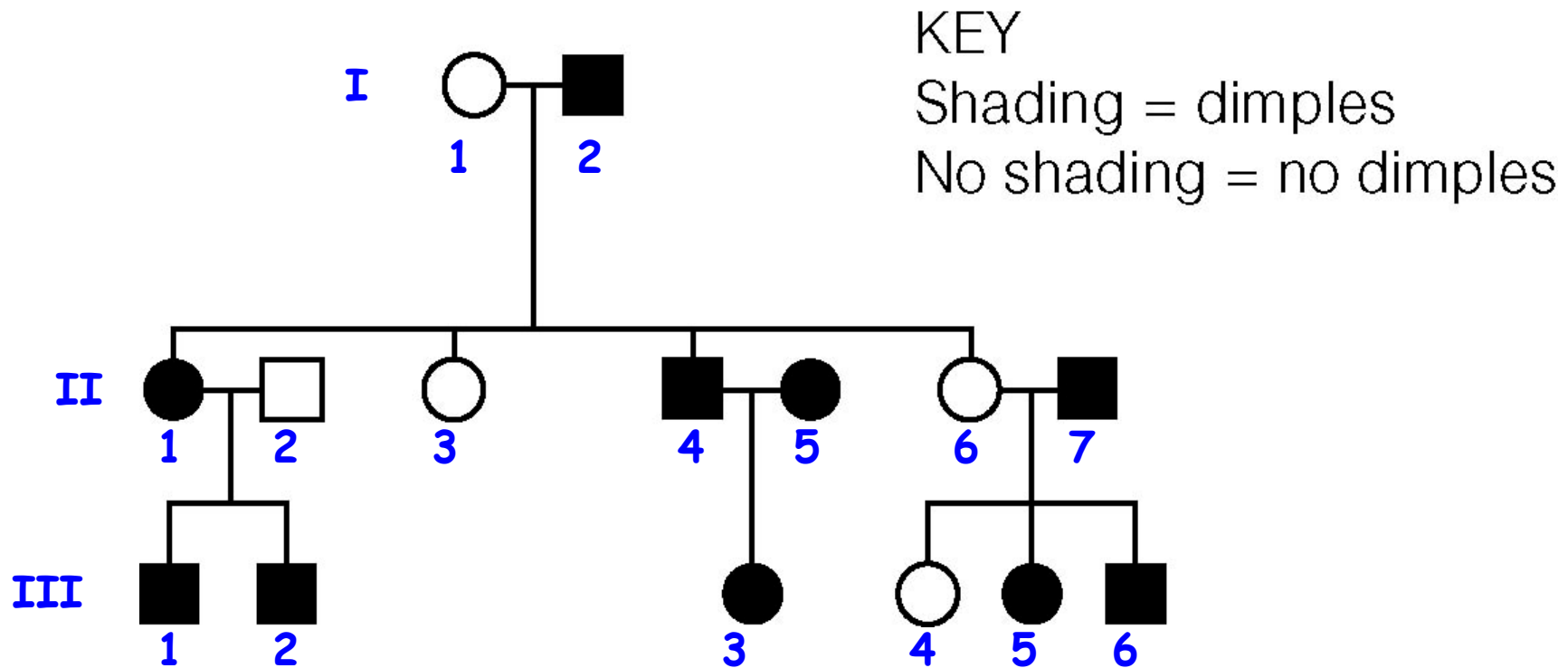
- Line between circle and square indicates mating
- Line down from this line indicates offspring
- Oldest offspring are always on the left
- Affected individuals are shaded in
- Roman numerals symbolize generations
- Regular numbers symbolize individuals within a generation

Pedigrees

		
<ul style="list-style-type: none"> • The circle represents a <u>female</u>. • The square represents a <u>male</u>. • Shaded shapes represent family members with one expression of a trait (for example, dimples). • Shapes that are <i>not</i> shaded represent members with no dimples. In this example, the <u>female</u> has dimples. 	<ul style="list-style-type: none"> • A horizontal line is used to connect <u>two parents</u>. 	<ul style="list-style-type: none"> • Lines connect parents and <u>children</u>. • The oldest children are placed on the <u>left</u> and the youngest on the <u>right</u>. In this example, there are three children — two females and a male. The <u>male</u> child has no dimples.

Pedigrees

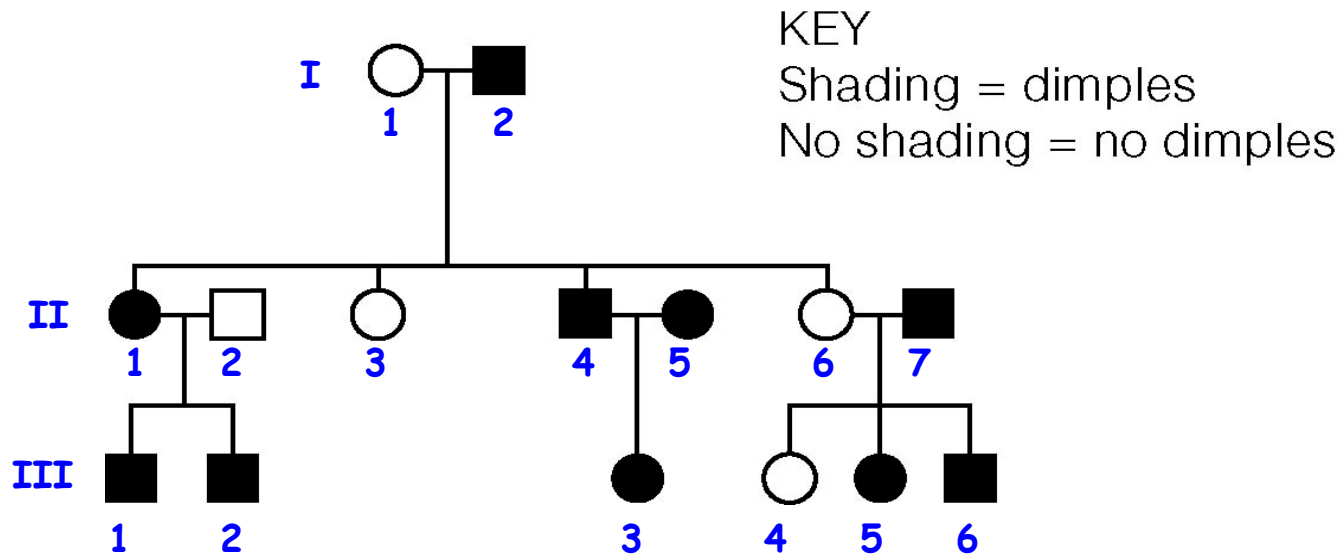
Lee Family



1. Label the generations and each member of the generations.

Pedigrees

Lee Family

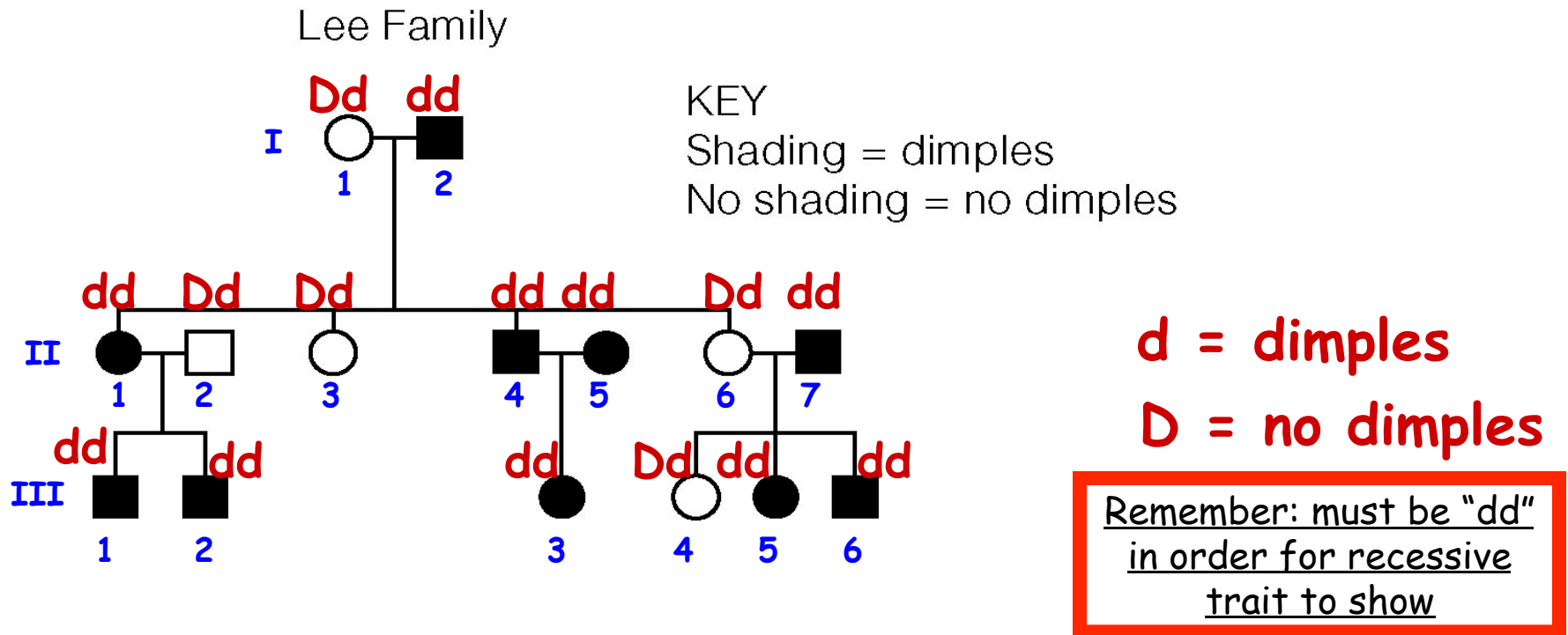


2. How many children did I-1 and I-2 have? 4

3. What was their sex? Female, female, male, female

4. Which one is the oldest child? II-1

Pedigrees

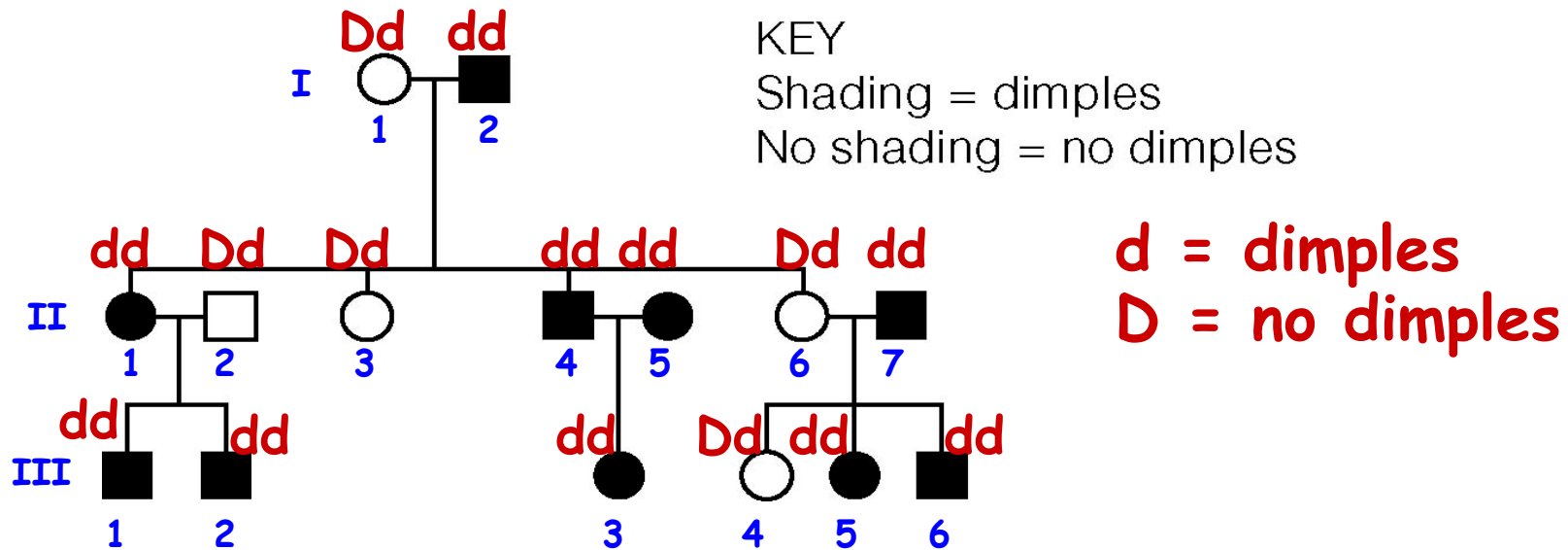


5. Assuming that having dimples is the recessive trait and no dimples is the dominant trait. Write the genotypes for all the individuals on the pedigree if **I1** is heterozygous and **I2** is homozygous recessive. (write above on the pedigree)

Question: Why couldn't **I1** be DD?

Pedigrees

Lee Family

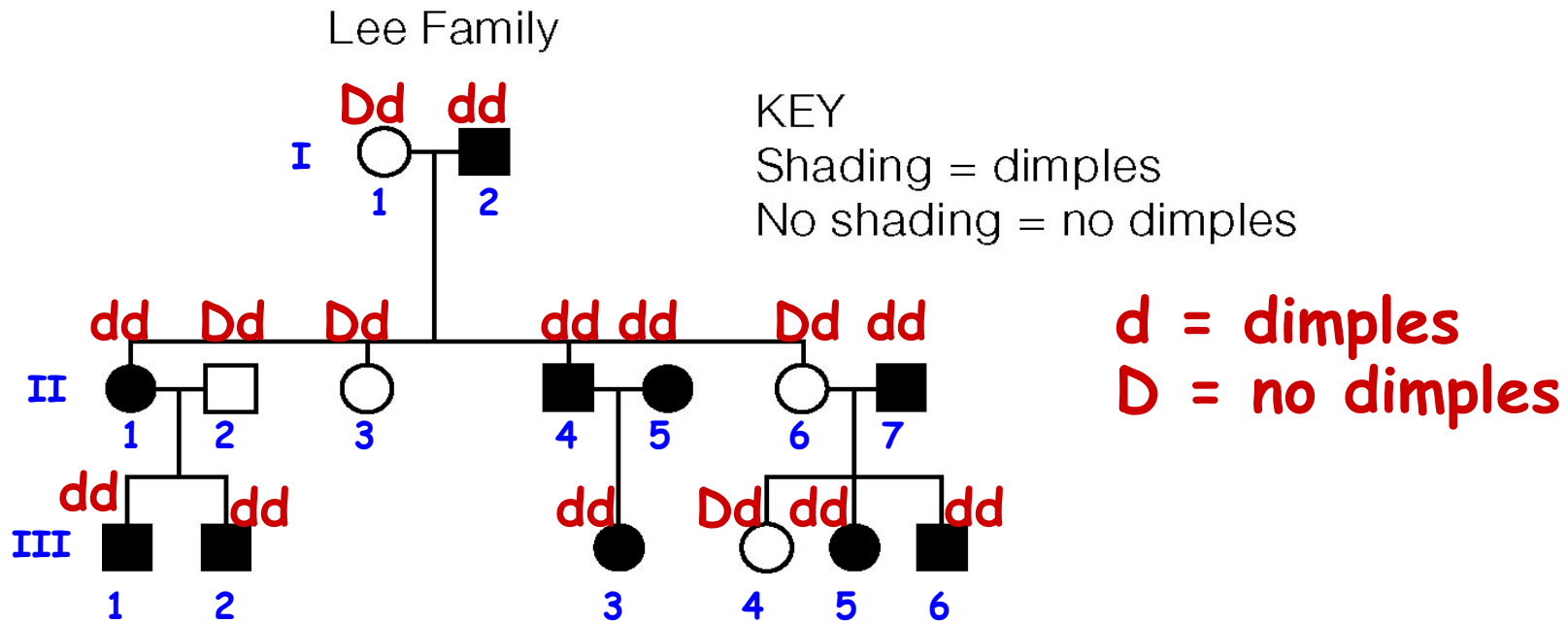


6. What is the chance that the next child of individuals II-1 and II-2 will have dimples?

The chance that their next child will have dimples is 50%.

	D	d
d	Dd	dd
d	Dd	dd

Pedigrees



7. What is the chance that the next child of II-4 and II-5's will be a boy with dimples?

$$1 \times 0.5 = 0.5$$

The chance that their next child will be a boy with dimples is 50%.

	d	d
d	dd	dd
d	dd	dd

Modes of Inheritance

The Big 4:

Autosomal Recessive

(eg) “a” for albino

Autosomal Dominant

(eg) “T” for tongue rolling

X-Linked Recessive

(eg) “ X^bX^b ” for colourblindness (recessive trait responsible)

X-Linked Dominant

(eg) “ X^B ” for brown spotted teeth

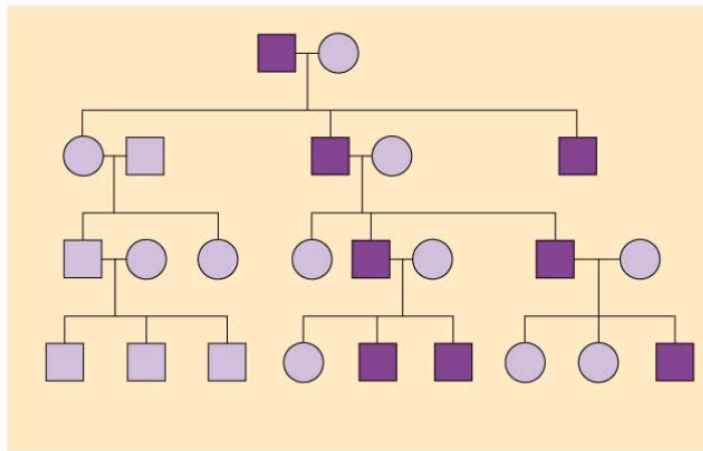
Other Modes of Inheritance

Y-linked – (eg) “ XY^B ”- ALL males affected, father pass to sons only

Mitochondrial Inheritance - mothers passes mtDNA to ALL offspring

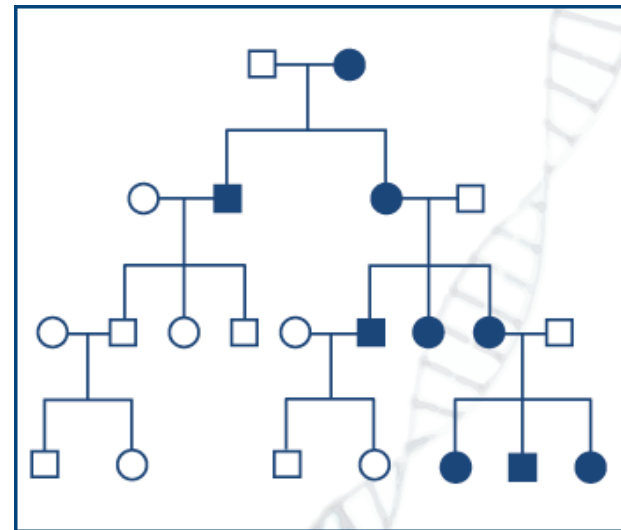
Determining the Mode of inheritance of a Trait

Pedigree for Y-Linked Trait



-Genes on Y chromosome mostly have to do with male traits ie. Proteins
-ALL MALES AFFECTED

Pedigree for Mitochondrial Inheritance



-Mitochondrial traits passed down BY MOTHER to ALL OFFSPRING

Determining the Mode of inheritance of a Trait

Question 1: Are males and females affected equally?

If NO, then trait you are looking at is most likely **X-linked**
(but check to make sure no male to male only transmission...)
-if there is, its probably a Y linked trait)

If YES, (equal males and females affected), then the trait is most likely **AUTOSOMAL**

Determining the Mode of inheritance of a Trait

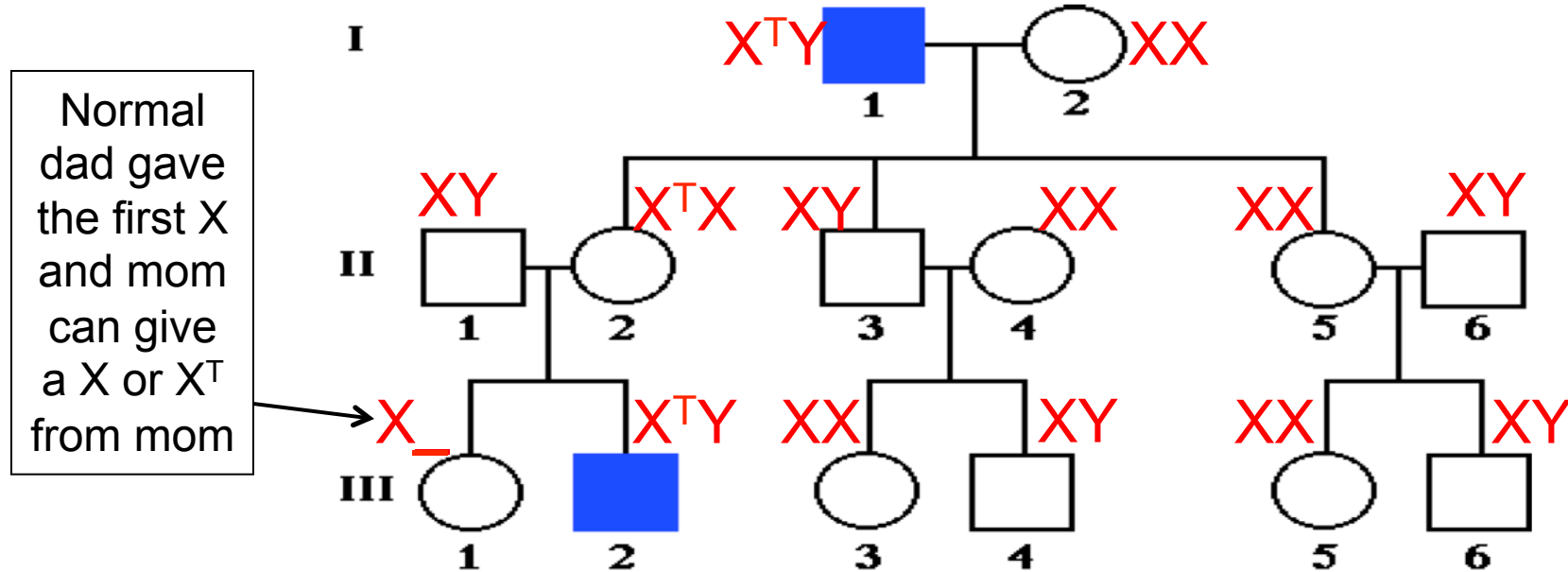
Question 2: Does the trait skip generations or does the trait appear in EVERY generation

If trait is in **EVERY GENERATION**, then the trait is most likely **DOMINANT**

If trait **SKIPS GENERATIONS**, then the trait is most likely **RECESSIVE**

Practice: #1

What is the most likely mode of inheritance?



Question 1: Are males and females affected equally?

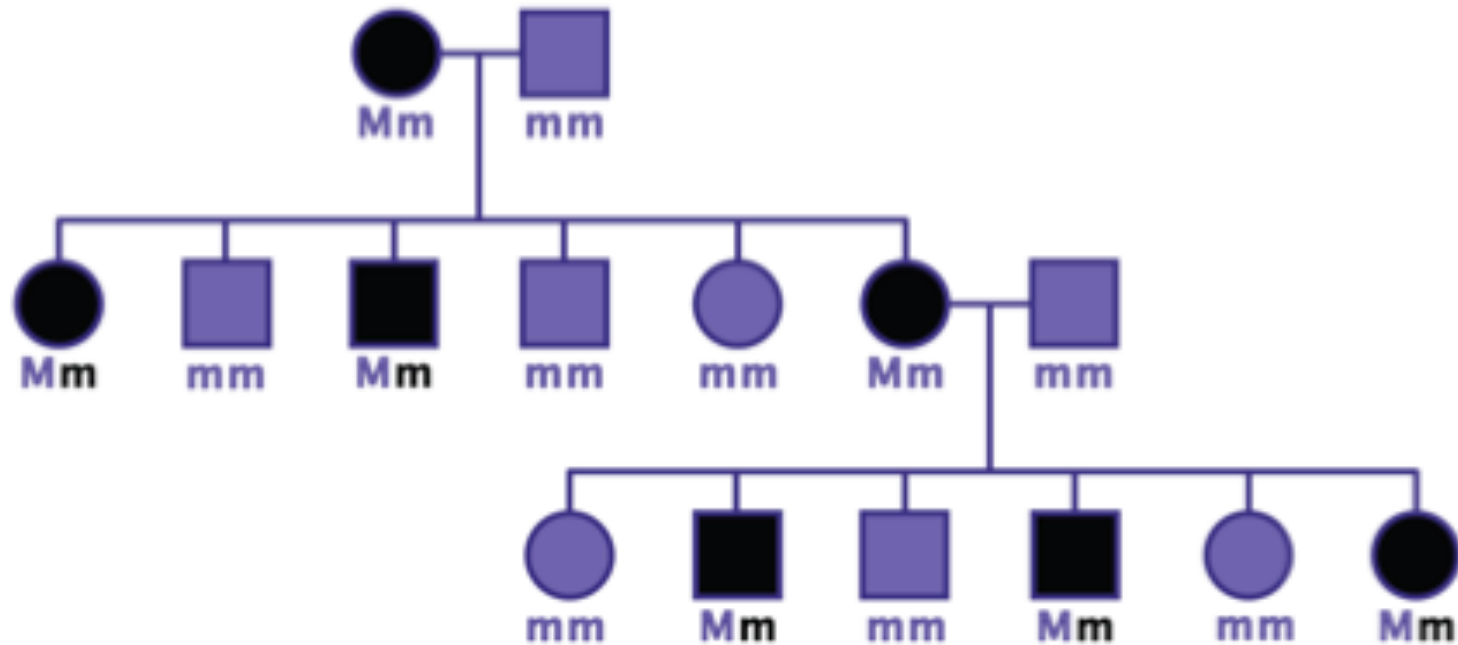
Question 2: Does the trait skip generations or does the trait appear in EVERY generation

NO = X-linked

SKIP = recessive

Practice: #2

What is the most likely mode of inheritance?



Question 1: Are males and females affected equally?

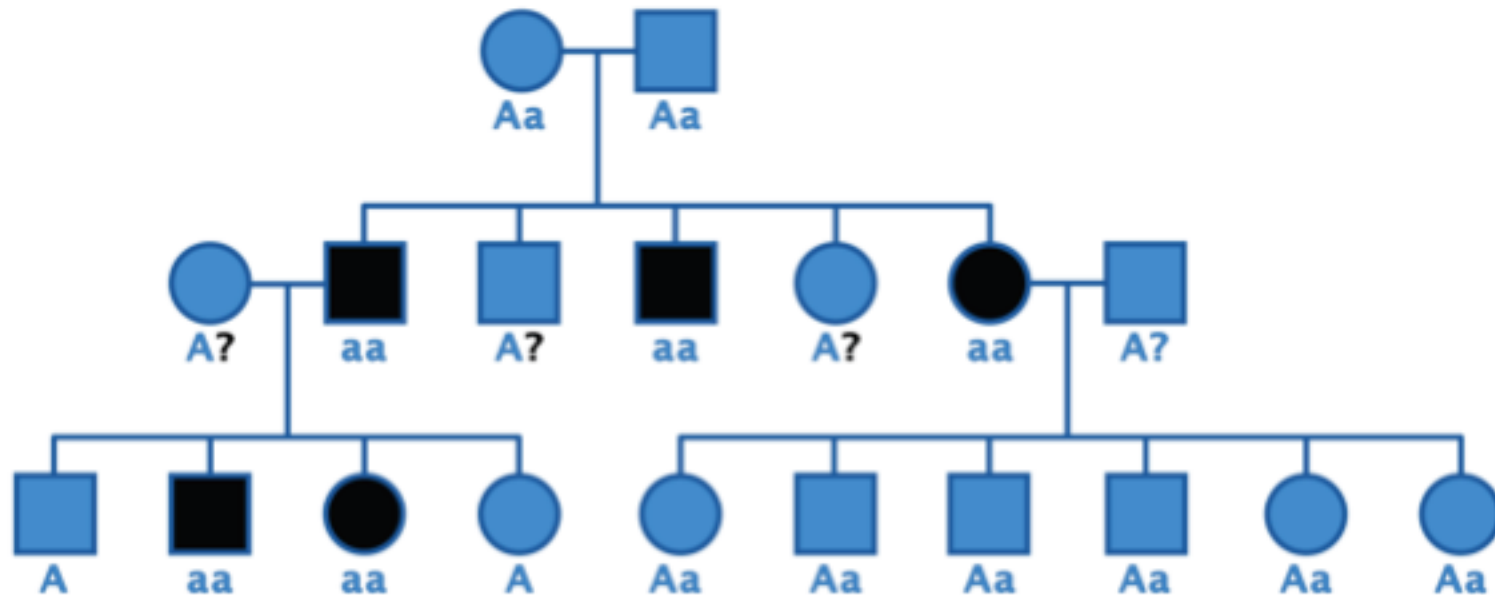
YES = Autosomal

Question 2: Does the trait skip generations or does the trait appear in EVERY generation

No skip = Dominant

Practice: #2

What is the most likely mode of inheritance?



Question 1: Are males and females affected equally?

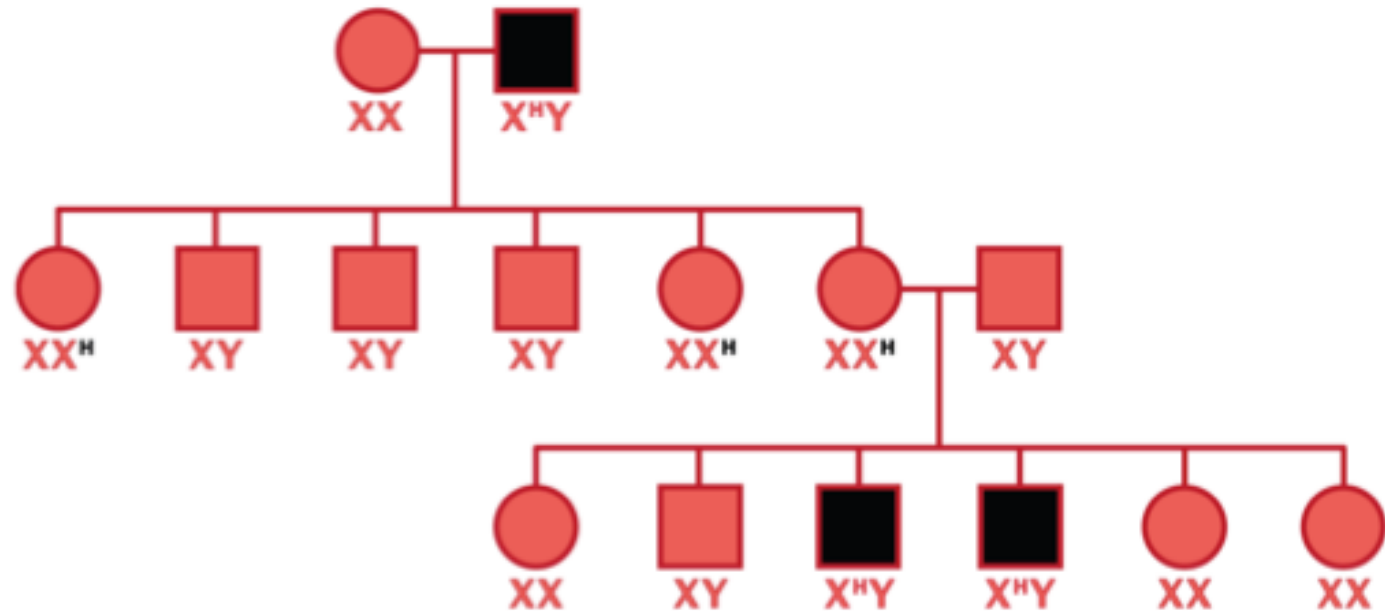
Question 2: Does the trait skip generations or does the trait appear in EVERY generation

YES = Autosomal

skip = recessive

Practice: #3

What is the most likely mode of inheritance?



Question 1: Are males and females affected equally?

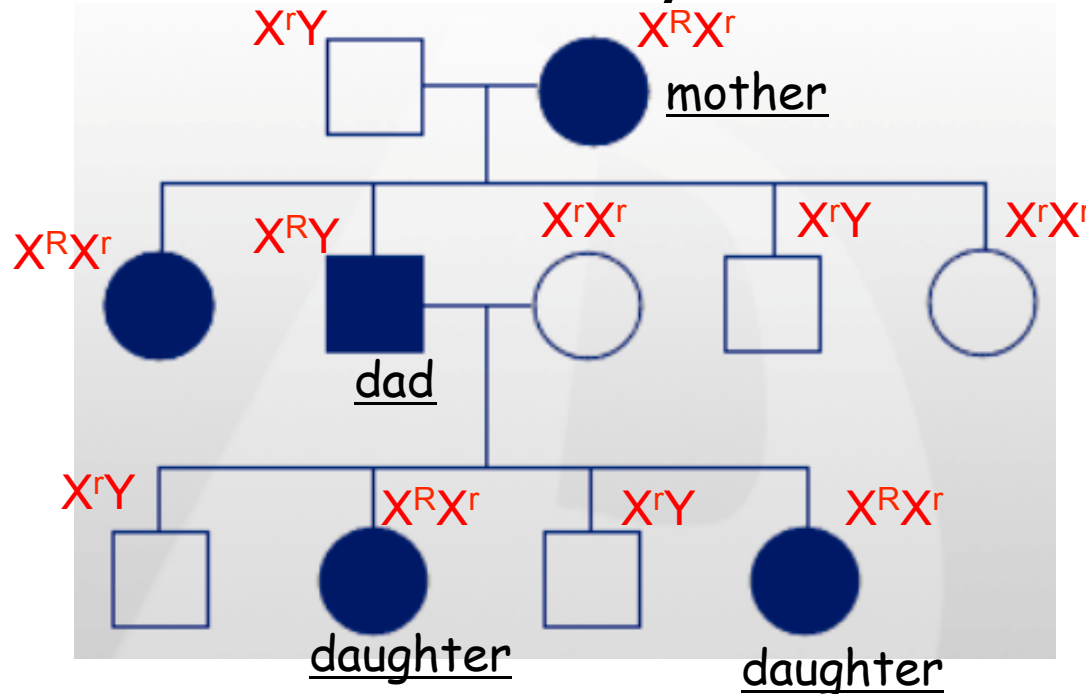
Question 2: Does the trait skip generations or does the trait appear in EVERY generation

NO = x-linked

SKIP = recessive

Practice: #3

What is the most likely mode of inheritance?



DDD

Dominant,
if Dads has then,
Daughter will
have
As well as...
Mother will have

Question 1: Are males and females affected equally?

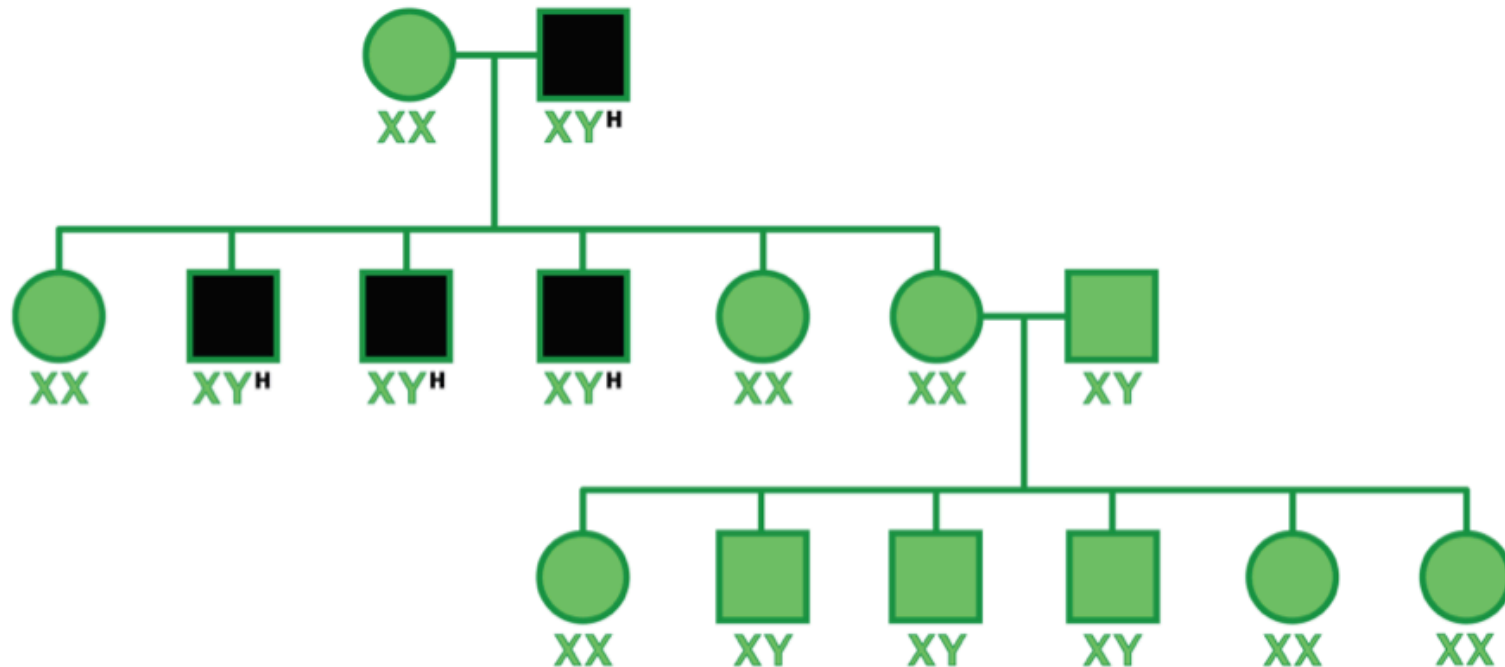
Question 2: Does the trait skip generations or does the trait appear in EVERY generation

NO = x-linked

NO SKIP = dominant

Practice: #4

What is the most likely mode of inheritance?

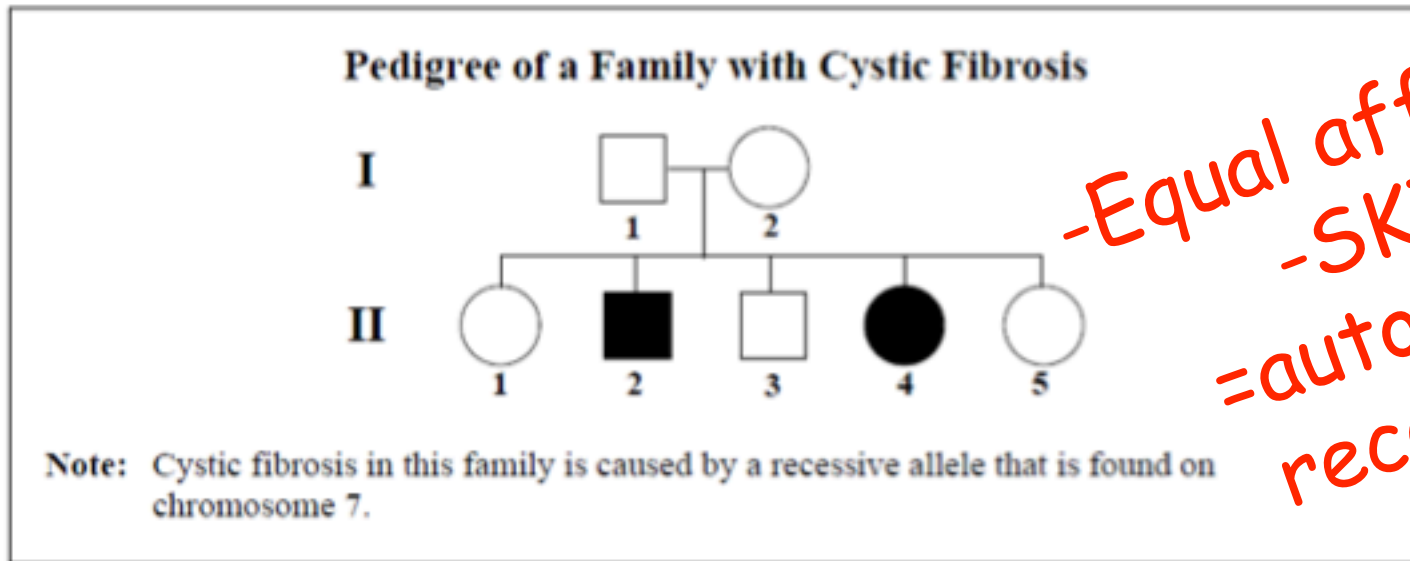


Question 1: Are males and females affected equally?

Question 2: Does the trait skip generations or does the trait appear in EVERY generation

Y-linked

Use the following additional information to answer the next question.



-Equal affected
 -SKIP
 =autosomal
 recessive

Prior to performing amniocentesis, a genetic counsellor collected pedigree information regarding the incidence of cystic fibrosis within this family. The row that indicates the genotypes of individuals I-1, I-2, and II-2 is

Row	I-1	I-2	II-2
A.	Aa	Aa	aa
B.	AA	aa	Aa
C.	$X^A Y$	$X^A X^A$	$X^a Y$
D.	$X^A Y$	$X^A X^a$	$X^A Y$

Yes b/c boys and girls affected and skips generation

NO because "aa" would be showing trait

NO because not X linked

NO because not X linked

Scientists have identified a genetic condition that apparently makes some men prone to impulsive, violent behaviour. A pedigree was drawn highlighting the violent members of a particular family. It appeared, from the pedigree, that men who displayed this violent behaviour inherited this condition from their mothers, not their fathers. Further evidence showed that this was the mode of inheritance.

—from *Richardson, 1993*

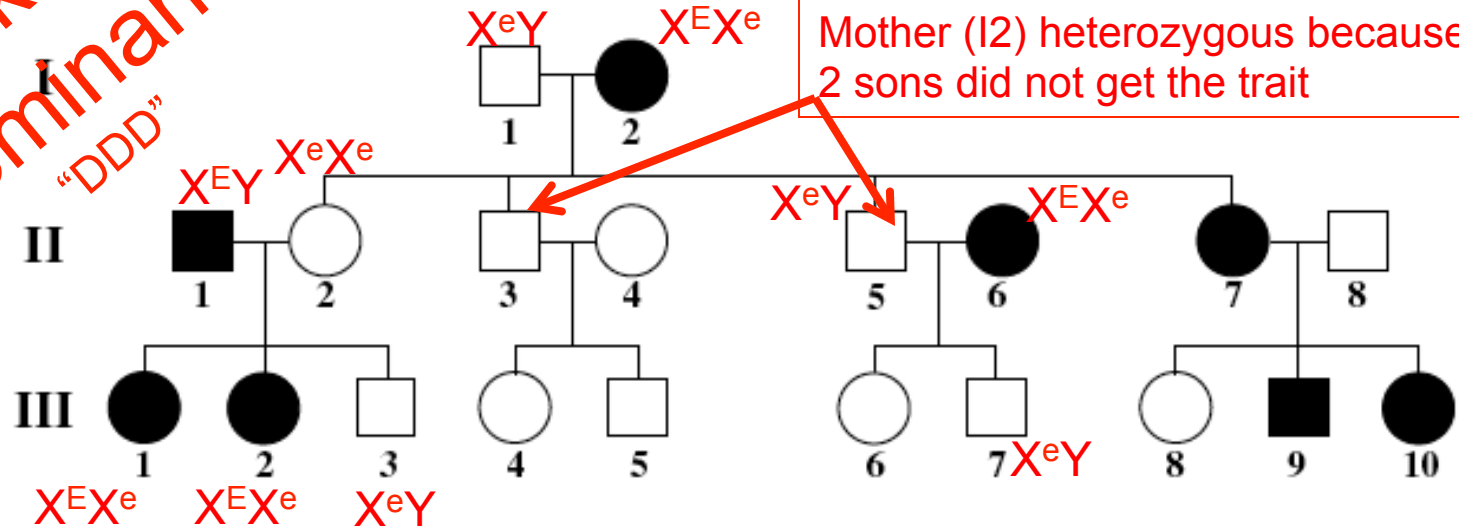
The inheritance pattern described indicates that this condition is

- A. X-linked
- B. Y-linked
- C. autosomal
- D. codominant

A dominant allele, X^E , causes the formation of faulty tooth enamel. The X^e allele, which is carried on the X chromosome, causes either very thin or very hard enamel.

Pedigree Illustrating the Inheritance of Faulty Tooth Enamel

X linked dominant
"DDD"



The genotypes of individuals II-6 and III-7 are identified in row

Row	II-6	III-7
A.	$X^E X^E$	$X^E Y$
B.	$X^E X^e$	$X^e Y$
C.	$X^e X^e$	$X^E Y$
D.	$X^E X^E$	$X^e Y$

THE ACCURATE WAY

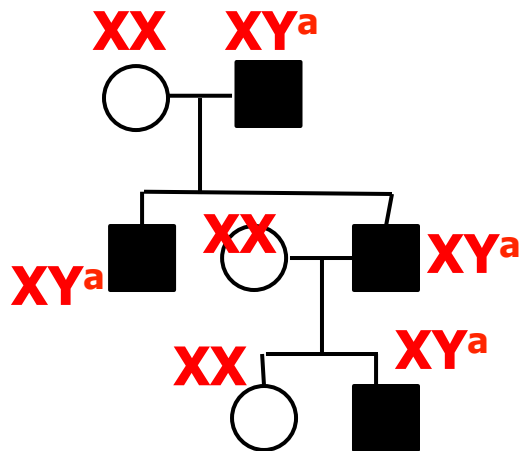
to determine the
Mode of Inheritance
(but more knowledge intensive)

Steps in determining the mode of inheritance

START

Y-linked (XY^a)

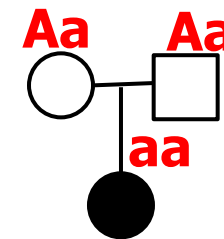
-Only in males. ---
Affected fathers
must have all
affected sons



If NO

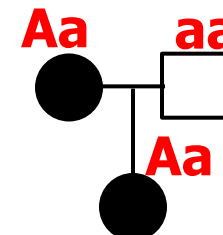
Recessive (aa) or (X^aX^a)

**-2 unaffected parents CAN
have an affected child.
-Can skip a generation.**

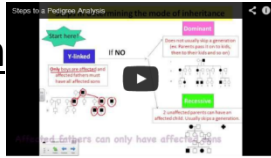


Dominant (Aa , AA , X^AX^A , X^AX^a)

Does **not** skip a generation

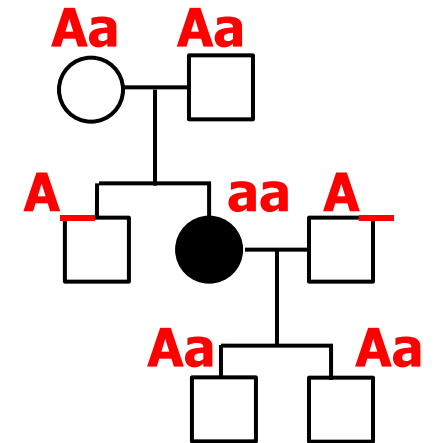


Click to watch
a tutorial



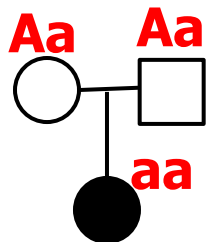
Autosomal (AR) aa

Usually skips a generation



Recessive

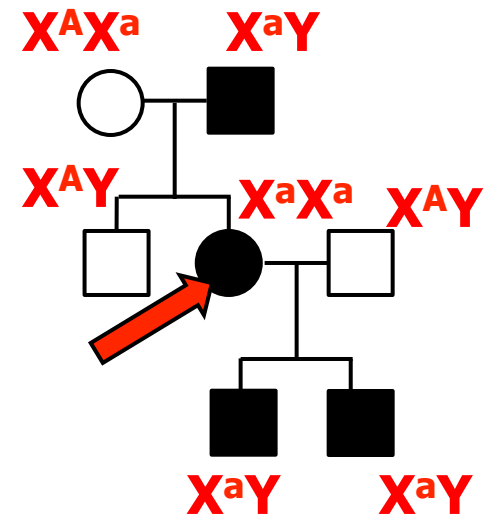
2 unaffected parents have an affected child. Can skip a generation.



If Yes

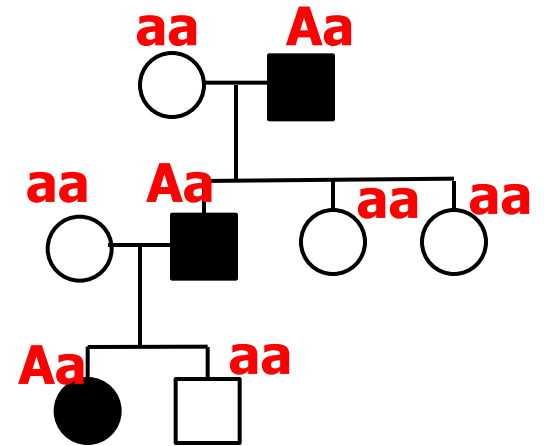
X- Linked (XR) X^a

-More often in males.
-affected **females** have all affected sons and affected fathers



Autosomal (AD) A

Affected individuals have at least 1 affected parent



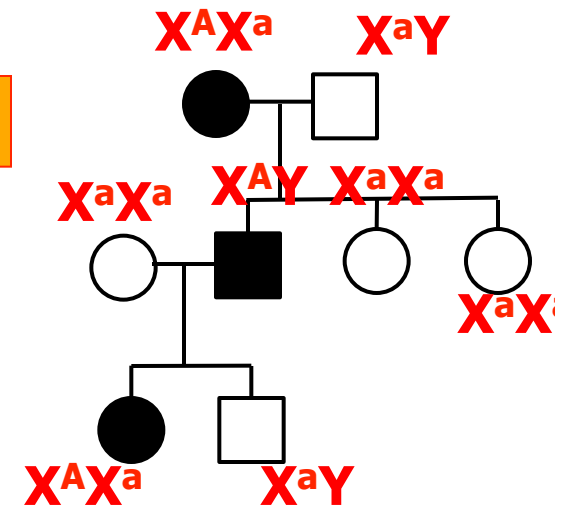
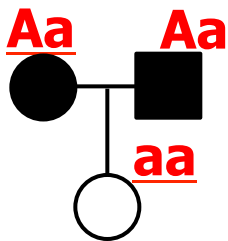
Dominant

Does **not** skip a generation

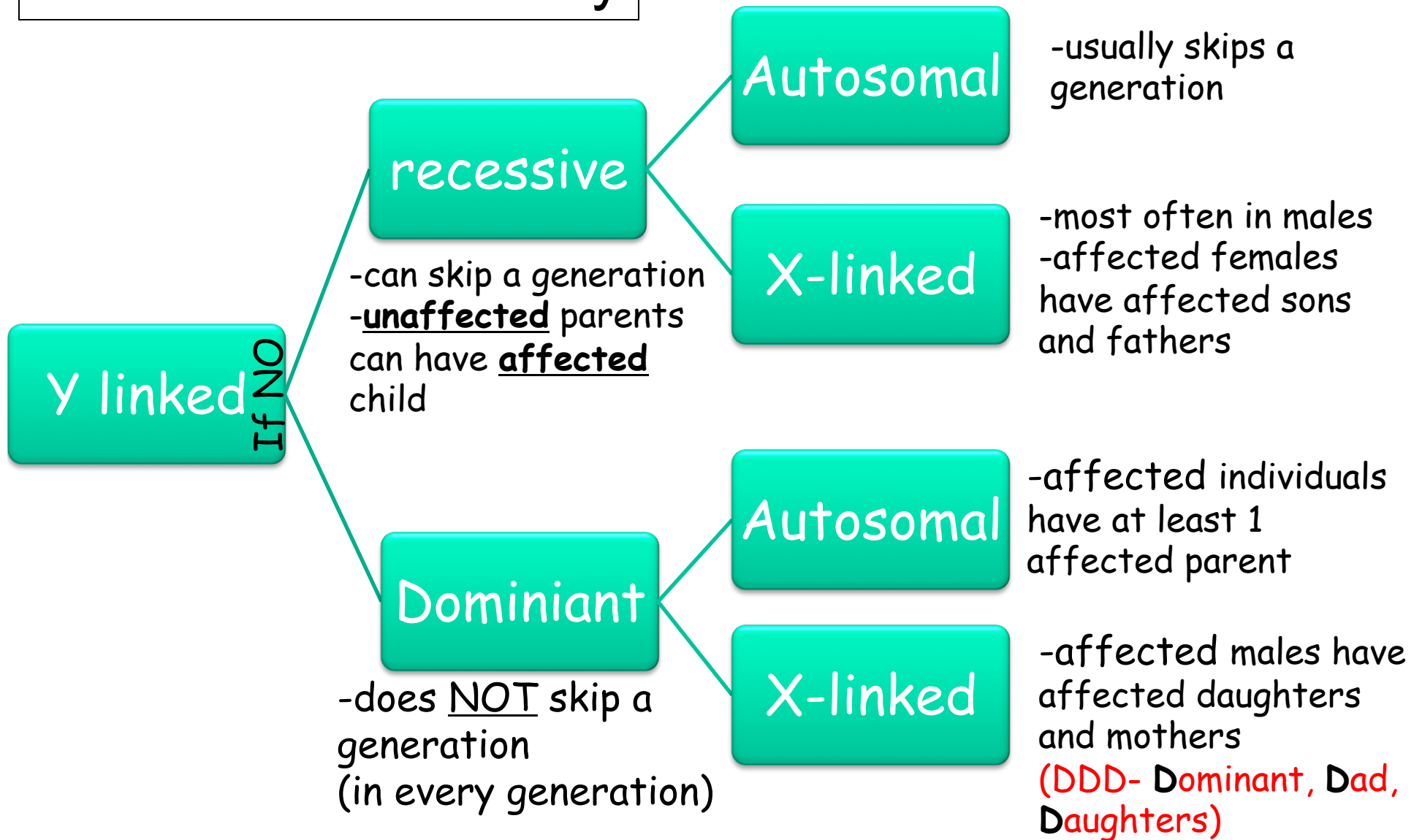
If Yes

X- Linked (XD) X^A

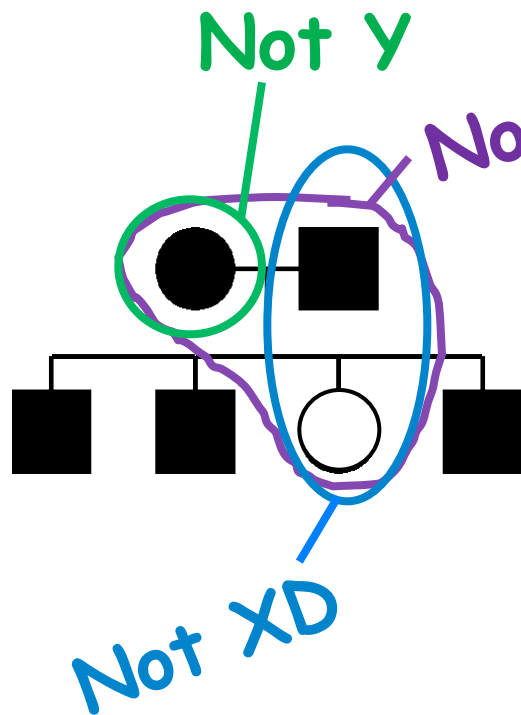
Affected **males** have all affected daughters and affected mothers.



Mode of Inheritance Flow Chart Summary



Example 1



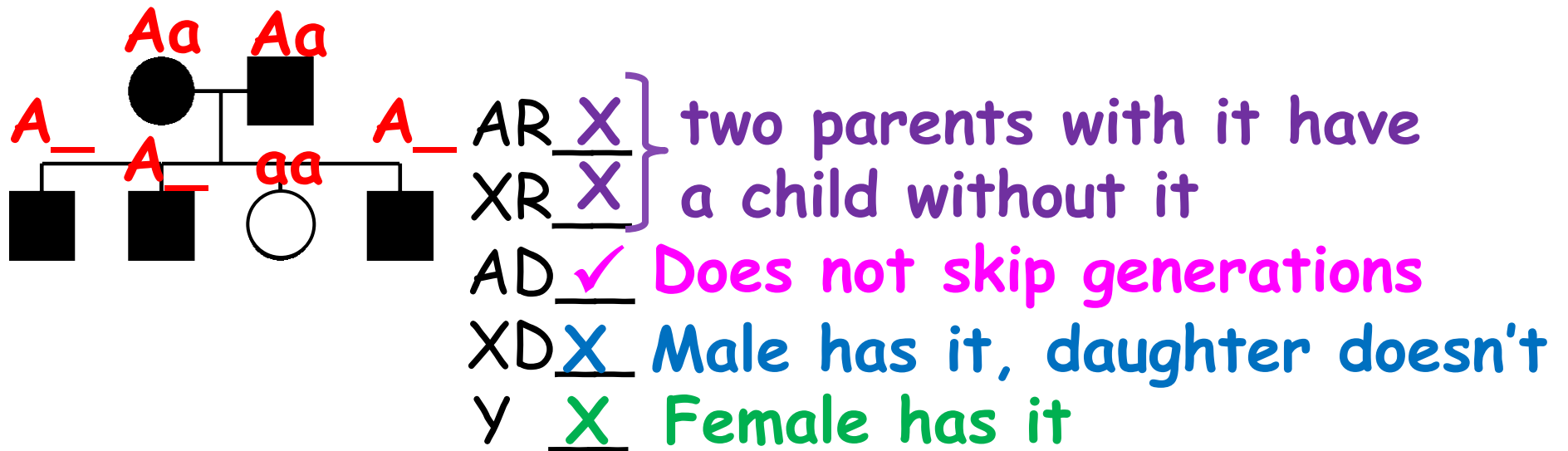
- AR X } two parents with it have
- XR X } a child without it
- AD ✓ Does not skip generations
- XD X Male has it, daughter doesn't
- Y X Female has it

Autosomal dominant

A = affected

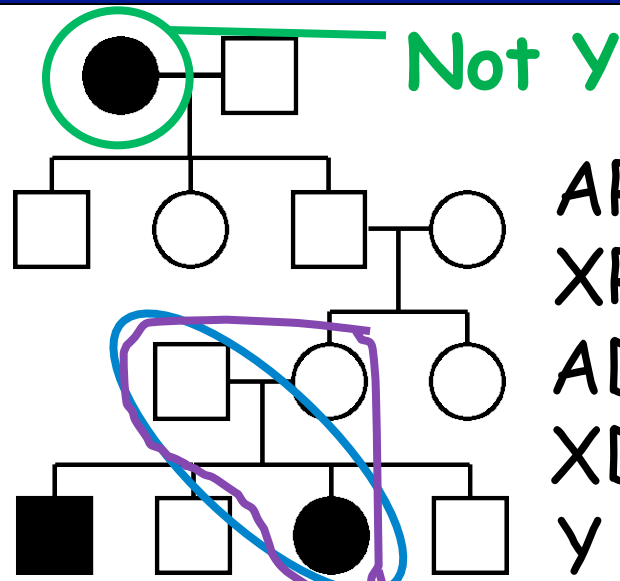
a = unaffected

Example 1



Autosomal dominant A = affected
 a = unaffected

Example 2



Not Y

AR ✓ skips generations

XR X Female has it, father doesn't

AD X } Skips a generation

XD X

Y X Female has it

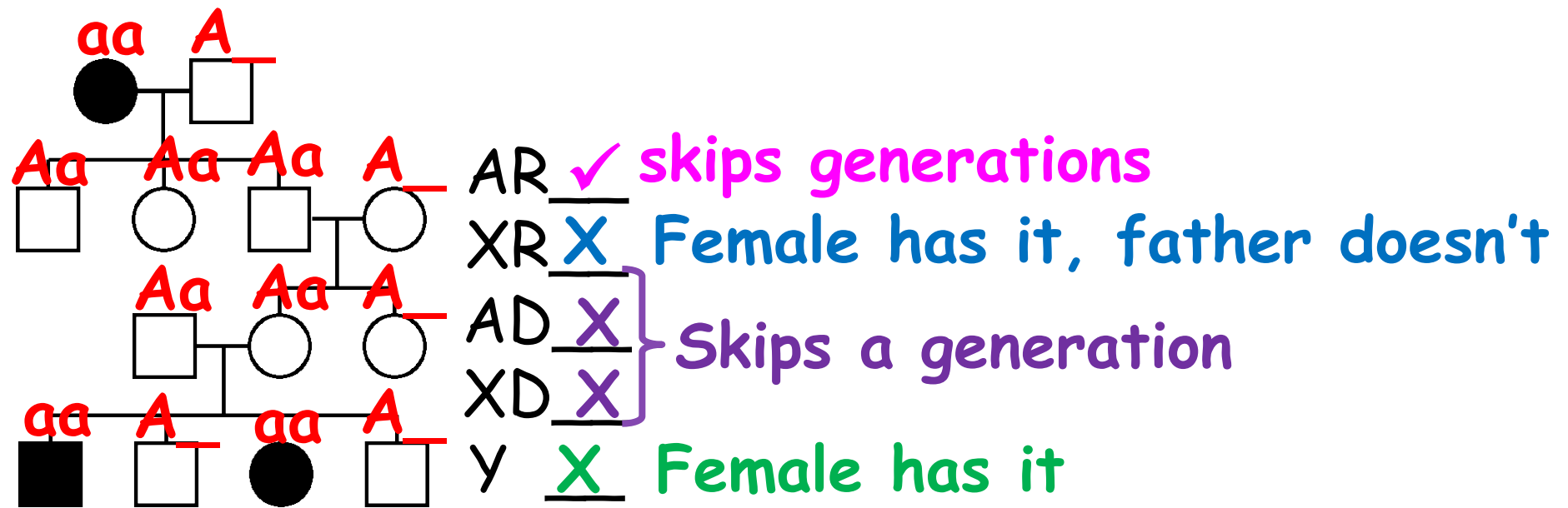
Not XR
Not Dominant

Autosomal recessive

a = affected

A = unaffected

Example 2



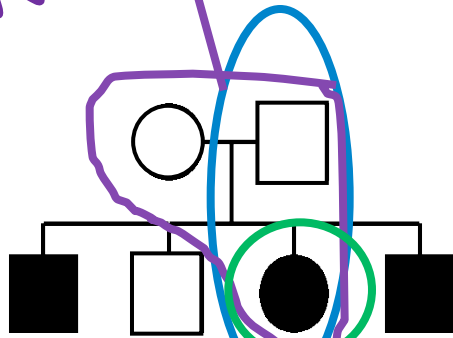
Autosomal recessive

a = affected

A = unaffected

Example 3

Not Dominant



Not XR

Not Y

AR ✓ skips generations

XR X Female has it, father doesn't

AD X } Skips a generation

XD X }

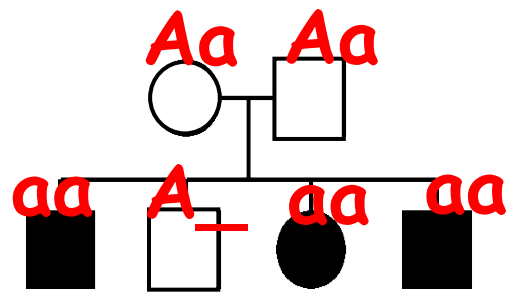
Y X Female has it

Autosomal recessive

a = affected

A = unaffected

Example 3



AR ✓ skips generations

XR X Female has it, father doesn't

AD X } Skips a generation

XD X }

Y X Female has it

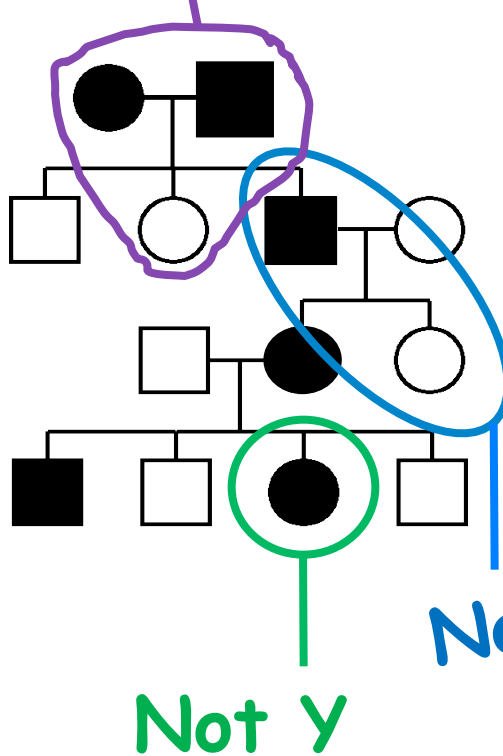
Autosomal recessive

a = affected

A = unaffected

Example 4

Not Recessive



- AR X } two parents with it have
- XR X } a child without it
- AD ✓ Does not skip generations
- XD X Male has it, daughter doesn't
- Y X Female has it

Not XD

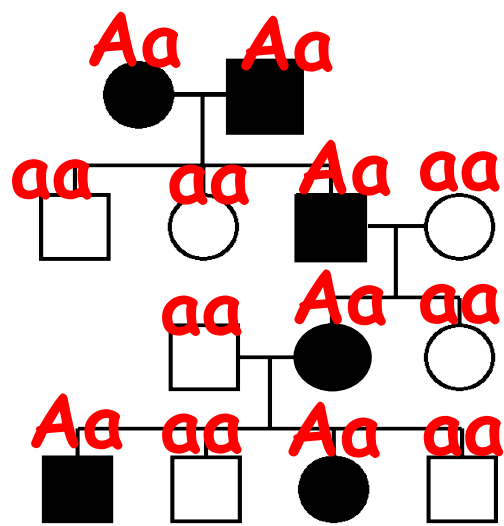
Not Y

Autosomal dominant

A = affected

a = unaffected

Example 4



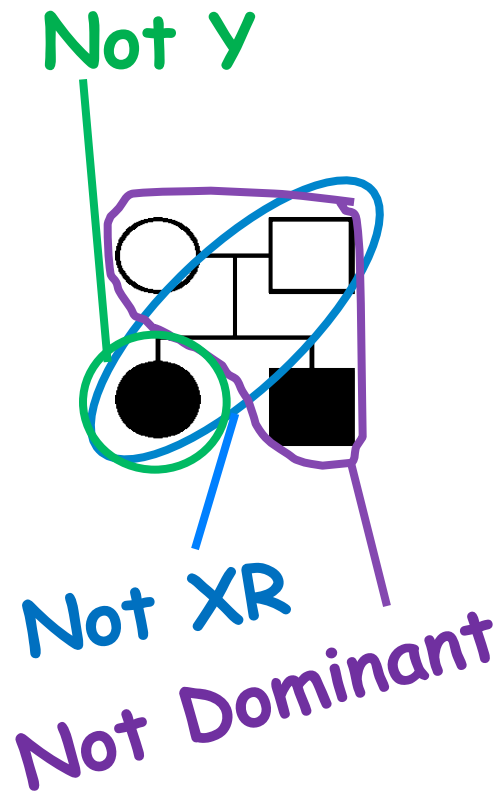
- AR X } two parents with it have
- XR X } a child without it
- AD ✓ Does not skip generations
- XD X Male has it, daughter doesn't
- Y X Female has it

Autosomal dominant

A = affected

a = unaffected

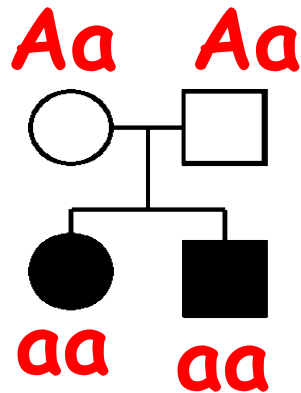
Example 6



- AR ✓ skips generations
- XR X Female has it, father doesn't
- AD X } Skips a generation
- XD X }
- Y X Female has it

Autosomal recessive
a = affected
A = unaffected

Example 6



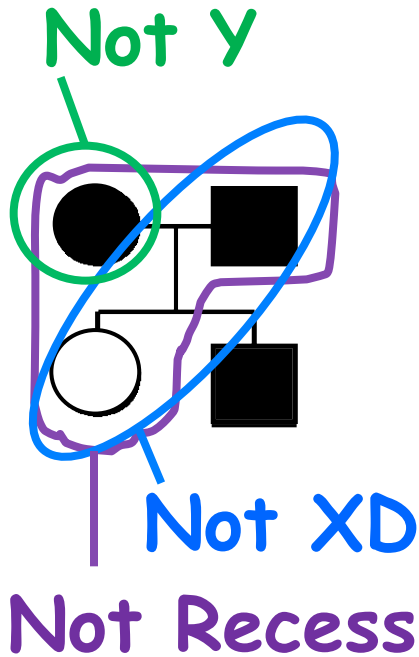
AR ✓ skips generations
XR X Female has it, father doesn't
AD X
XD X } Skips a generation
Y X Female has it

Autosomal recessive

a = affected

A = unaffected

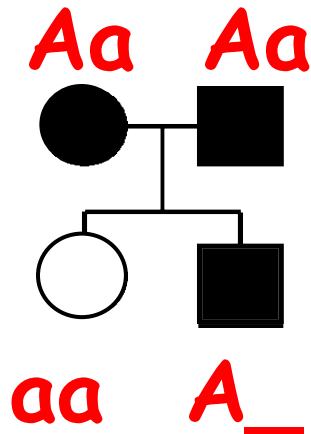
Example 8



- AR X } two parents with it have
- XR X } a child without it
- AD ✓ Affected parents can have an unaffected child
- XD X Dad has it, daughter does not
- Y X Female has it

Autosomal dominant
 A = affected
 a = unaffected

Example 8

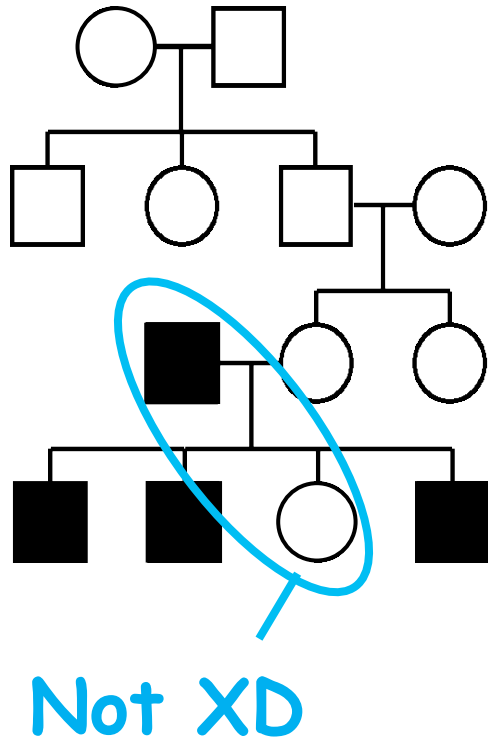


AR X } two parents with it have
 XR X } a child without it
 AD ✓ Affected parents can have
 an unaffected child
 XD X Dad has it, daughter does not
 Y X Female has it

**Autosomal
dominant**

**A = affected
a = unaffected**

Example 9



AR maybe Doesn't have to skip
XR maybe more males affected
than females

AD maybe Doesn't skip generations

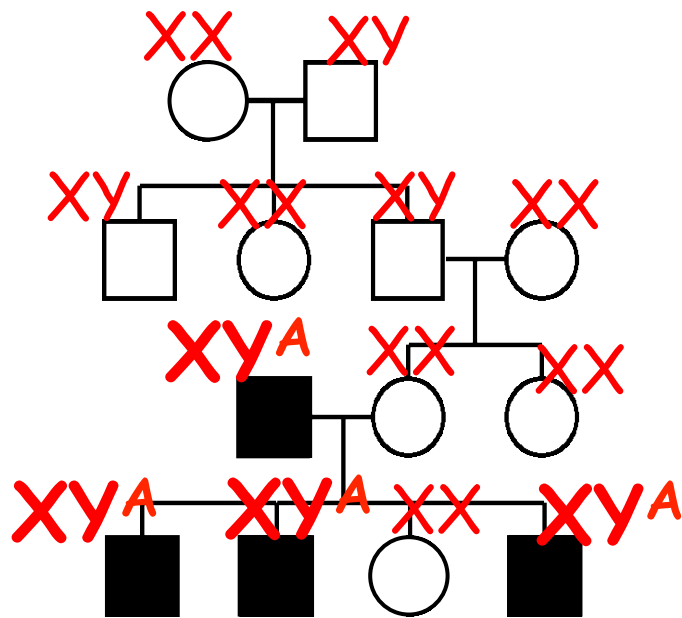
XD X Daughter of affected
dad must have it

Y ✓ Most likely because
affected father has
all affected sons.

Y-Linked

Y^A = affected

Example 9



AR maybe skips a generation

XR maybe more males affected than females

AD maybe Doesn't skip generations

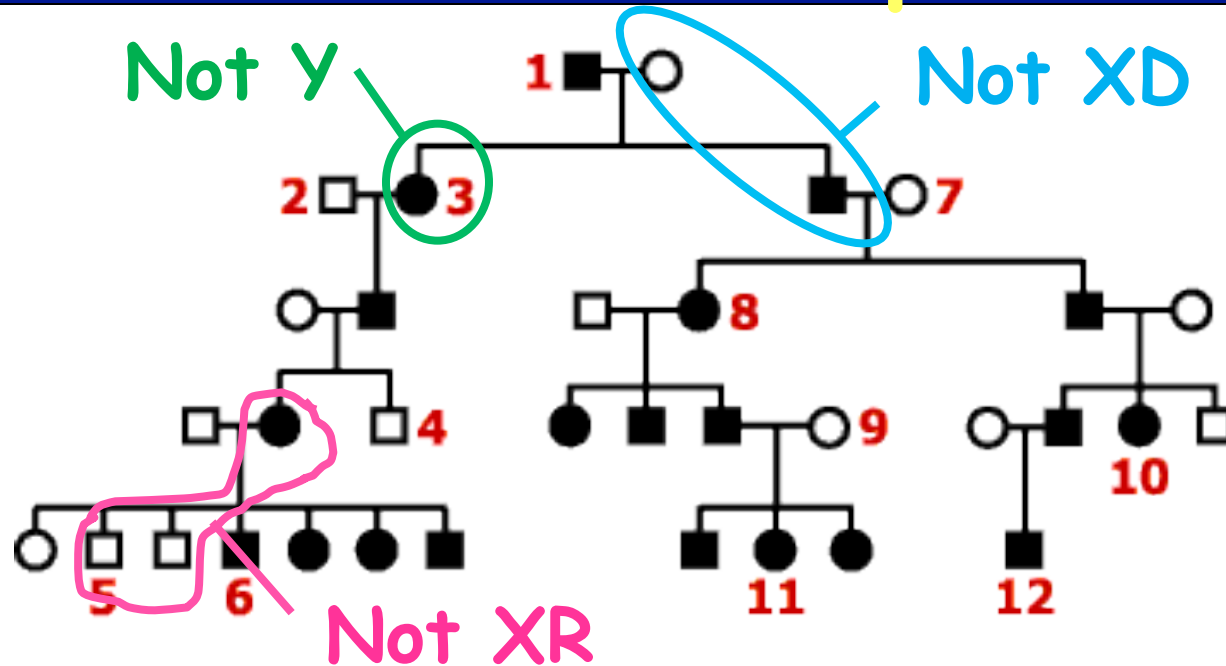
XD X Daughter of affected dad must have it

Y ✓ Affected father has all affected sons.

Y Linked

Y^A = affected

Example 10



Autosomal dominant

A = affected
a = unaffected

AR maybe Cannot disprove

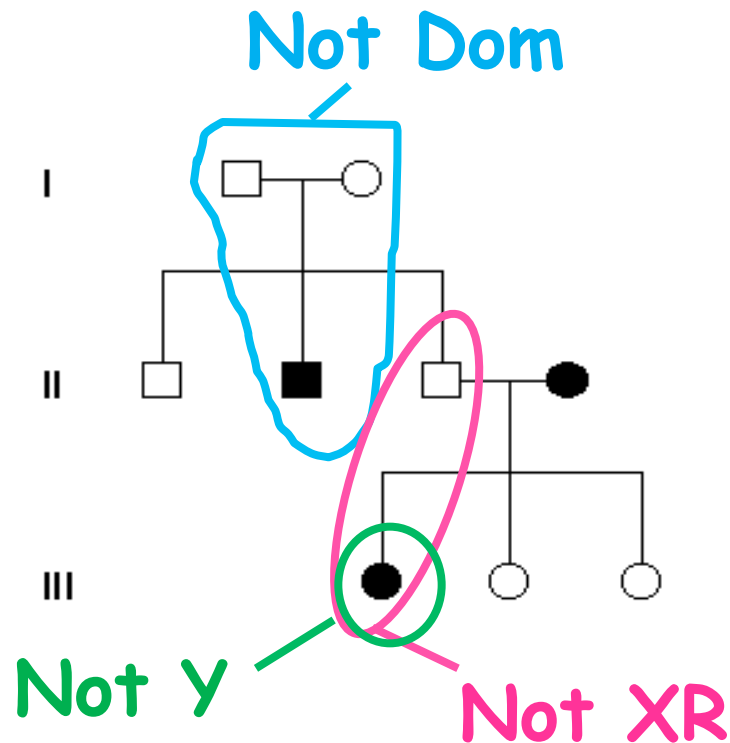
XR X Affected female has unaffected sons

AD ✓ Most likely - Does not skip generations
(Affected children must have affected parent)

XD X Male has it, but mother does not

Y X Female has it

Example 12



AR ✓ Skips a generation

XR X Affected female must have affected father.

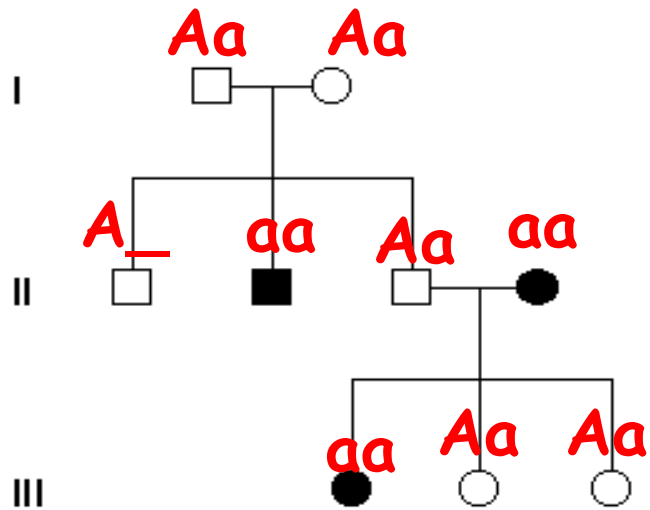
AD X } Skips a generation
XD X }

Y X Female has it

Autosomal
recessive

a = affected
A = unaffected

Example 12



AR ✓ Skips a generation

XR X Affected female must have affected father.

AD X } Skips a generation

XD X }

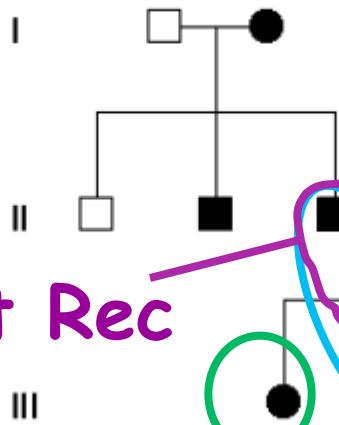
Y X Female has it

Autosomal
recessive

a = affected
 A = unaffected

Example 13

13.



AR X
 XR X } All children must be affected

AD ✓ Affected child has at least one affected parent

XD X Affected males must have all affected daughters

Y X Female has it

Not Rec

Not Y
 Not XD

Autosomal dominant

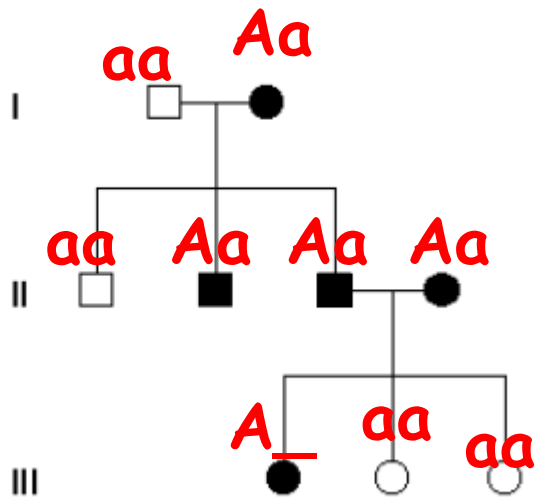
A = affected
 a = unaffected

From:

<http://peter.mackenzie.org/history/geneal1.htm>

Example 13

13.



AR X
 XR X } All children must be affected

AD ✓ Affected child has at least one affected parent

XD X Affected males must have all affected daughters

Y X Female has it

Autosomal dominant

A = affected
 a = unaffected

From:

<http://peter.mackenzie.org/history/geneal1.htm>

Video that shows how to do a
pedigree by trial and error.
(No memorization of rules)

<http://www.youtube.com/watch?v=HbIHjsn5cHo>