

Autosomal vs. sex-linked traits

- Autosomal traits are caused by genes on autosomes (chrms #1 - #22)
 - e.g., we speak of autosomal recessive or autosomal dominant traits or diseases
- Sex-linked traits are caused by genes on the sex chrms (X or Y)
 - e.g., we speak of X-linked recessive or X-linked dominant traits or diseases

Dominant inheritance

- If **D** is the disease allele and **d** is normal, then only **dd** genotypes are disease free*
- Dominant trait/disease found in every generation*
- Affected kid **never**** born to unaffected parents

* Assuming 100% penetrance

** Assuming no new mutation

Recessive inheritance

- If **d** is the disease allele and **D** is normal, then only **dd** genotypes are affected
- typically **not** seen in every generation
- Affected kid **can** be born to unaffected parents

X-linked recessive inheritance

- Rules for recessive inheritance apply
- Mostly males are affected

X-linked dominant inheritance

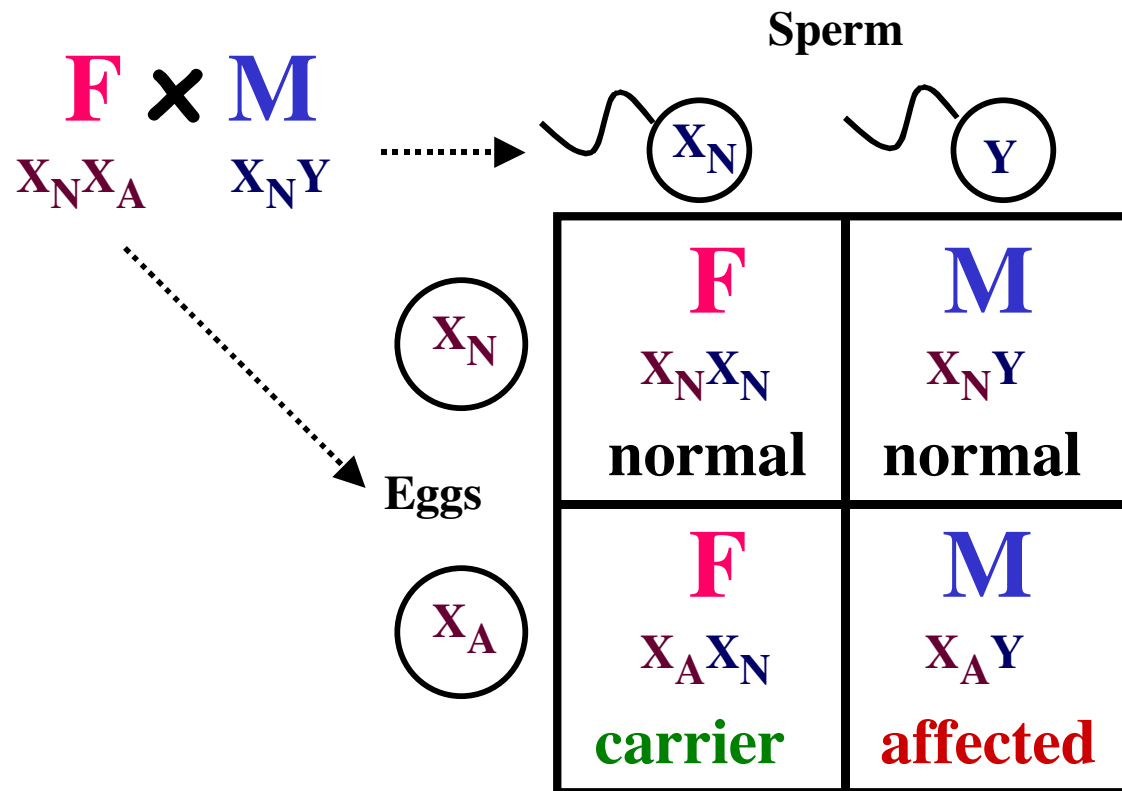
- Rules for dominant inheritance apply
- Dad's pass disease to all of their daughters and none of their sons

X-linked genes (and X-linked diseases)...

- Males: haploid (= hemizygous) for most X-linked genes.
- --> men are more frequently affected by diseases caused recessive alleles of X-linked genes

Female carrier* mates with normal male

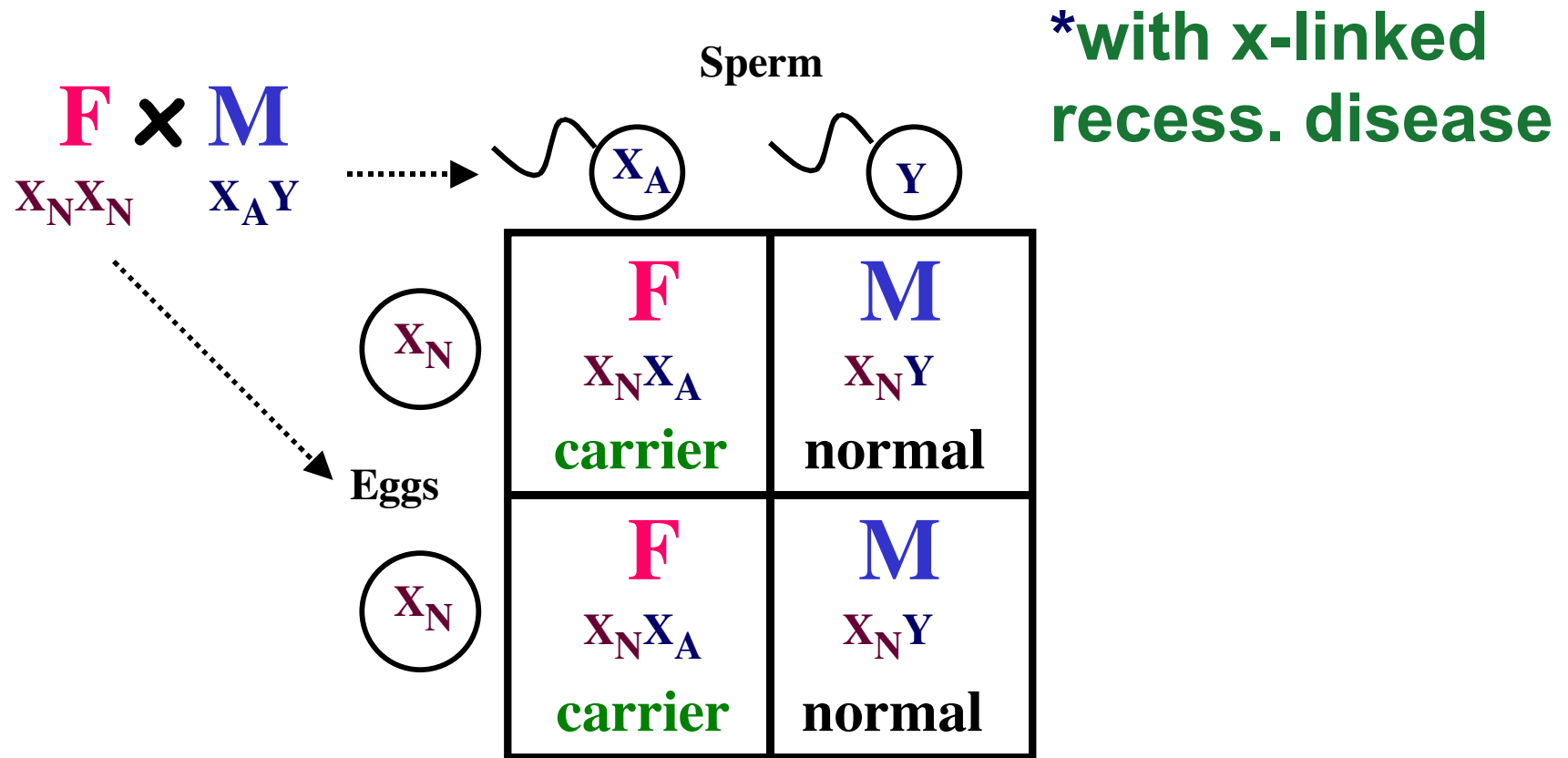
*of x-linked
recess. disease



- Half* her daughters will be carriers
- Half* her sons will be affected

*on average

Affected male* mates with normal female



- All his daughters will be carriers
- None of his sons will be affected

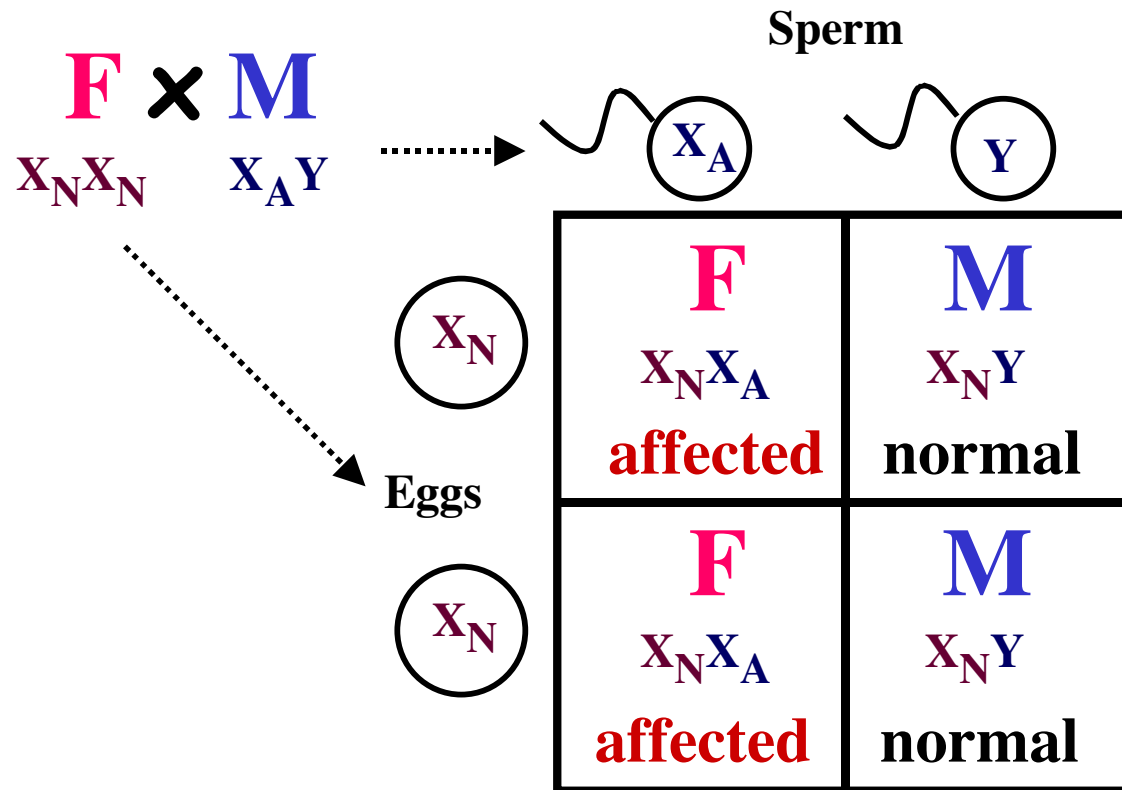
Some X-linked recessive human diseases

- Hemophilia A
- Hemophilia B
- Red-green color blindness
- Duchenne muscular dystrophy
- Retinitis pigmentosum (one of many loci)
- Lesch-Nyhan Syndrome
- Many others

No need
to memorize

X-linked dominant disease

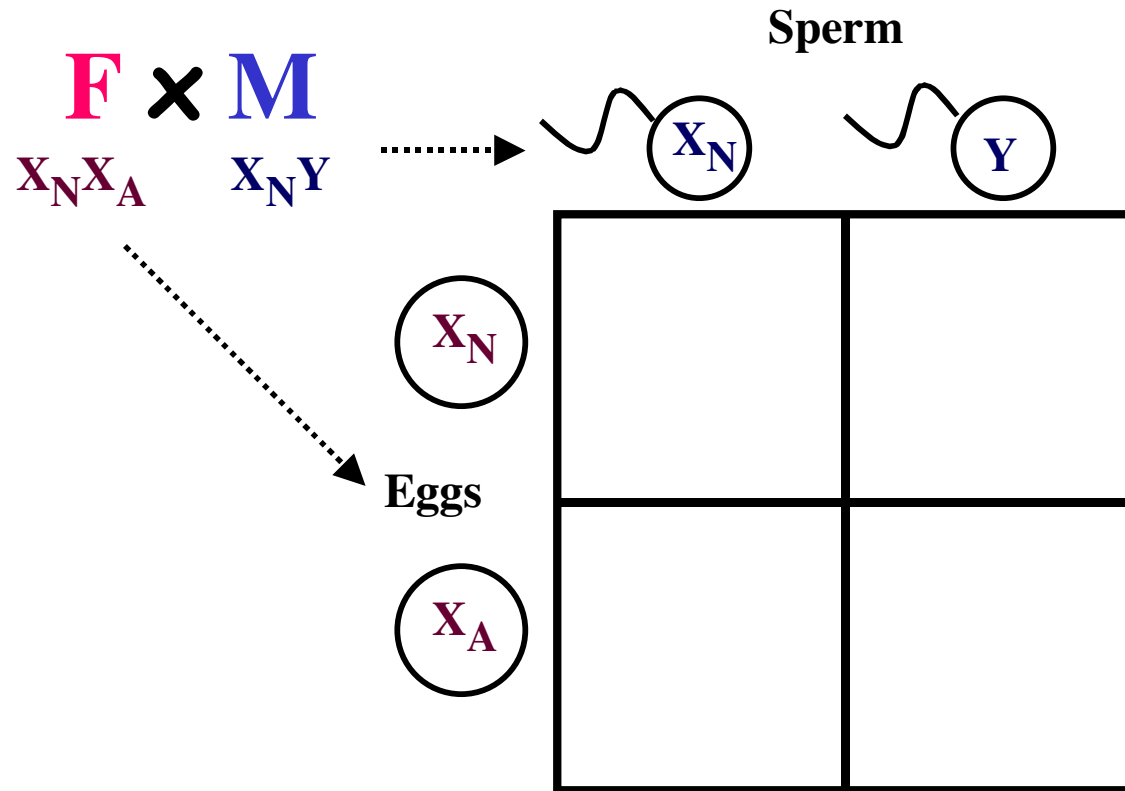
Affected male mates with normal female



- All his daughters will be affected
- None of his sons will be affected

X-linked dominant disease

Affected female mates with normal male



Work this out
for yourself

- _____ of her daughters will be _____
- _____ of her sons will be _____

Some X-linked dominant human diseases

- Incontinentia Pigmenti
- Hypophosphatemic Rickets
- Charcot-Marie-Tooth disease
- Chondrodysplasia Punctata

No need
to memorize

Pedigree Analysis

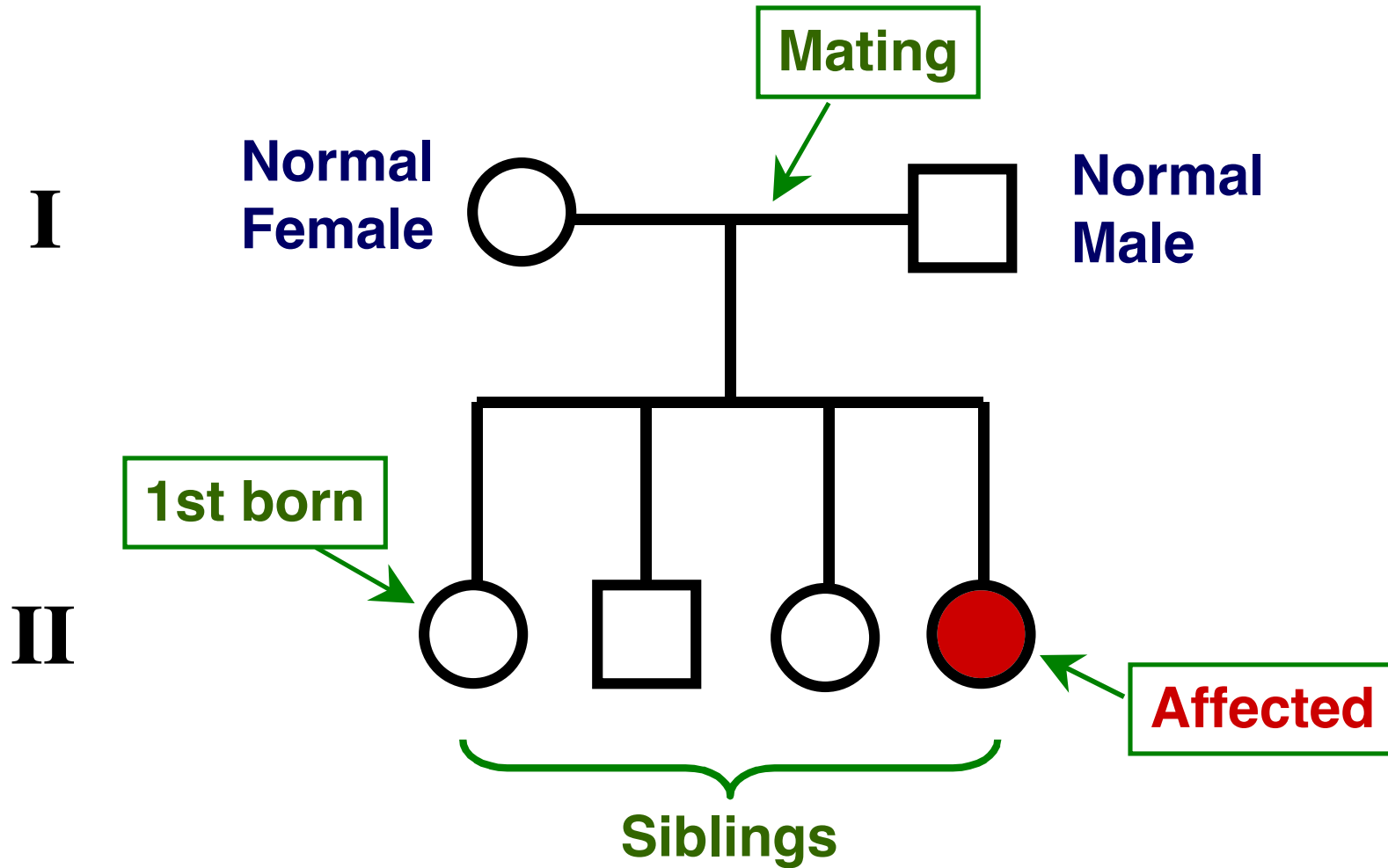
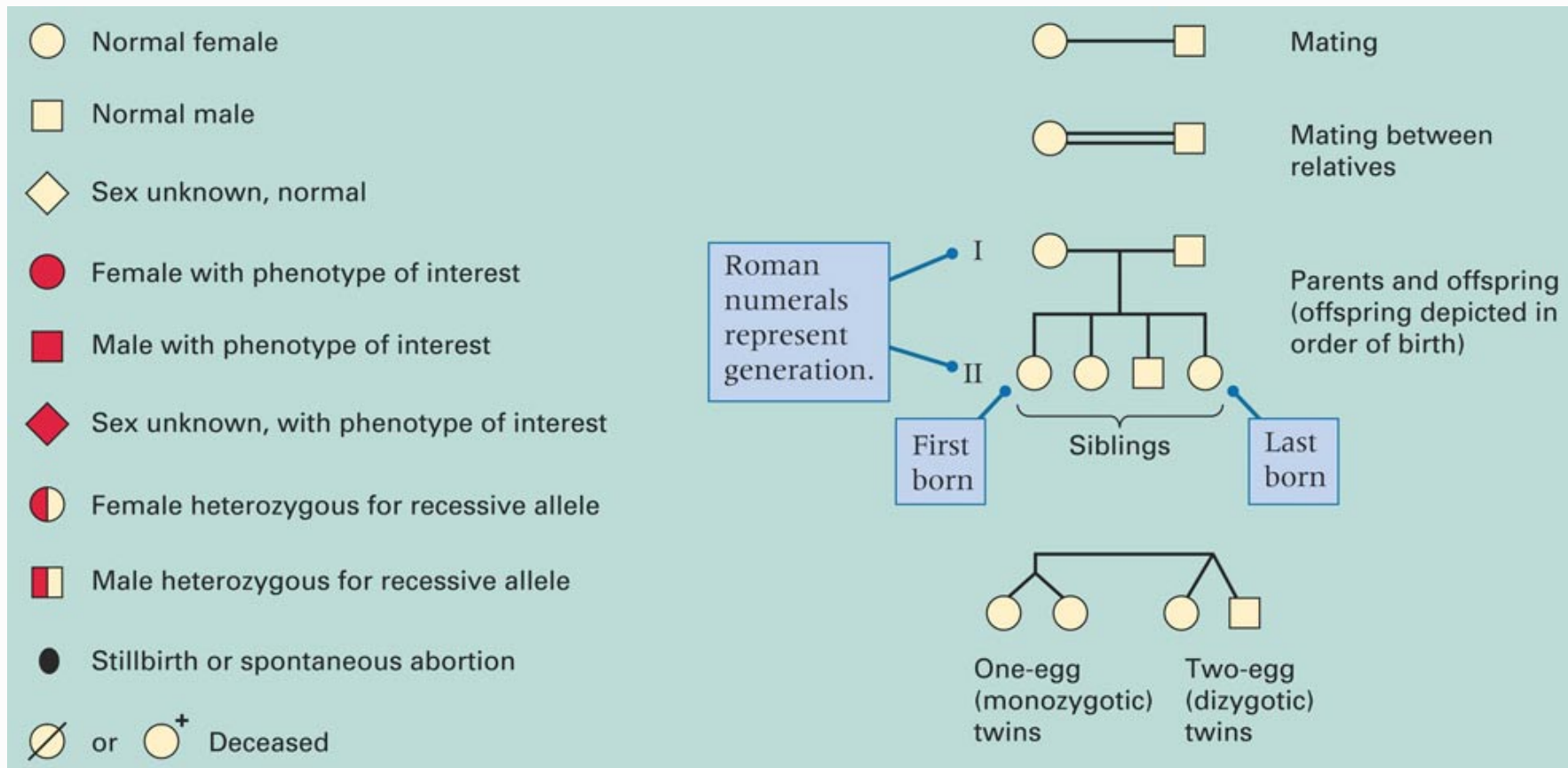


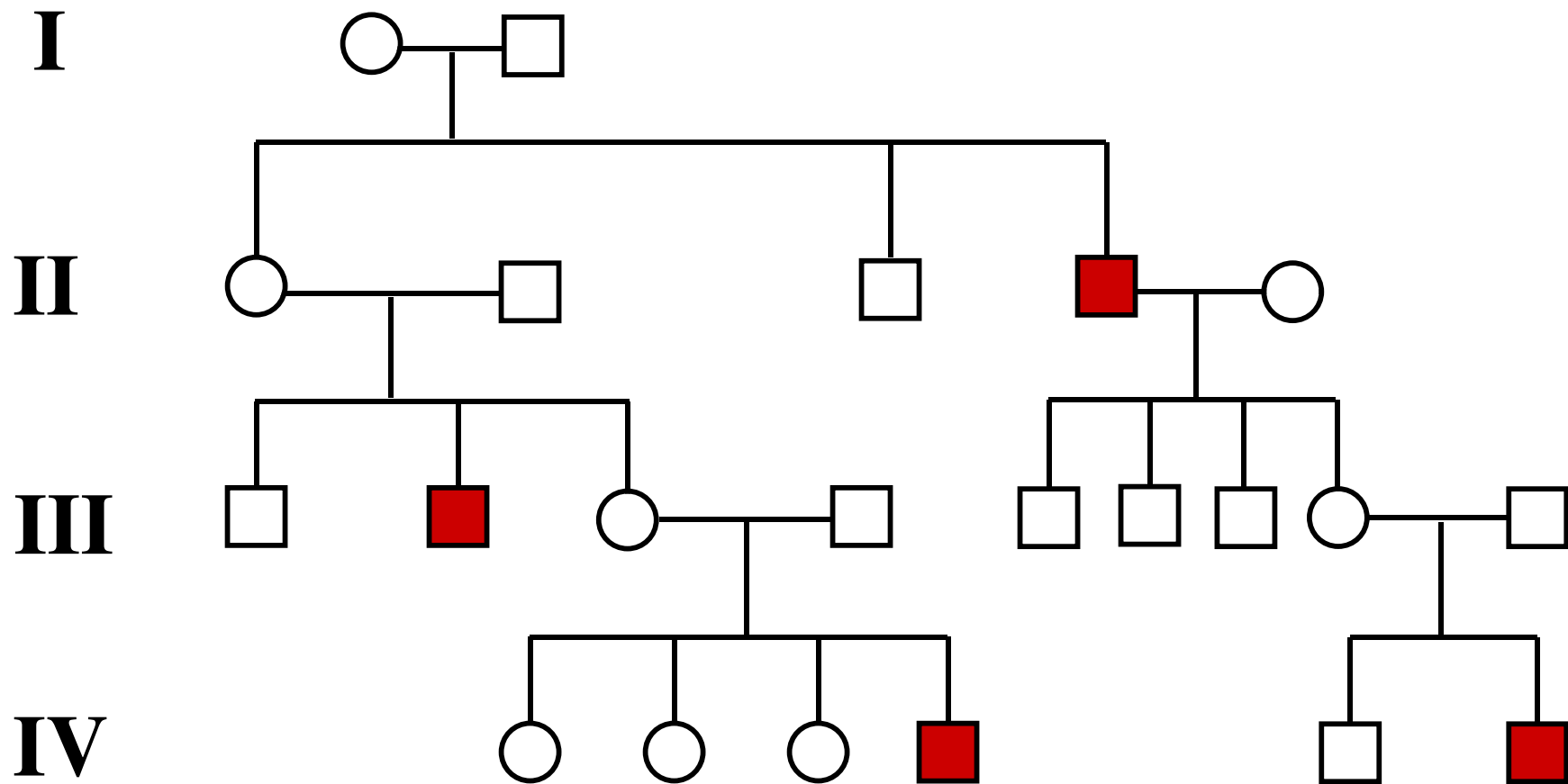
Fig. 2.17. Conventional symbols used in depicting human pedigrees.



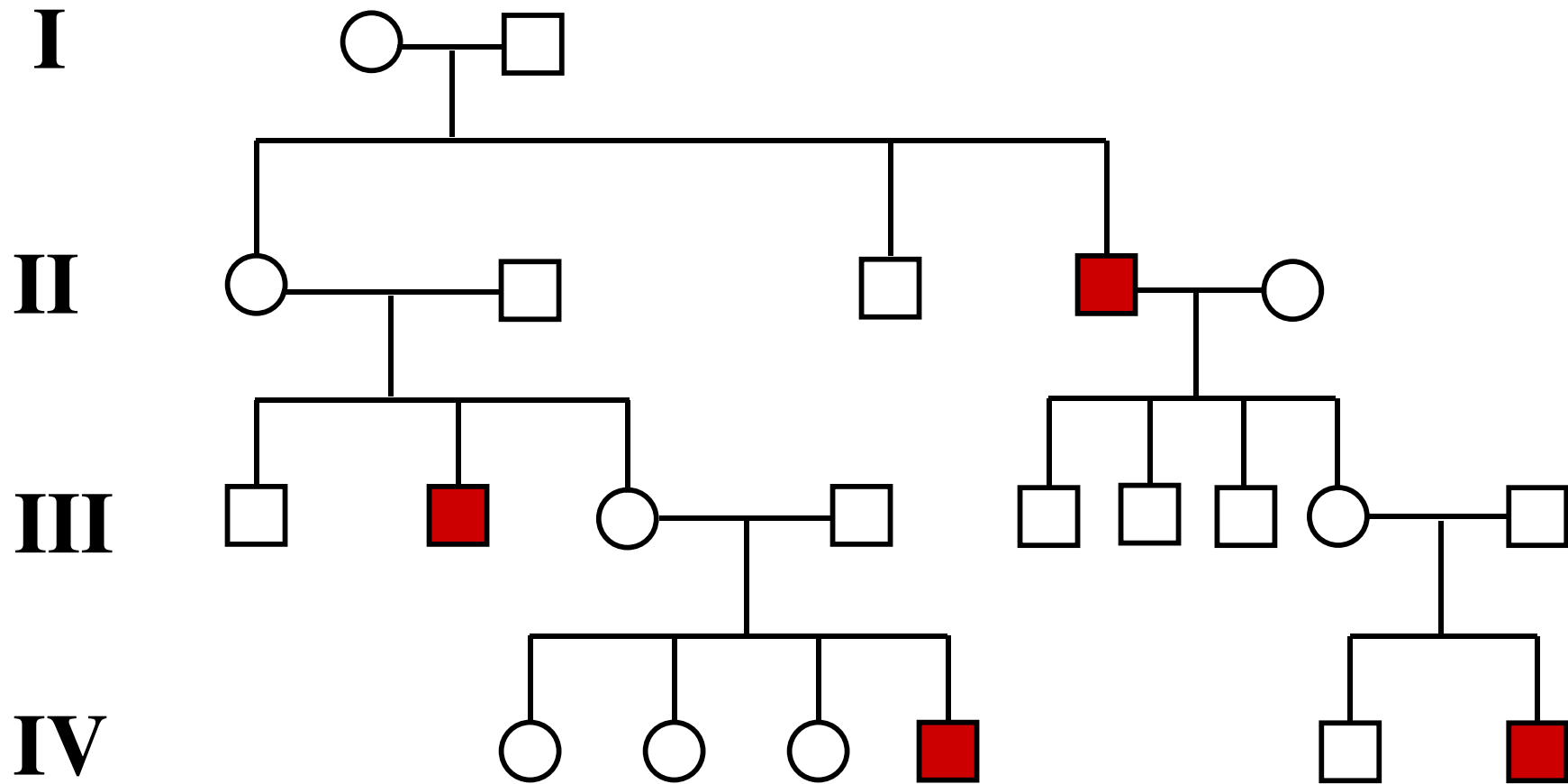
Warning:



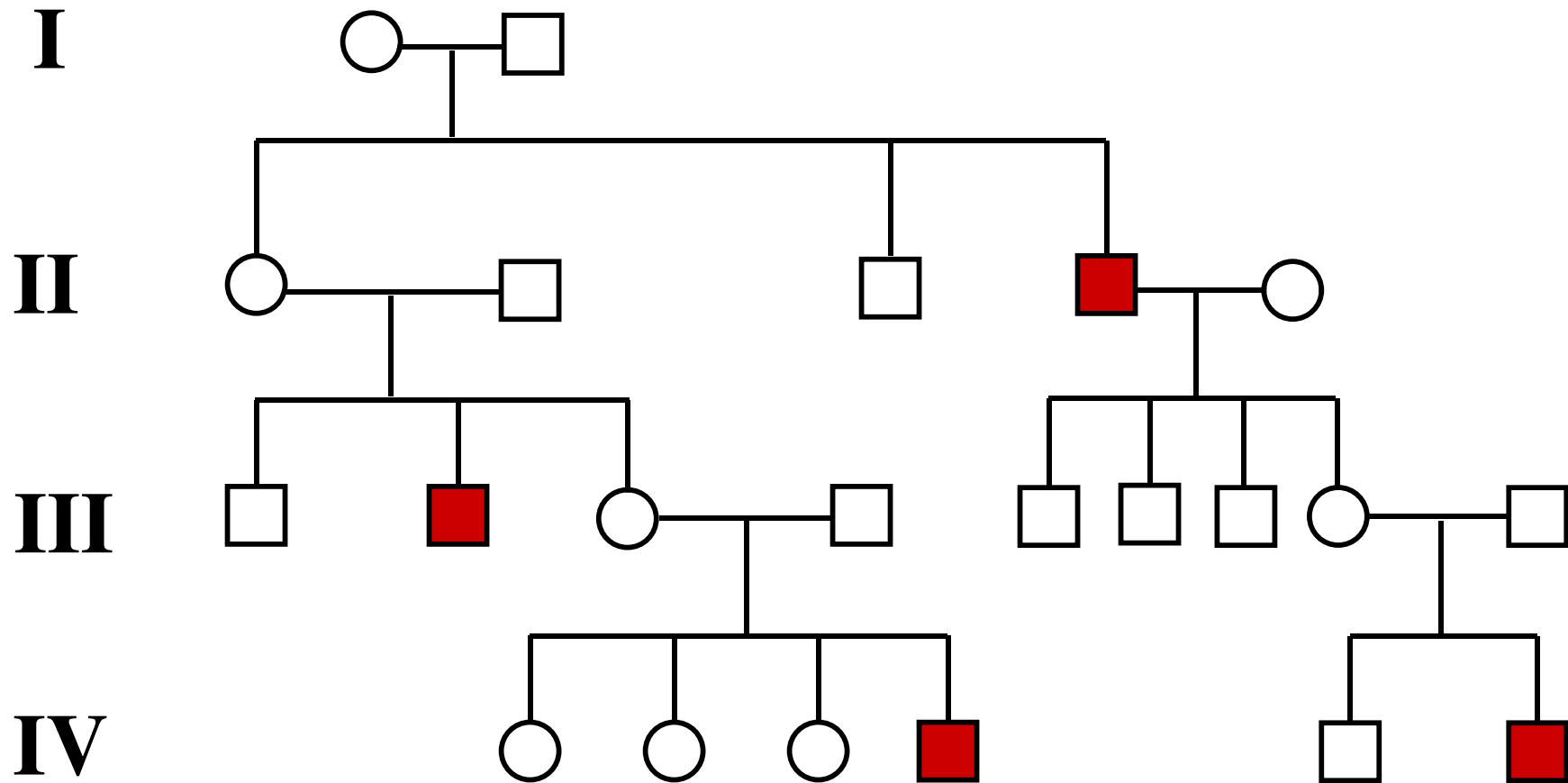
Pedigree showing X-linked recessive inheritance



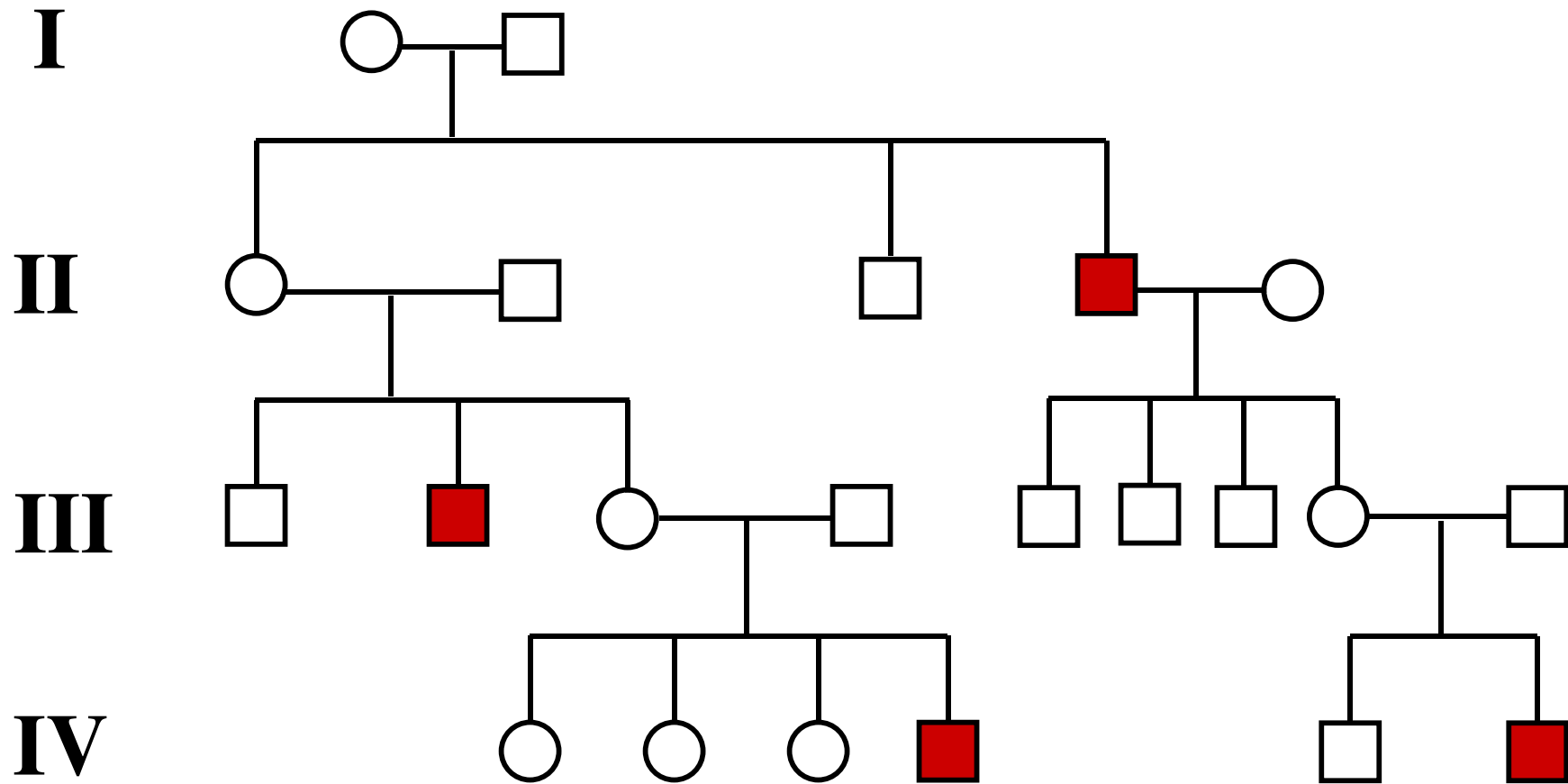
Could this be autosomal recessive?



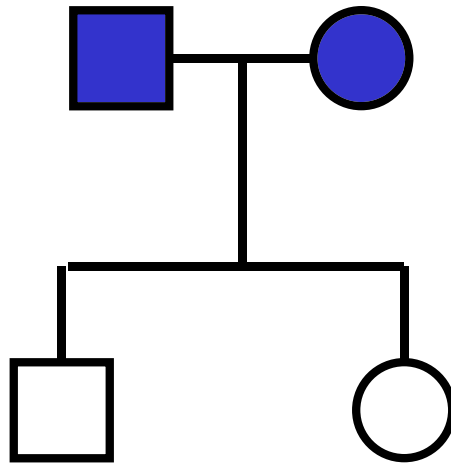
Could this be X-linked dominant?



Could this be autosomal dominant?



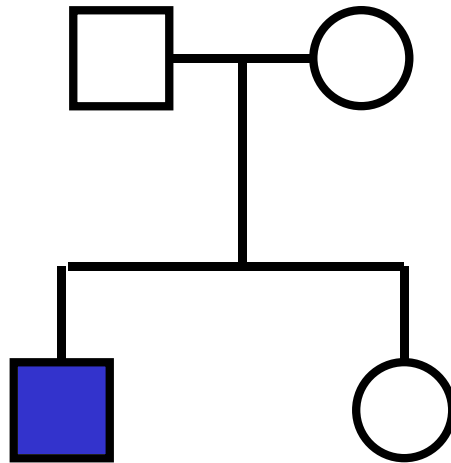
If two affected parents have an unaffected kid, recessiveness* can be ruled out



(assuming 100% penetrance)

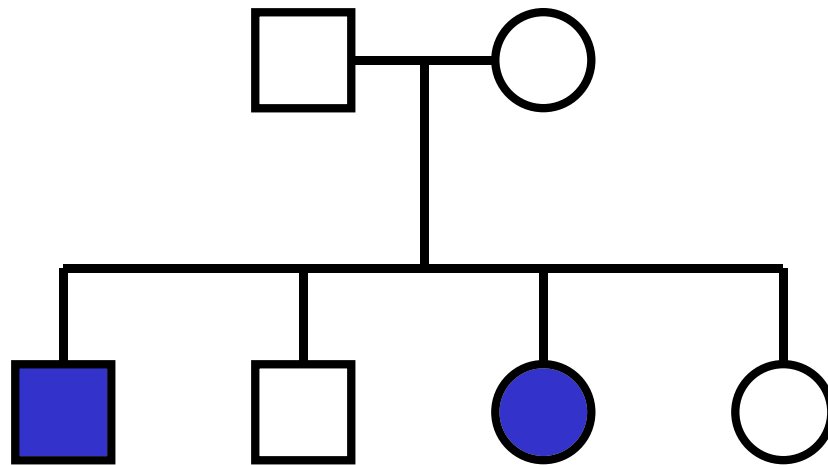
*both autosomal and x-linked

If unaffected parents have an affected kid, dominance* can be ruled out

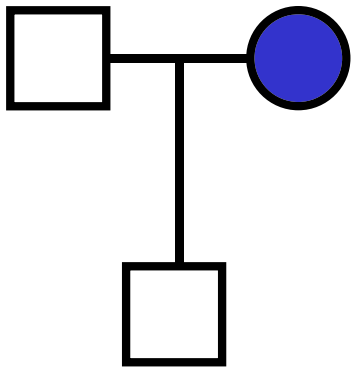


*both autosomal and x-linked

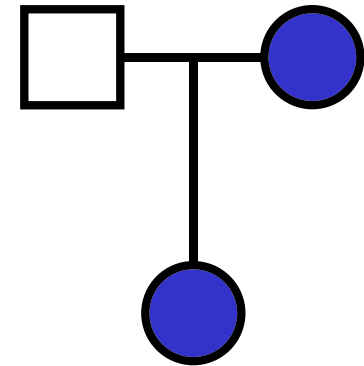
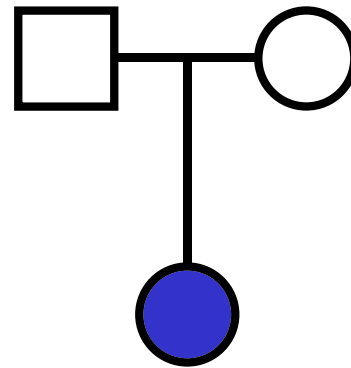
If unaffected parents have an affected daughter, dominance *and* x-linked recessive can be ruled out



If affected woman has unaffected son, *or*
unaffected man has affected daughter,
x-linked recessive can be ruled out

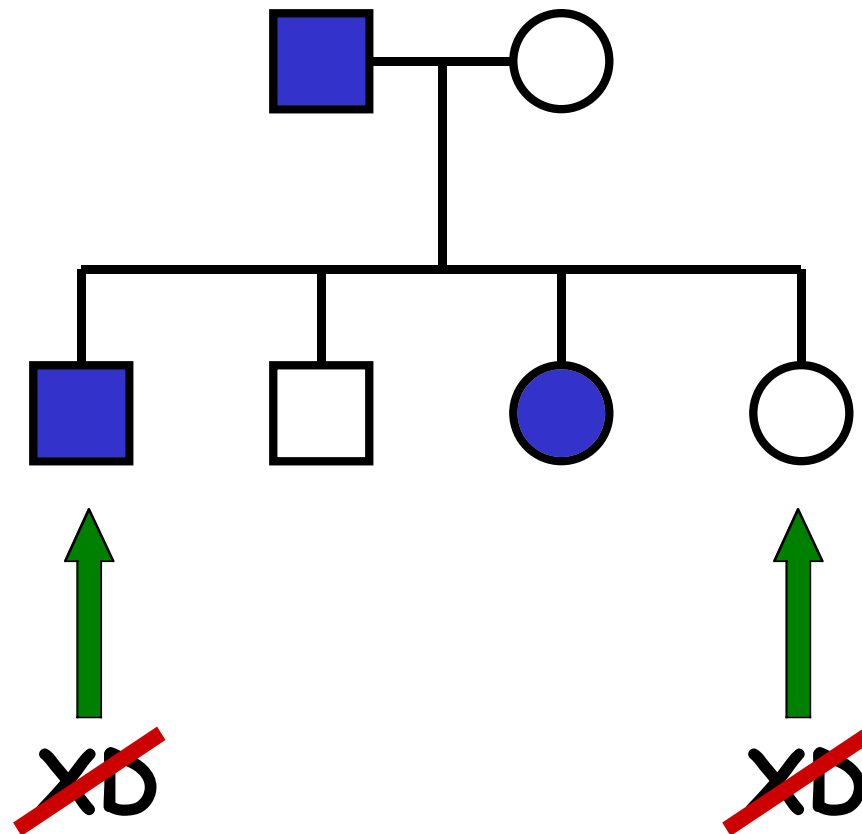


NOT XR



NOT XR

If unaffected woman has affected son, *or*
affected man has unaffected daughter,
x-linked dominant can be ruled out



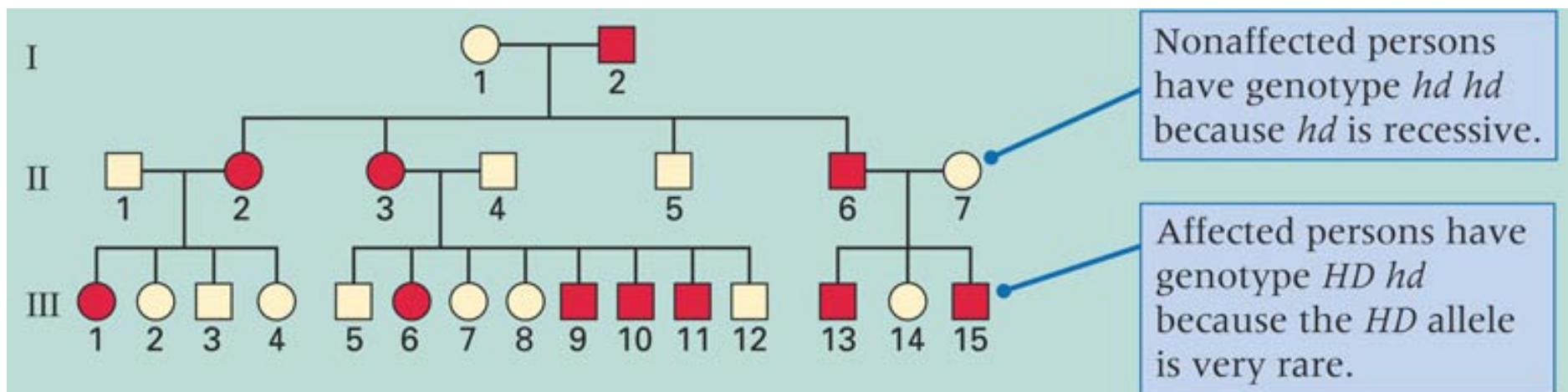
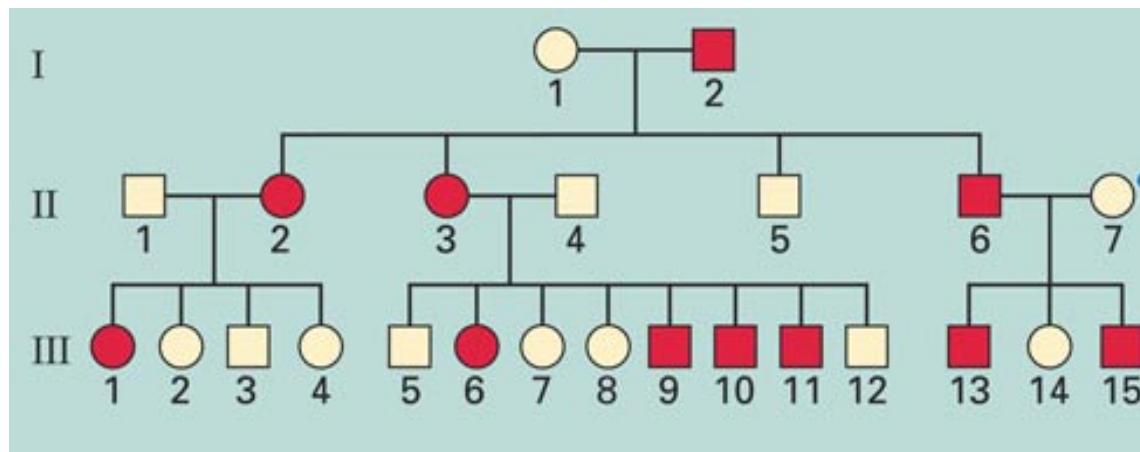


Fig. 2.18. Inheritance of dominant gene for Huntington disease

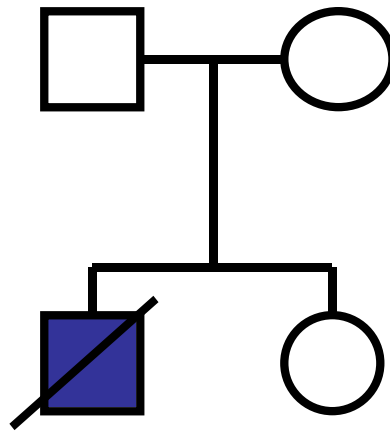
Could this be autosomal recessive?



Inheritance of dominant trait

Genetic Counseling

A woman's brother died from Tay Sach's Disease (autosomal recessive, lethal), but she is unaffected. What are the chances that she is a carrier of the disease?

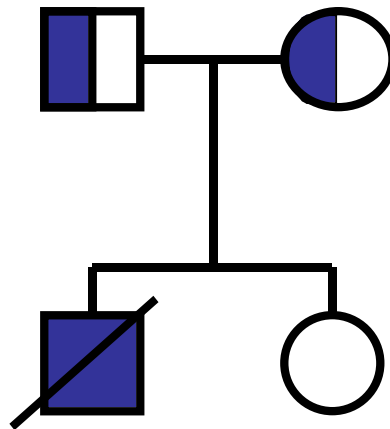


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- A. $2/3$ (67%) B. $1/2$ (50%) C. $1/4$ (25%)
D. $1/6$ (17%) E. $1/8$ (12.5%)

Hint

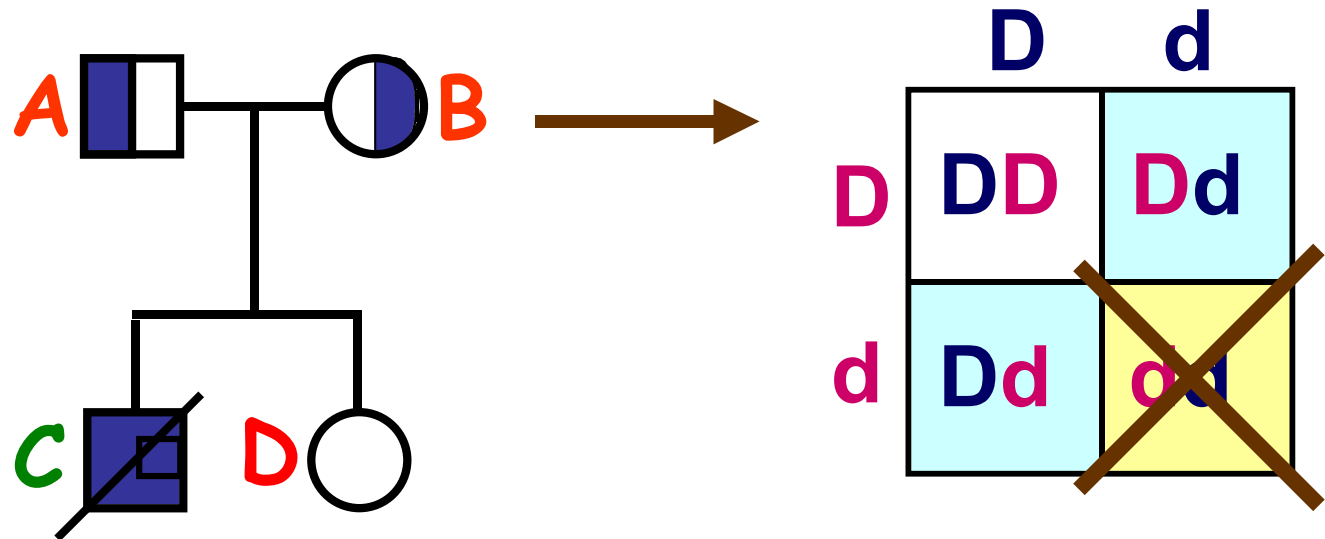
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D. $1/6$ (17%) E. $1/8$ (12.5%)

The answer is...

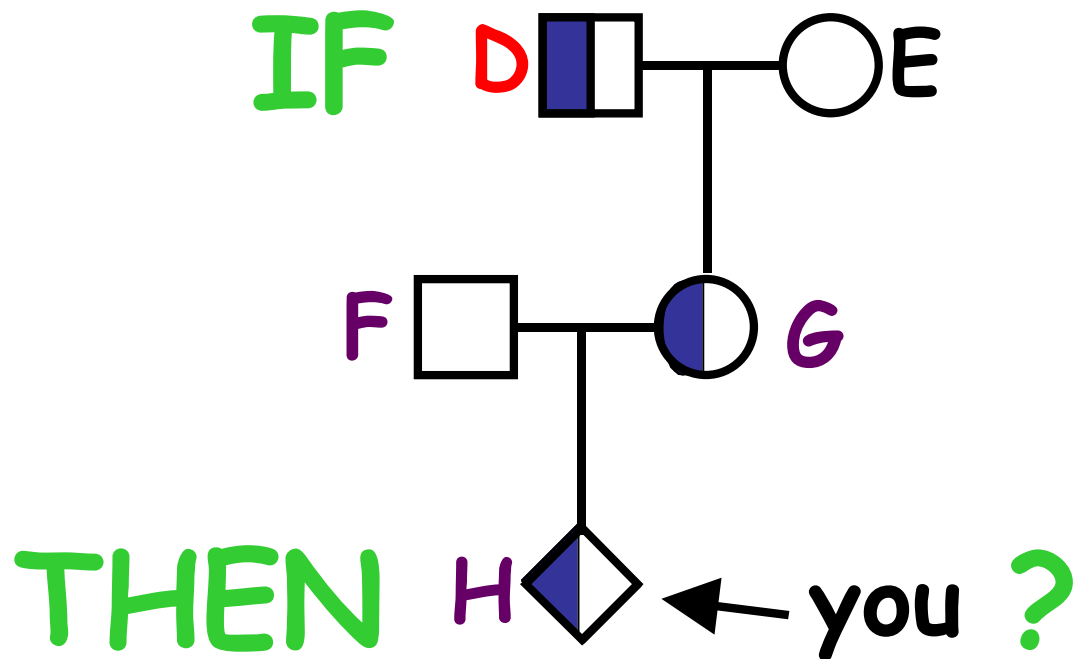


- A. 2/3 (67%) B. 1/2 (50%) C. 1/4 (25%)
D. 1/6 (17%) E. 1/8 (12.5%)

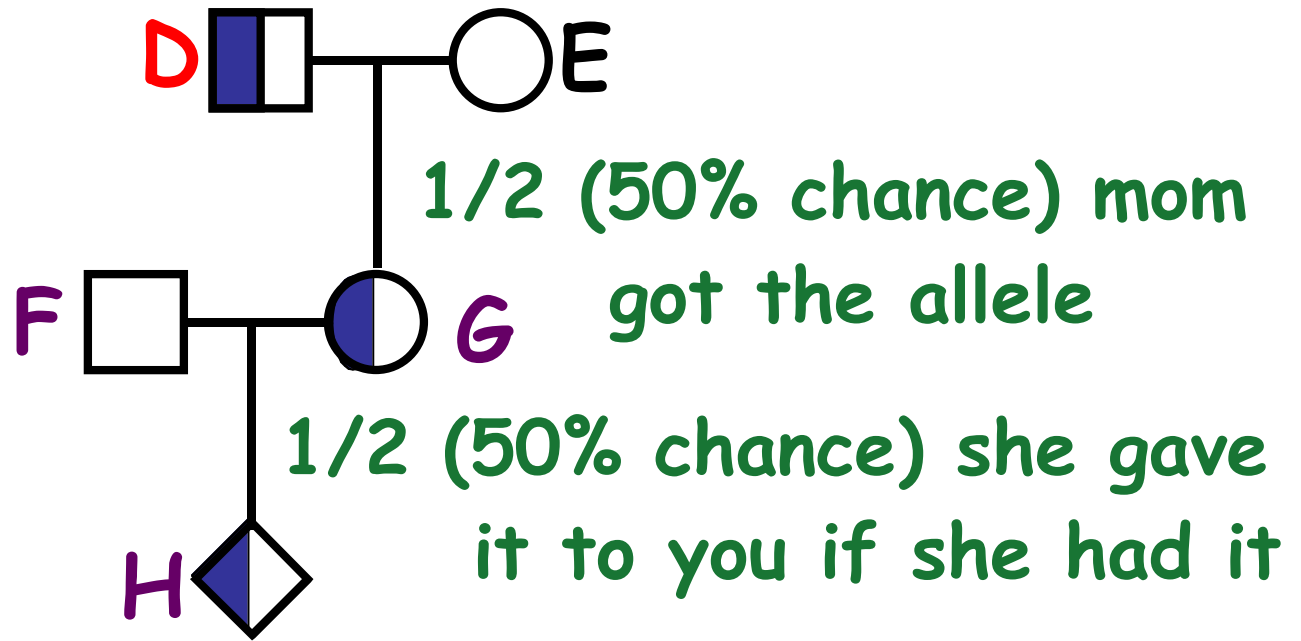
Problem 2

Assuming your grandfather is a carrier (heterozygote) for a rare recessive, disease causing allele of a given gene,

What's the chance that you are also a carrier of this allele?



- A. $2/3$ B. $1/2$ C. $1/4$
 D. $1/6$ E. $1/8$



$$1/2 \times 1/2 = 1/4$$

= Chance that you got a given allele from Grandpa D

Problem 3

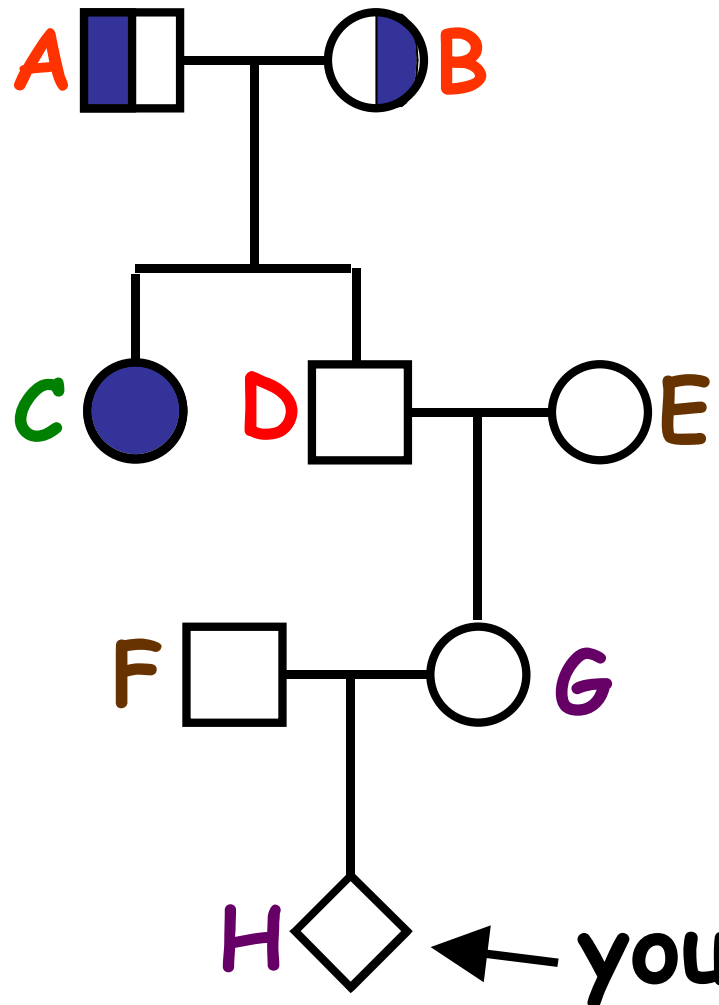
Your grandfather's sister had cystic fibrosis (rare, autosomal recessive). That's the only case in your family.

(A) What's the chance that you are a carrier of CF?

A. $2/3$ B. $1/2$ C. $1/4$

D. $1/6$ E. $1/8$

Your **grandfather's sister** had CF but **he, his parents, and his descendants** are unaffected, as are those who married into the family



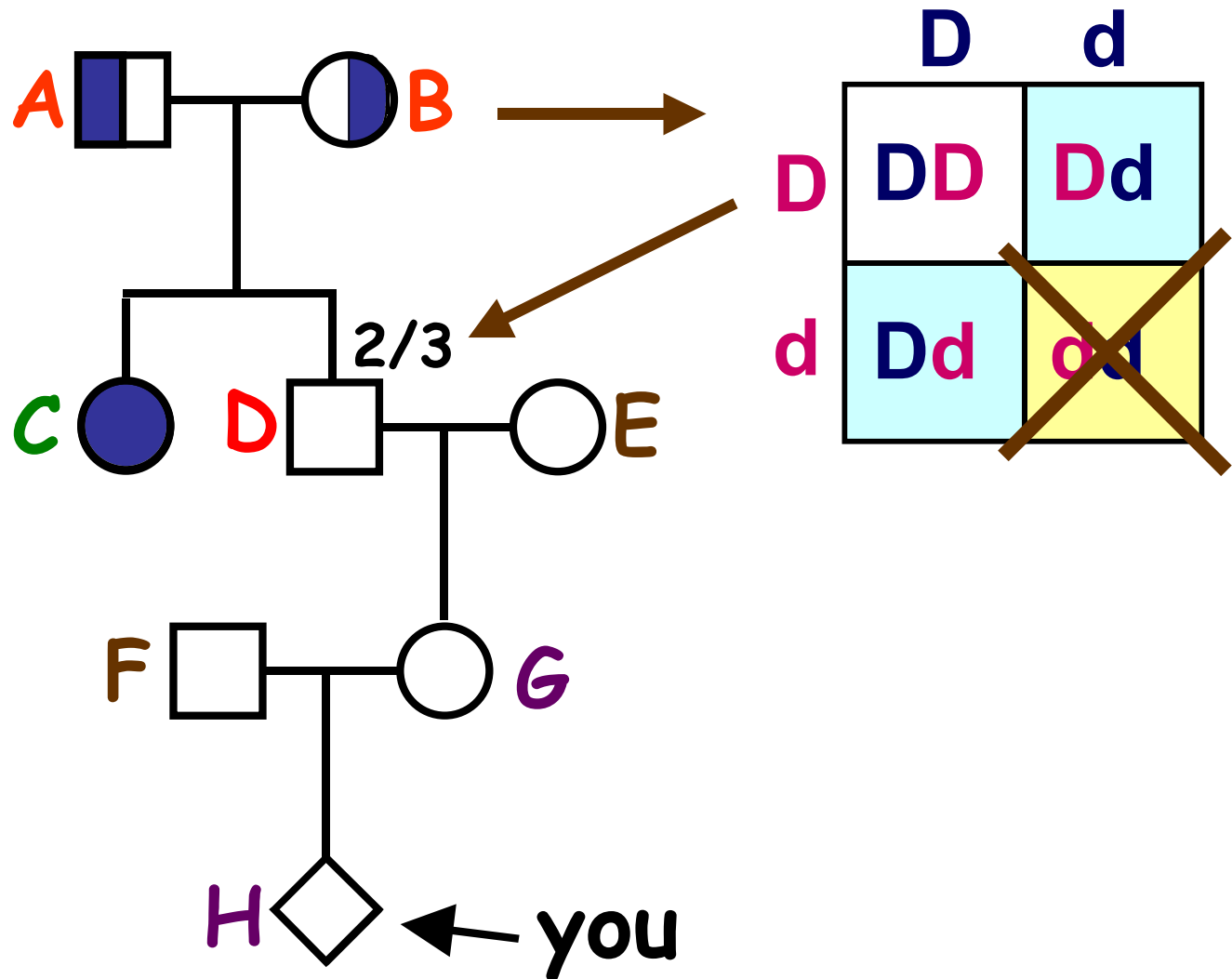
A. $2/3$

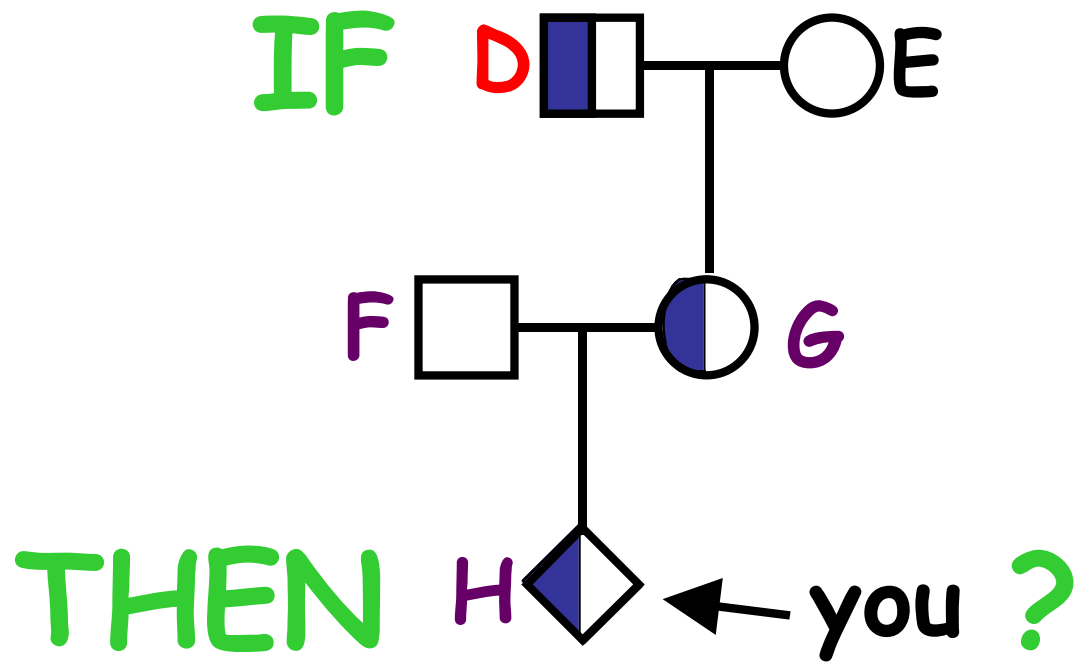
B. $1/2$

C. $1/4$

D. $1/6$

E. $1/8$





ANSWERS

A. $1/4$ = Chance that you got any particular allele from
from grandpa

B. $1/6$ = correct answer = $1/4$ (see A) \times $2/3$ (chances
that grandpa was a carrier)