Sex Determination and Sex-Linked Traits

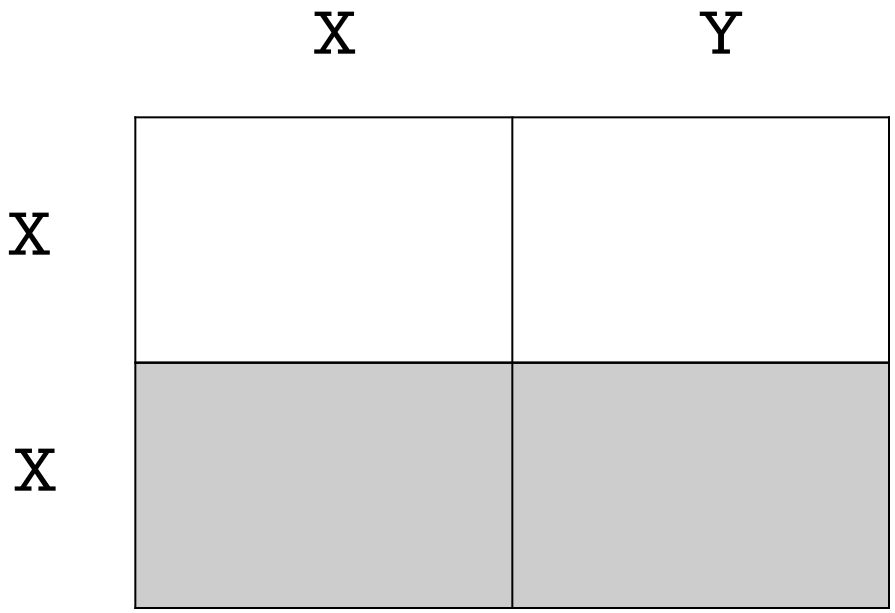
Sex Determination

- Each cell in your body, except for the gametes, contains 46 chromosomes, or 23 pairs of chromosomes.
- One pair of these chromosomes is the sex chromosomes.
- The other 22 pairs are called autosomes.

Sex Chromosomes

- Sex Chromosomes: Determine an individual's gender.
- 2 Types:
  - X and Y
- Individuals with 2 X Chromosomes are female.
- Individuals with an X and a Y are males.

Sex Determination



- What is the chance of producing a female? Male?

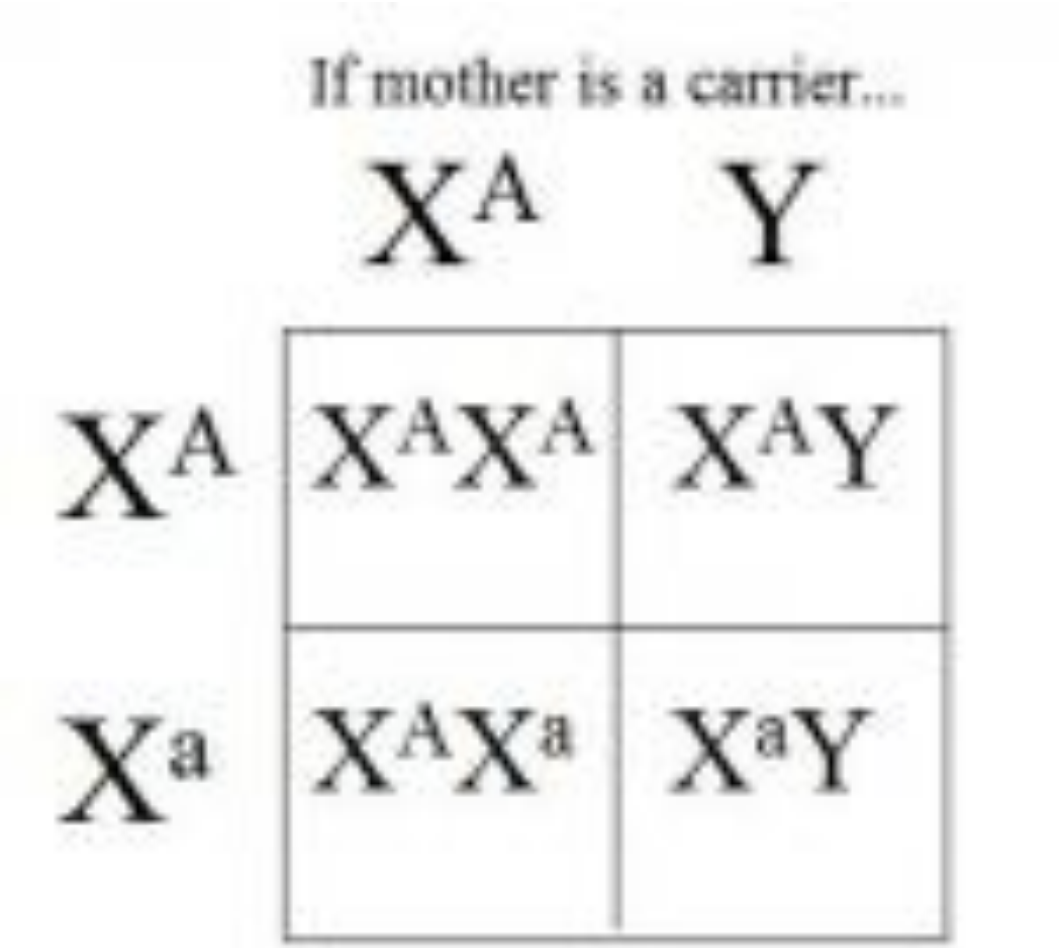
Sex-Linked Traits

- **Sex-Linked Traits:** Traits controlled by genes located on the X chromosome.

- Since males have only one X chromosome, they are affected by recessive X-linked traits more often than are females.

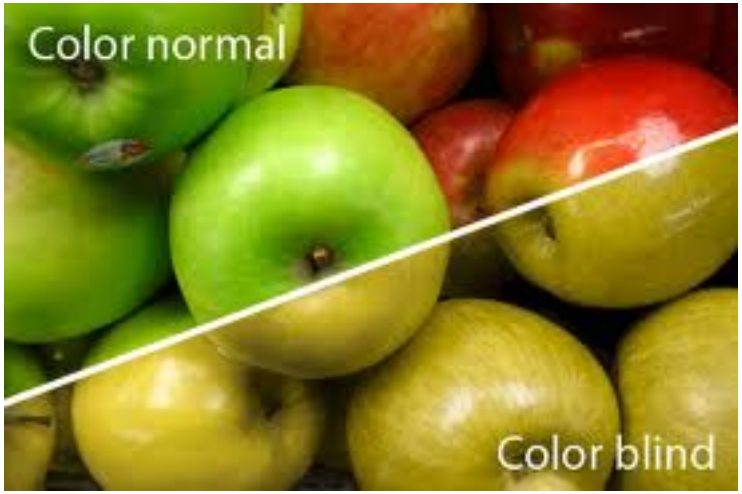
- Females likely would not express a recessive X-linked trait because the other X chromosome will mask the effect of the recessive trait.

Sex-Linked Punnett Squares

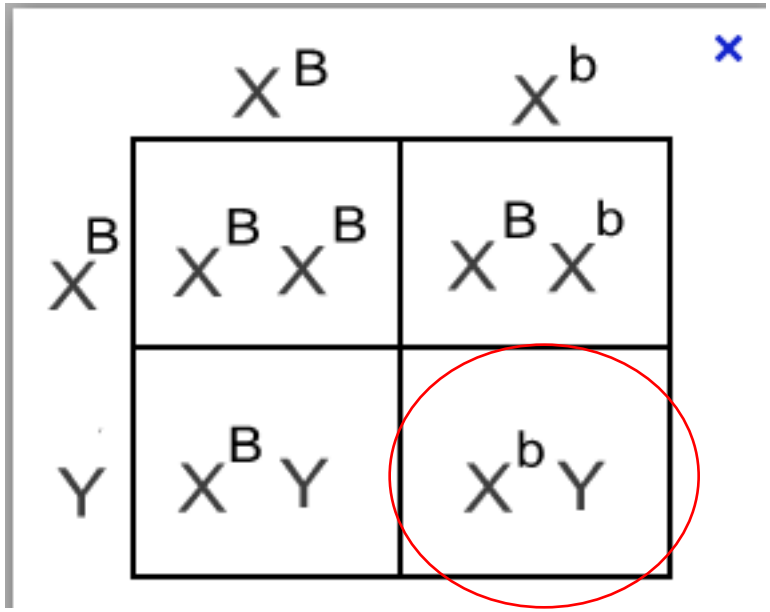


Example of Sex-Linked Trait: Red-Green Colorblindness

- Recessive X-linked trait.
- Effects about 8 % of males in the United States.
  - Because it is an X-linked trait, it is very rare in females.



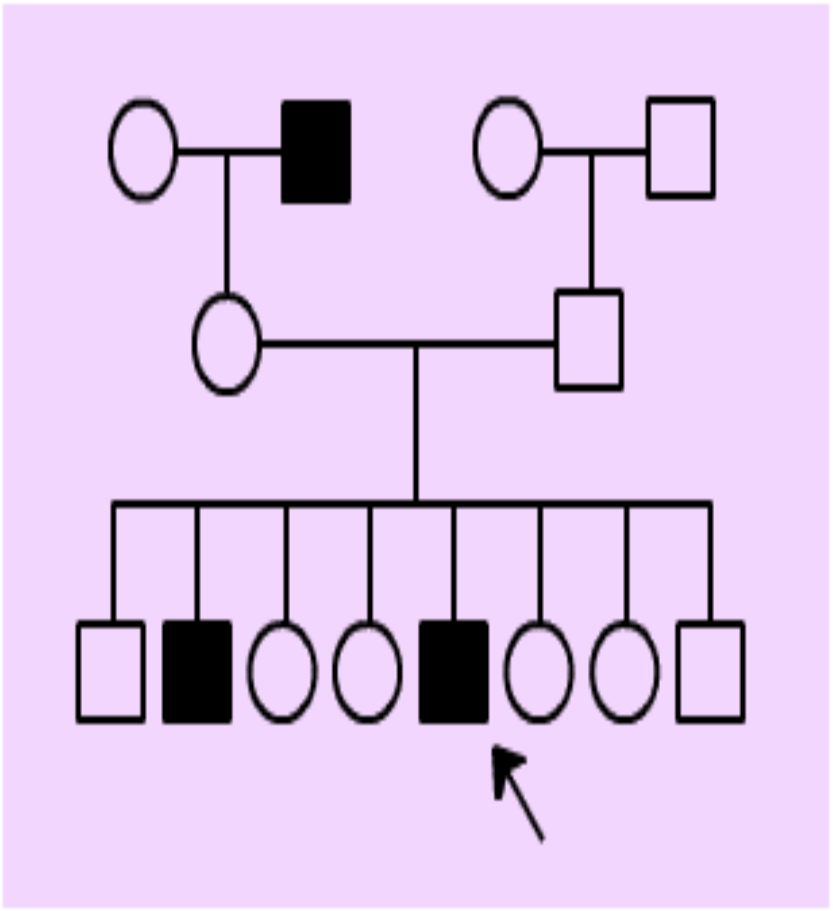
Red-Green Color Blindness



- The mother is a carrier because she has the recessive allele on one of her chromosomes.
- The father is not color blind
- The only child that can possibly have red-green color blindness is male.

Pedigrees

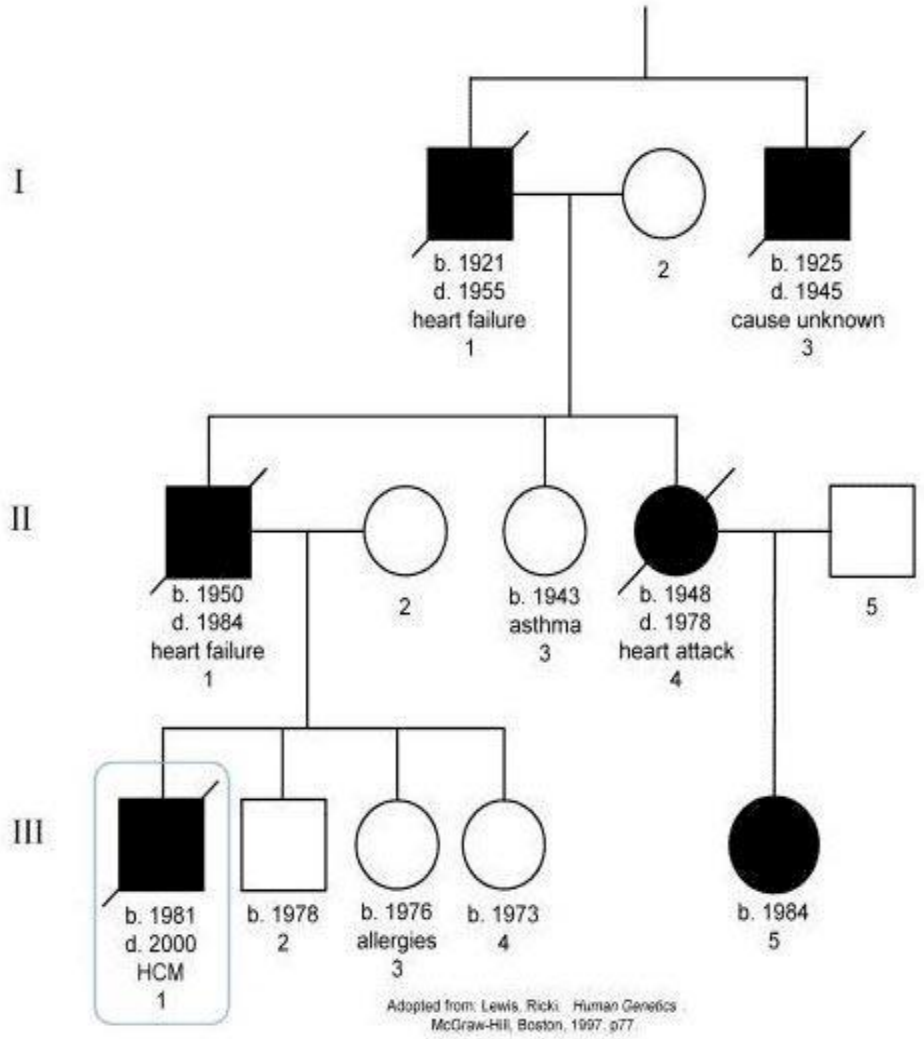
Pedigrees

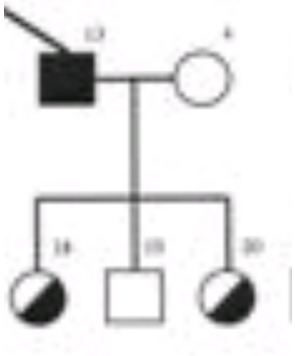


- Pedigrees study how a trait is passed from one generation to the next.
- Infers **genotypes** of family members
- Disorders can be carried on…
  - **Autosomes** (22 pairs of chromosomes)
  - **Sex Chromosomes** (X or Y)

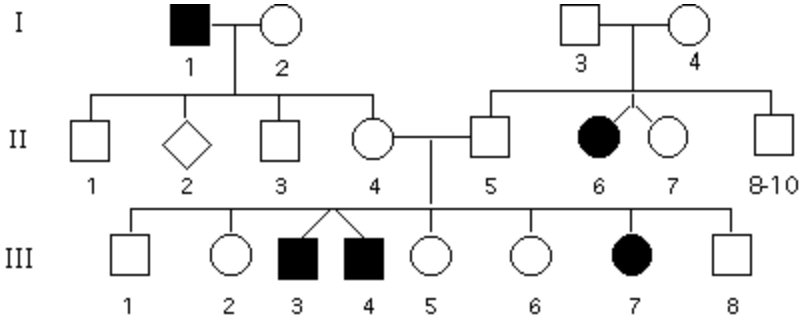
Parts of a Pedigree

- **Squares** are males (XY)
- **Circles** are females (XX)
- Horizontal lines connect breeding couples
- Vertical lines connect parents to children
- **Shading** means the individual has the trait
- **Half shading** means they carry the gene called a “carrier”
- **No shading** means the individual does not have the trait
- A diagonal line means death.
- Roman numerals show generations
- Numbers assign an individual to a generation
  - *Example*: What happened to II, 4?

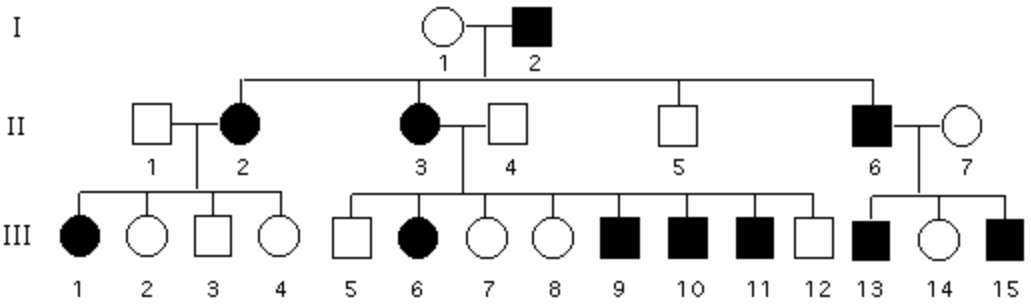




Interpreting Pedigrees



Recessive trait--human albinism



Dominant trait--Huntington's Disease

- 1. Determine if the trait is dominant or recessive.
  - Every other generation: It is **recessive**
  - Every generation: It is **Dominant**

Interpreting Pedigrees

- 2. Determine if the trait is autosomal or sex linked.
  - Affects males and females equally: **<u>Autosomal</u> (Aa)**
  - Affects one sex more than the other: especially MALES!

    <u>Sex-linked</u> (X^CX^c or X^cY)
- Typically sex-linked disorders or traits are carried on the **<u>X</u>** chromosome
  - Females tend to "carry" a trait and affect their sons.

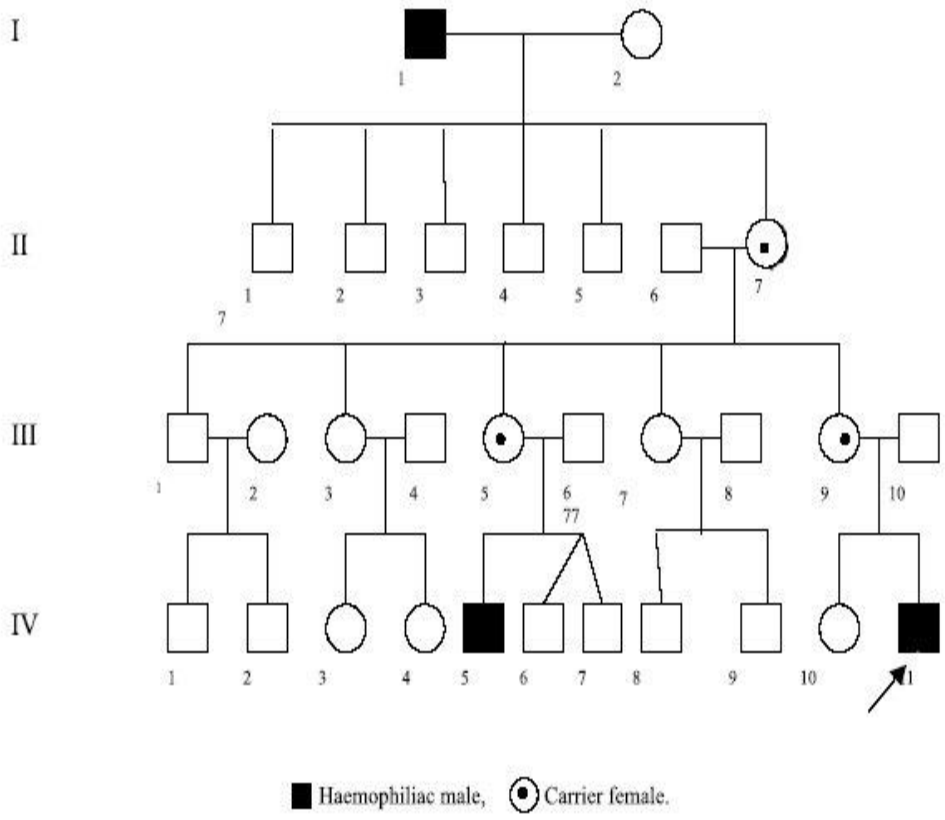
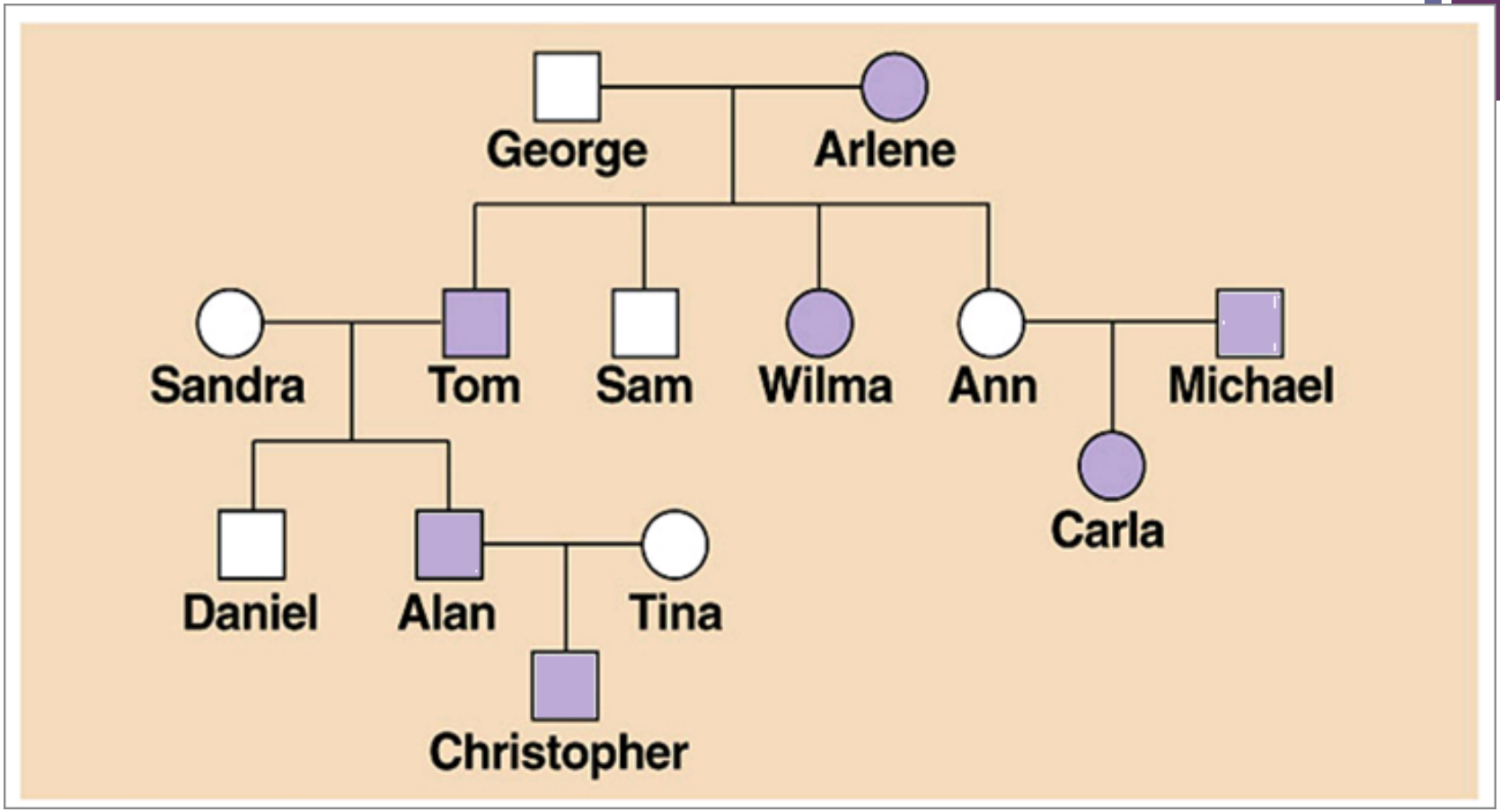


Fig. 1. Family showing familial type of Haemophilia A.
Haemophilia (2002), 8, 680–684

Recap on interpreting pedigrees

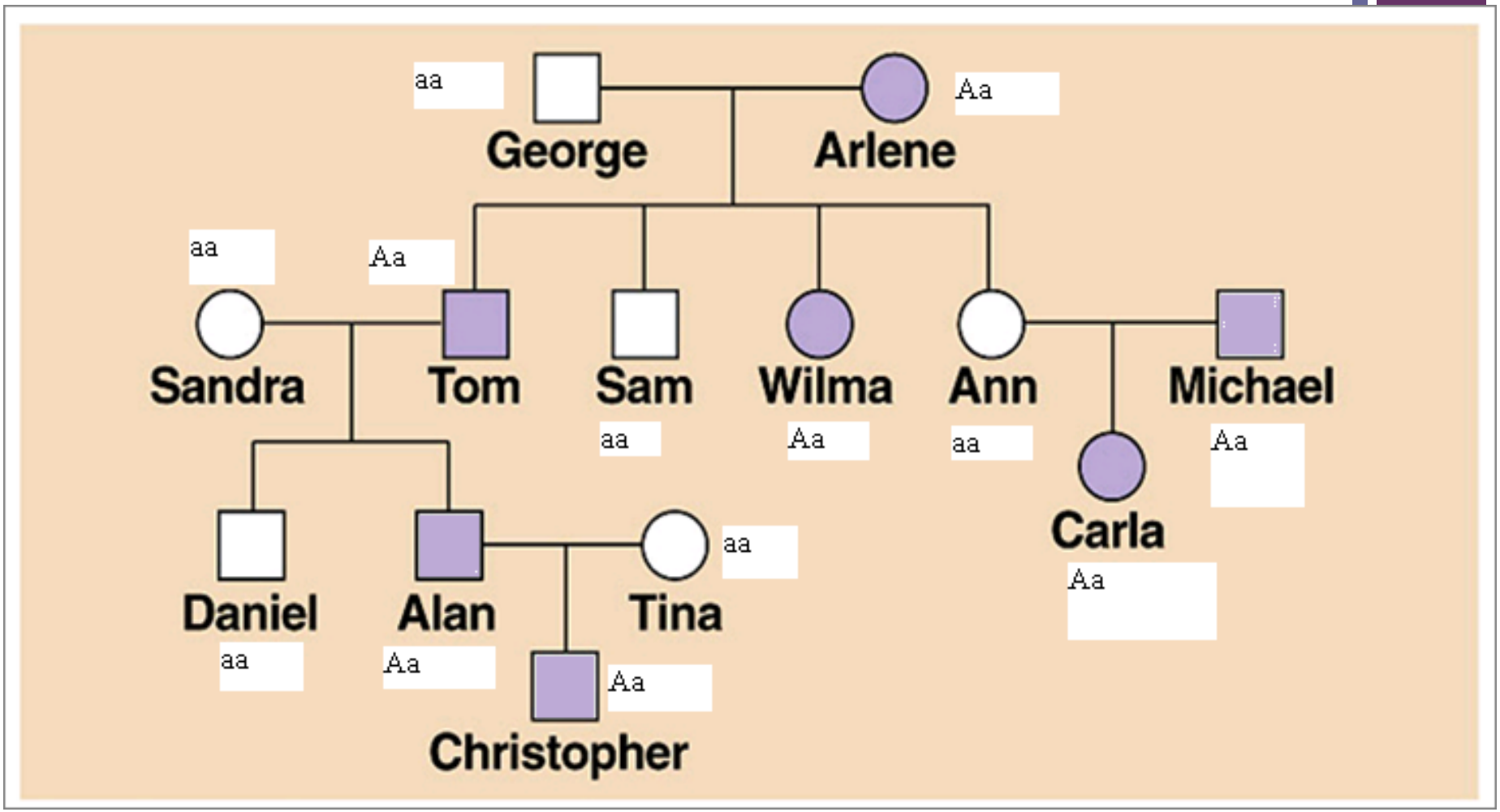
1. Determine if it is dominant or recessive.
2. Determine if it is autosomal or Sex-linked.
3. Assign genotypes to affected (shaded) individuals first.
   - If Autosomal then use two alleles to show inheritance. (AA, Aa or aa for example)
   - In Sex-linked the shaded males will carry the gene (X^cY) and be affected.
   - In Sex-linked the females can be unaffected, affected or carriers and marked with a dot. (X^CX^c)
4. Assign remaining genotypes to unaffected individuals .
   - In Sex-linked the unshaded males will not carry the gene (X^CY) and be unaffected.
5. Double check your work, does the pedigree make sense?

Your Turn!



Is this dominant or recessive? Autosomal or Sex-linked?
Assign genotypes to the pedigree to show the inheritance pattern.

Check your work



Autosomal dominant inheritance.