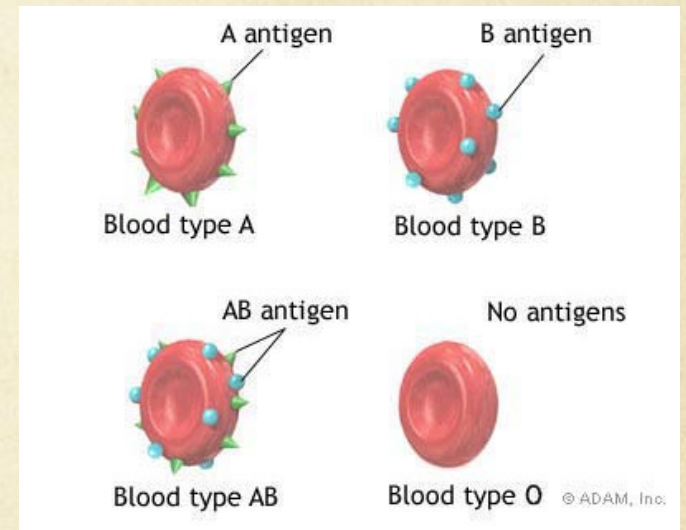


Blood Type and Sex Linked Inheritance

The Classic Example of Codominance in Humans is BLOOD TYPE

- Gene that controls ABO blood type codes for an enzyme that makes a glycolipid on blood cells
- Two alleles (I^A and I^B) (call them “A” and “B”) are codominant
- Third allele (I^O) (call it “O”) is recessive to A and B



Possible Genotypes for Blood Types

○ If the Phenotype: A

○ Genotype(s): AA, AO

○ If the Phenotype: AB

○ Genotype(s): AB

○ If the Phenotype: B

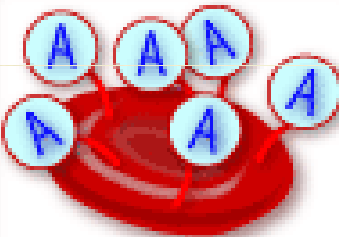
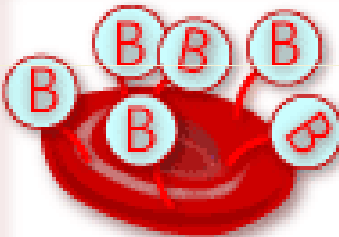

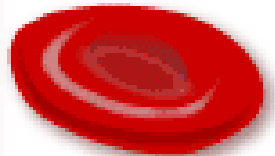
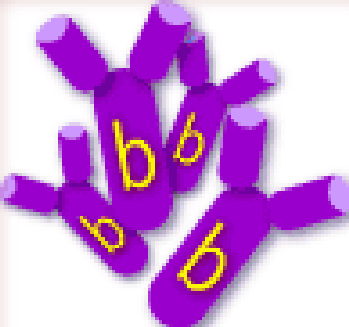

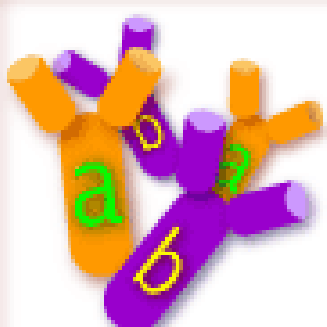
○ Genotype(s): BB, BO

○ If the Phenotype: O

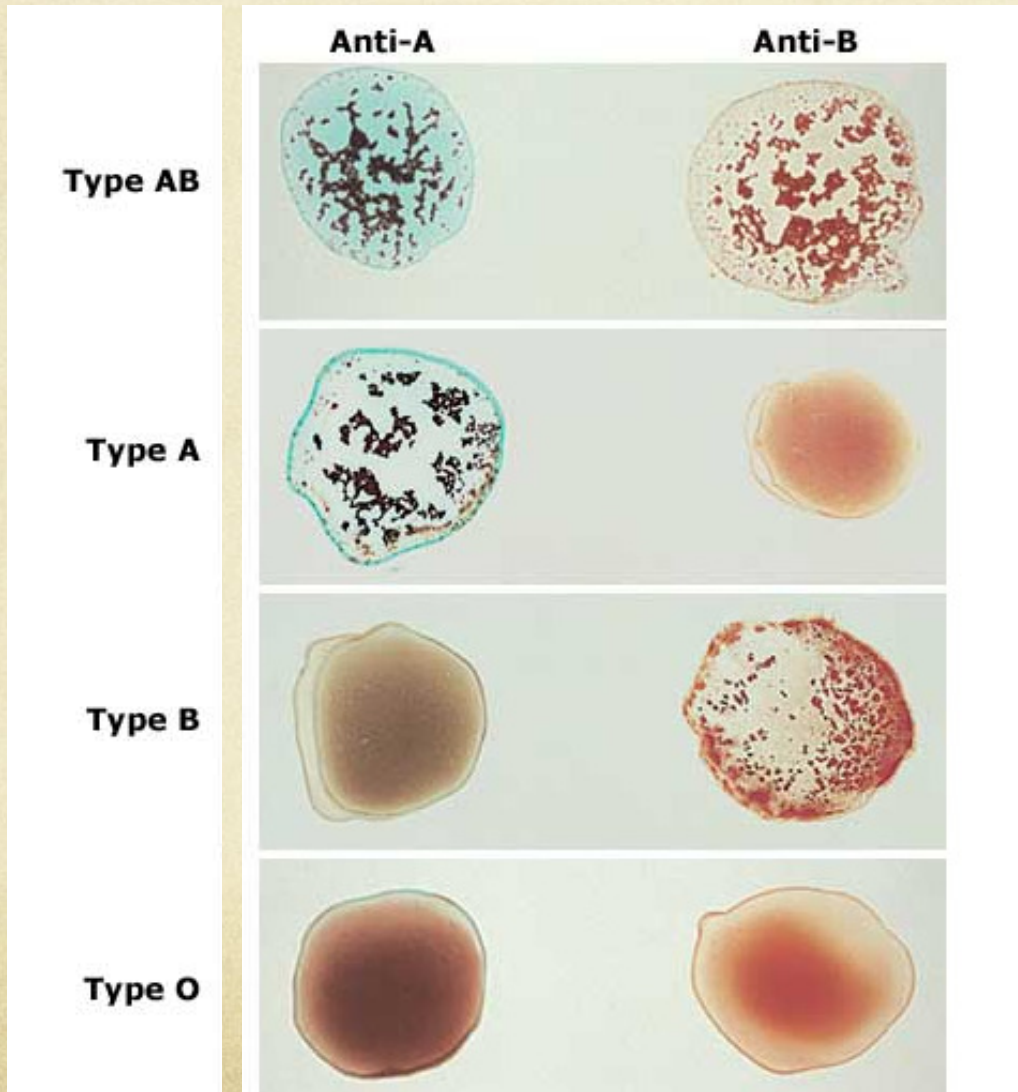
○ Genotype(s): OO

Your blood type is determined by A and/or B proteins on red blood cell surfaces

The ABO Blood System

Blood Type (genotype)	Type A (AA, AO)	Type B (BB, BO)	Type AB (AB)	Type O (OO)
Red Blood Cell Surface Proteins (phenotype)	 <p>A agglutinogens only</p>	 <p>B agglutinogens only</p>	 <p>A and B agglutinogens</p>	 <p>No agglutinogens</p>
Plasma Antibodies (phenotype)	 <p>b agglutinin only</p>	 <p>a agglutinin only</p>	<p>NONE</p> <p>No agglutinin</p>	 <p>a and b agglutinin</p>

Blood Tests are done by adding antibodies to the sample



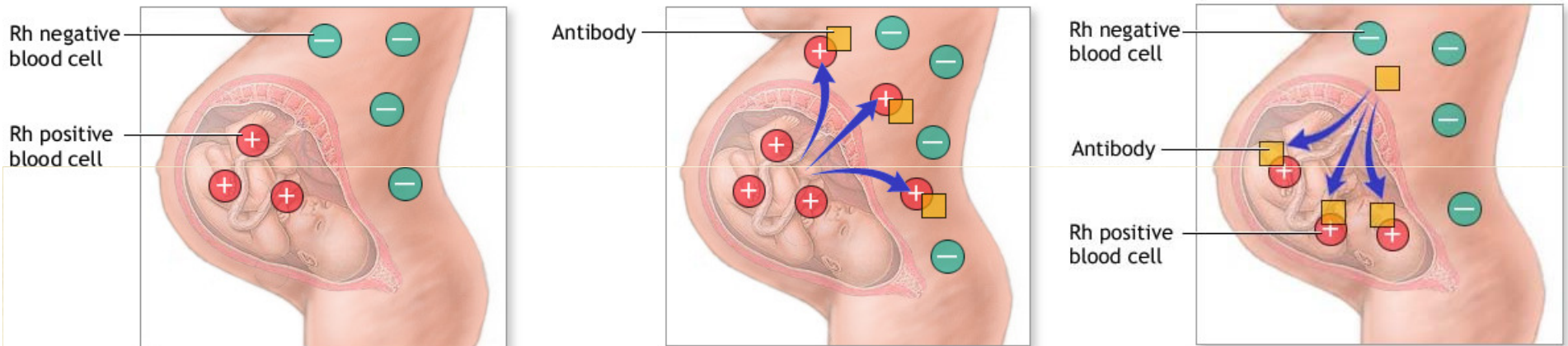
- Which blood type clots with both anti-A and anti-B? AB
- Which blood type doesn't clot with anti-A or anti-B? O
- Do you know what YOUR blood type is?



The Rhesus Factor

You are either R(+) or R(-) for the
Rhesus Protein

○ A problem for Rh (-) moms ...



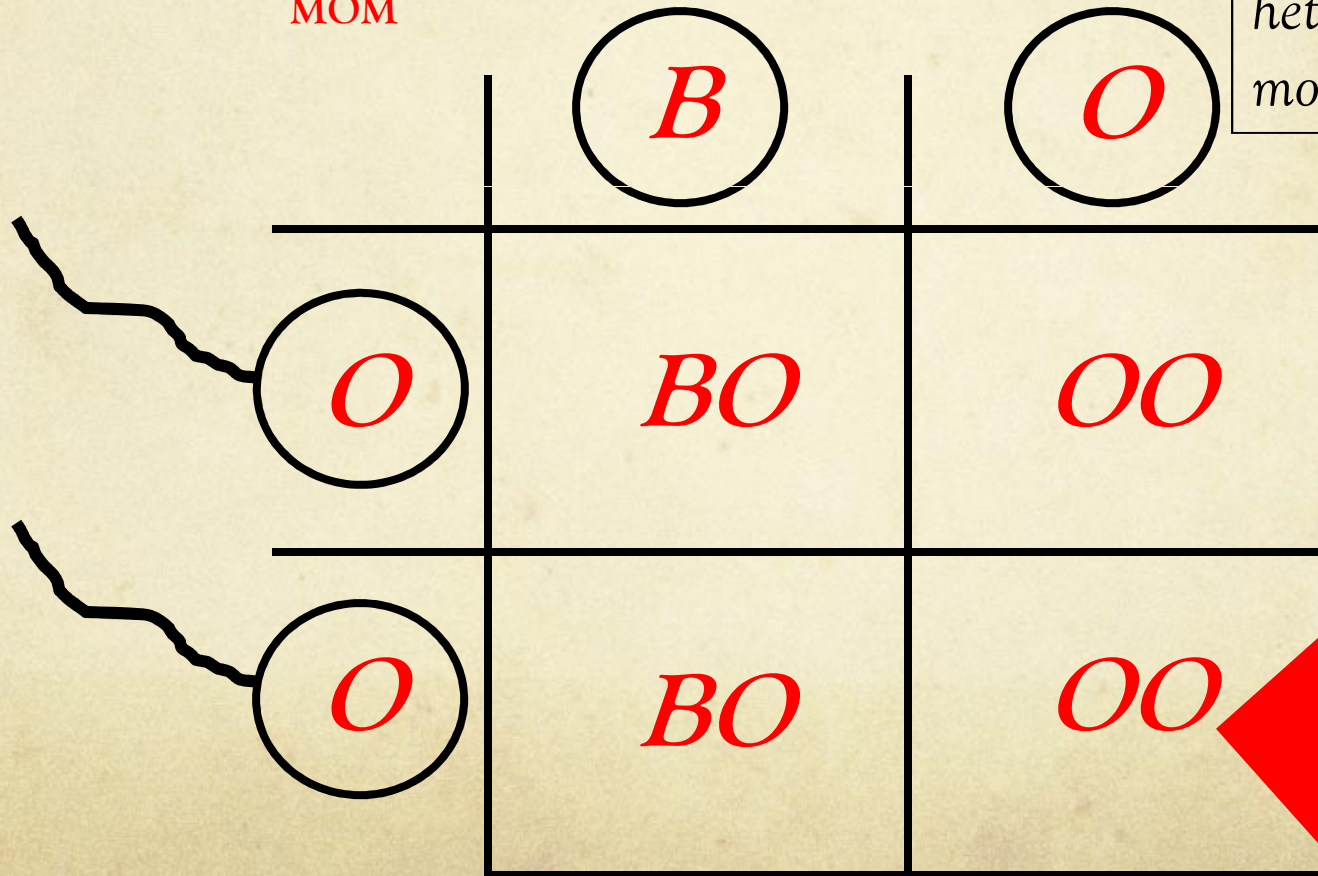
- What if baby is Rh (+)?
- Doctor can give Mom a shot (Rhogam, at about 28 weeks) that removes or hides R(+) cells from Mom's bloodstream

A Real Problem:

Mom is Type B, Dad is Type O ... Baby is Type AB. Is this possible?

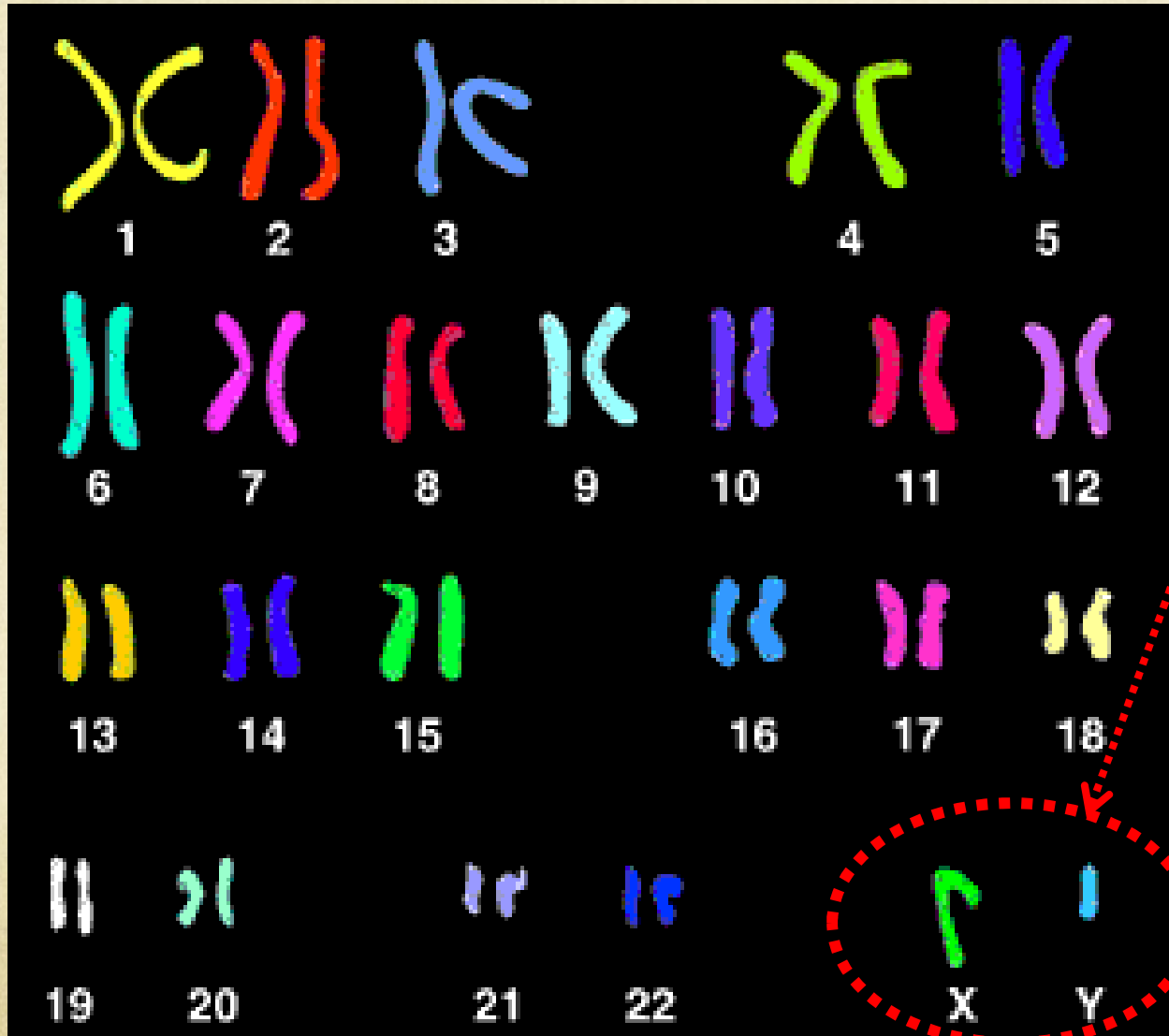
• Cross: \boxed{BO} X \underline{OO}
MOM

Remember, when in doubt, heterozygous is more likely



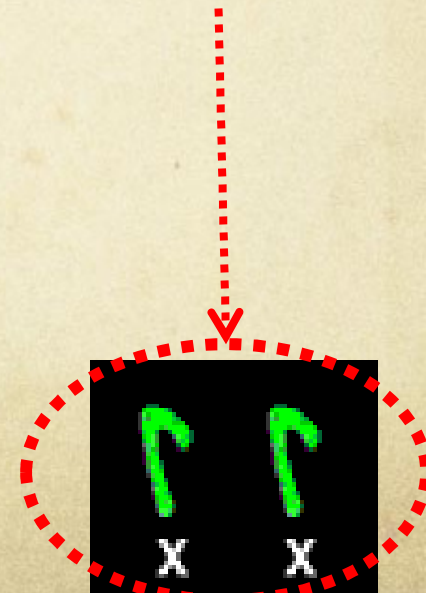
SORRY! NOT POSSIBLE!

Sex Chromosomes:
the 23rd pair in humans



○ All others (1-22) are called autosomes

Boy *Girl*





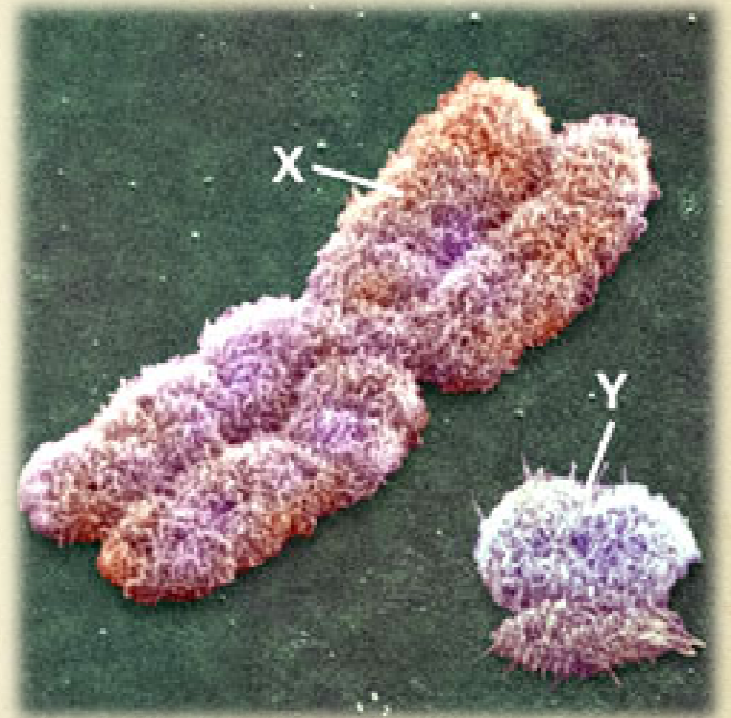
The Sex Chromosomes

○ The “X” Chromosome

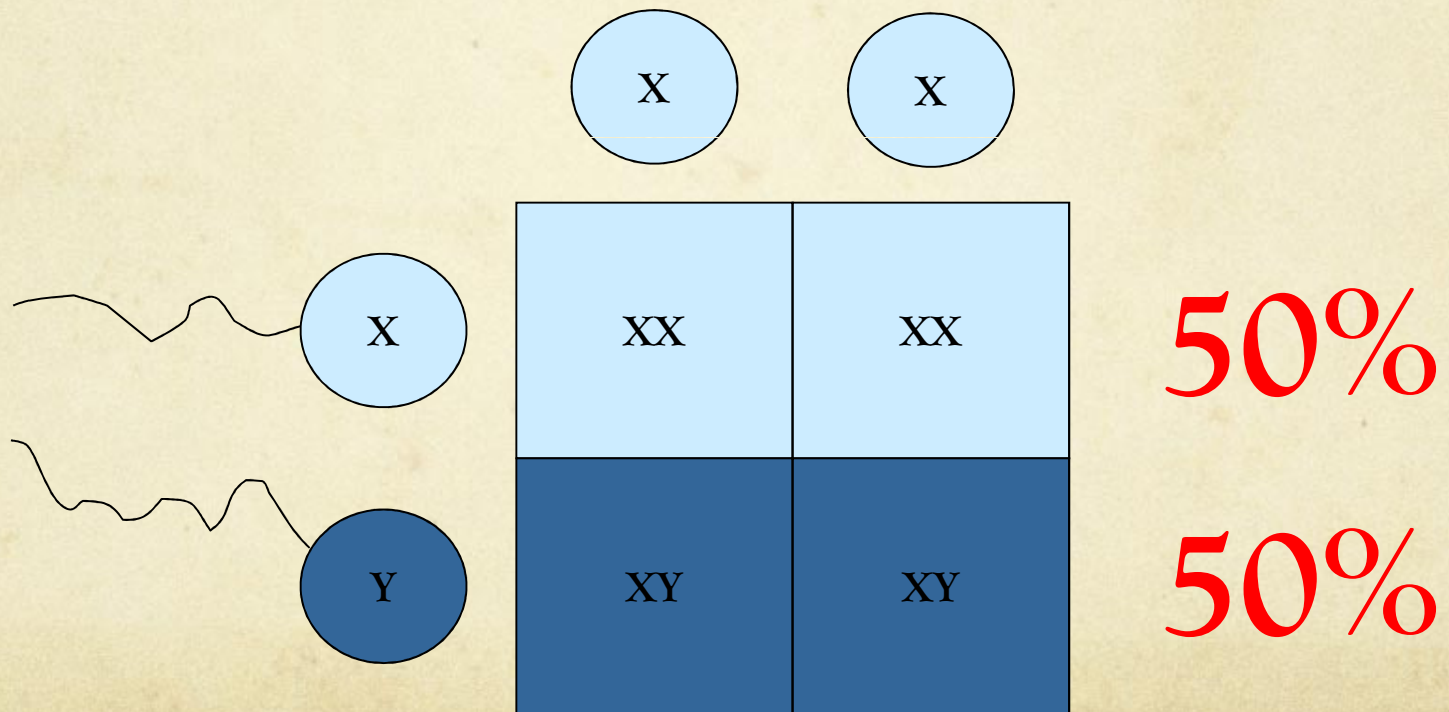
- Has essential genes
- Can't live without it!
- Female 23rd pair = **XX** (one usually deactivated)

○ The “Y” Chromosome

- Few genes
- Determines if testes develop
- Male 23rd pair = **XY**



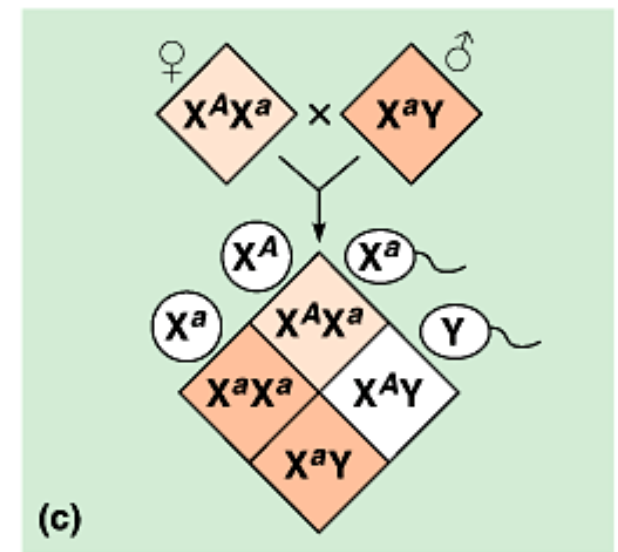
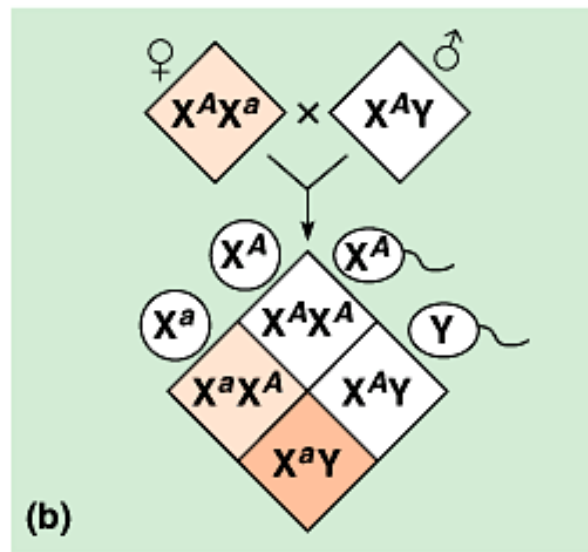
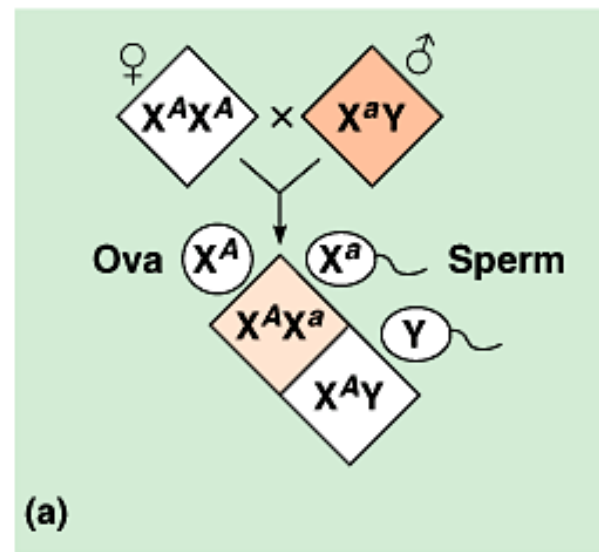
What's the probability of having a boy or girl?





Sex-Linked (X-Linked) Traits

- Sex-Linked traits are usually found on the X (not Y) chromosome (“X-linked”)
- Males are affected or not, no heterozygotes... *WHY, do you think?*

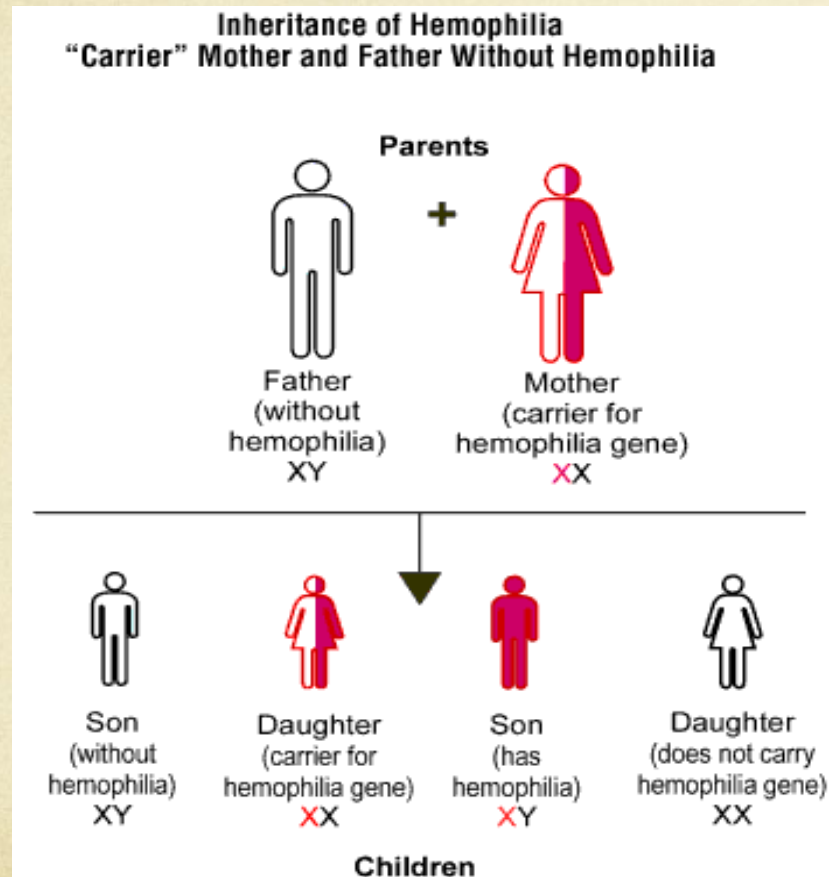


Some X-Linked Traits:

- Haemophilia (missing clotting enzymes)
- Colorblindness
- “Male-pattern” baldness

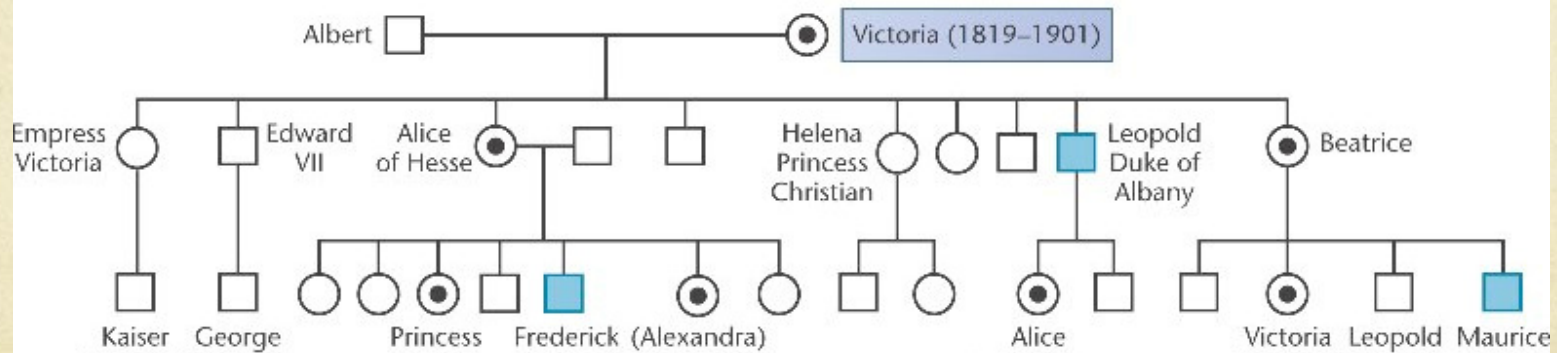
- Most are recessive

Haemophilia

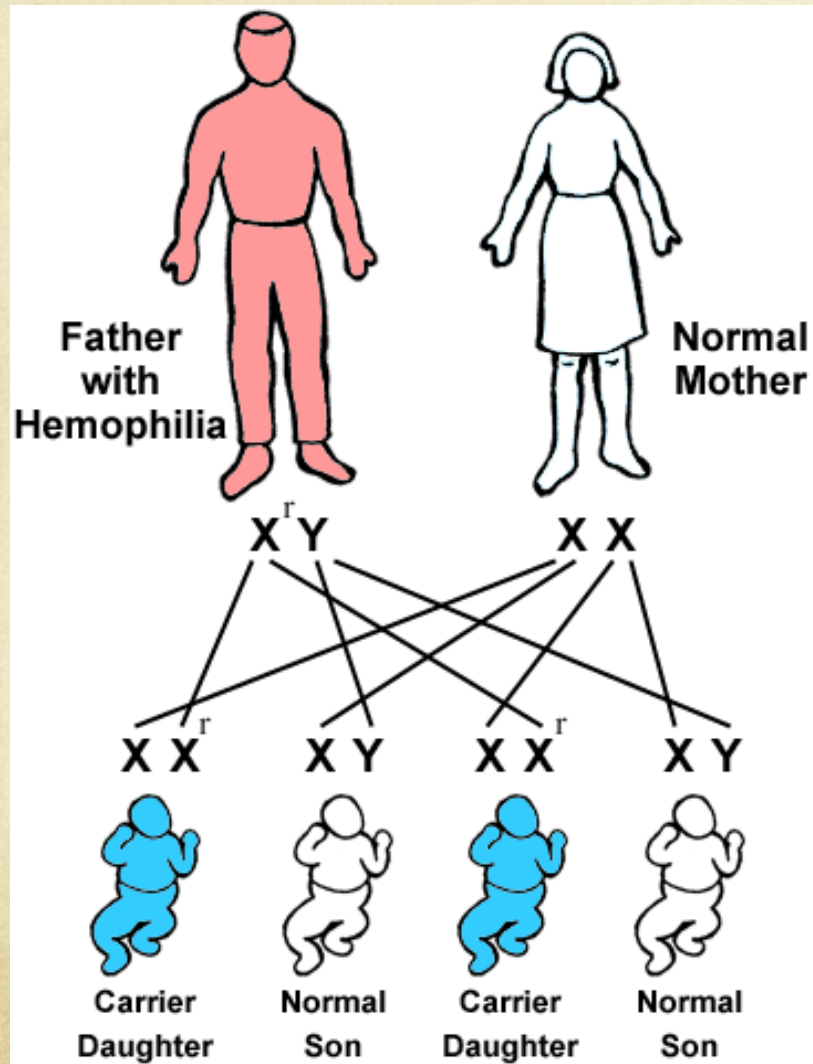


- Ability of blood to clot is impaired.
- The main treatment for hemophilia is called replacement therapy—giving or replacing the clotting factor that's too low or missing.

“The Royal Disease”



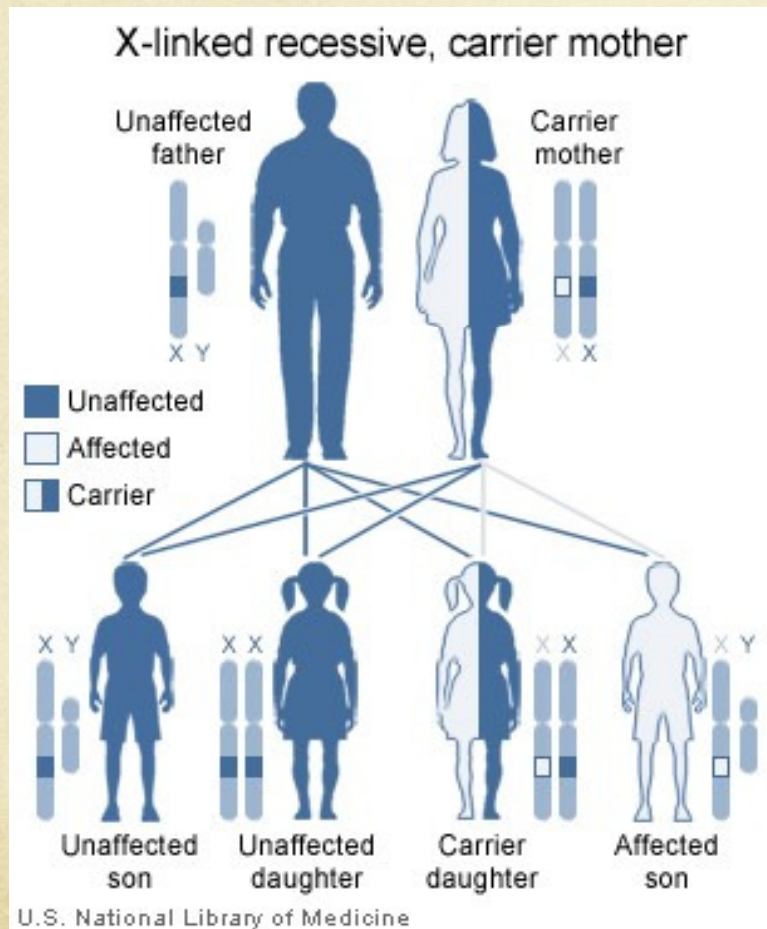
A *haemophiliac man* marries a *healthy woman*. What is the probability that they will have any haemophiliac children?



0%

- All sons healthy
- All daughters carriers

Colorblindness



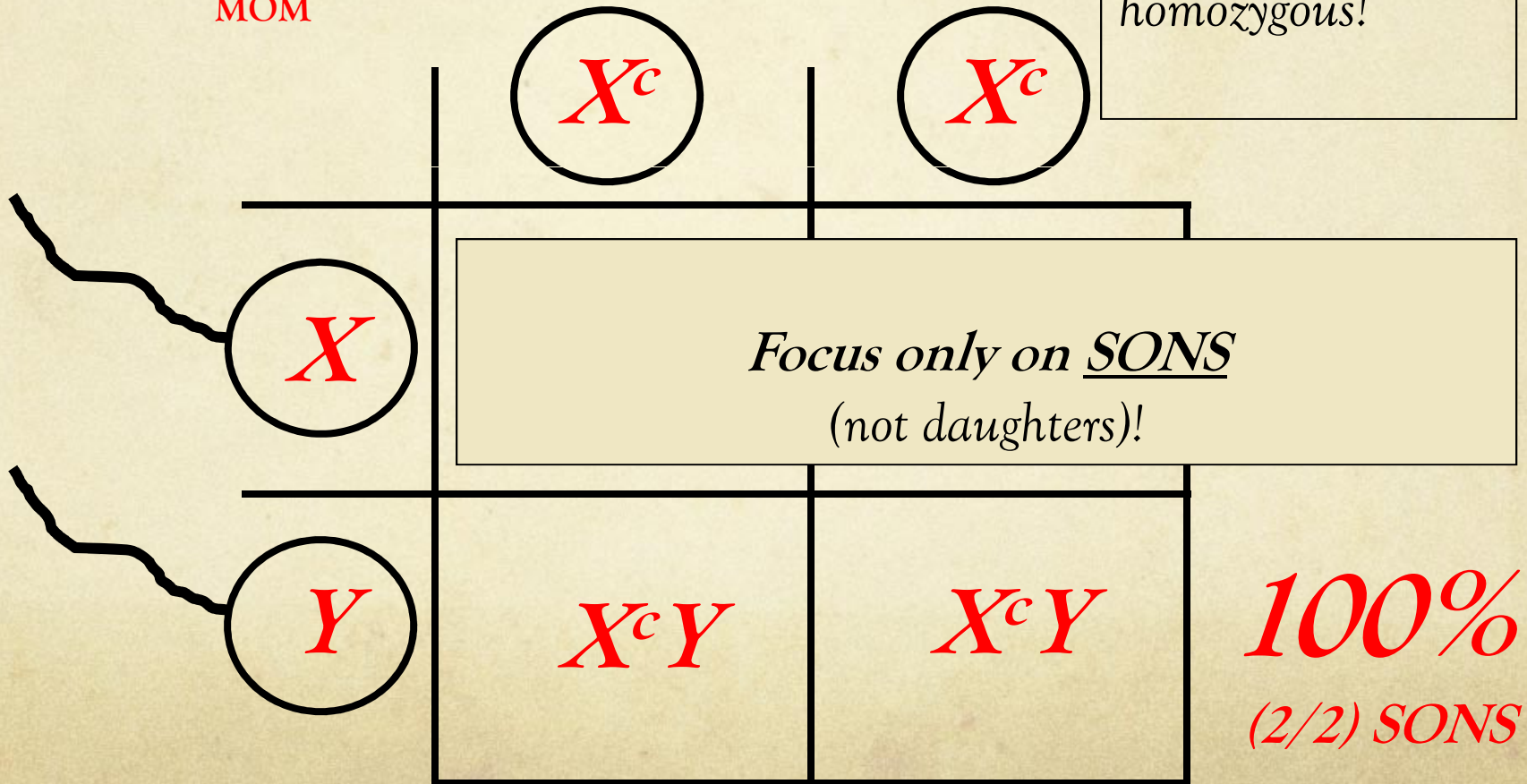
- Red-green colorblindness-
 - red and green are perceived as identical.
- Affects:
 - 1 in 10 males in the US
 - 1 in 100 females in the US
- **Remember:** Males have just one X chromosome. All X-linked alleles are expressed in males.



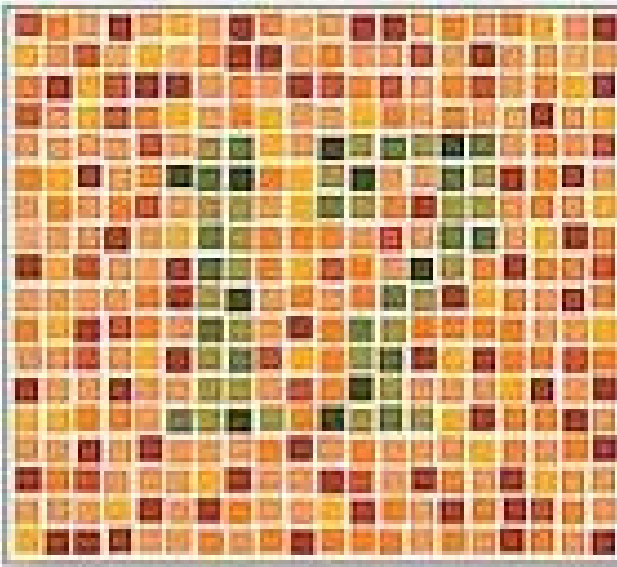
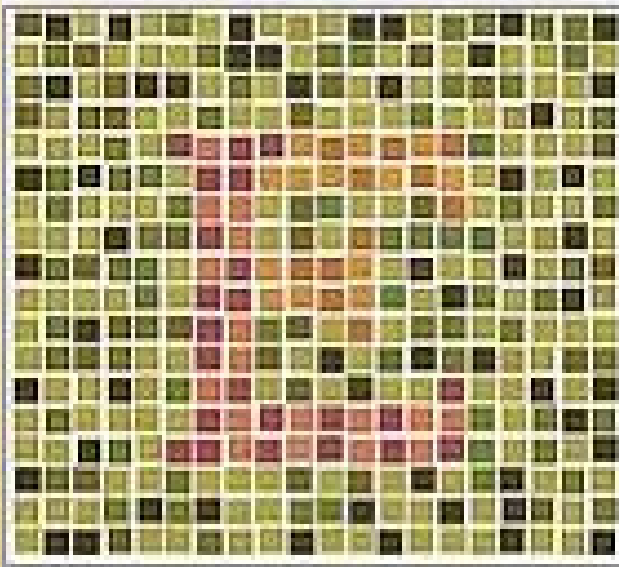
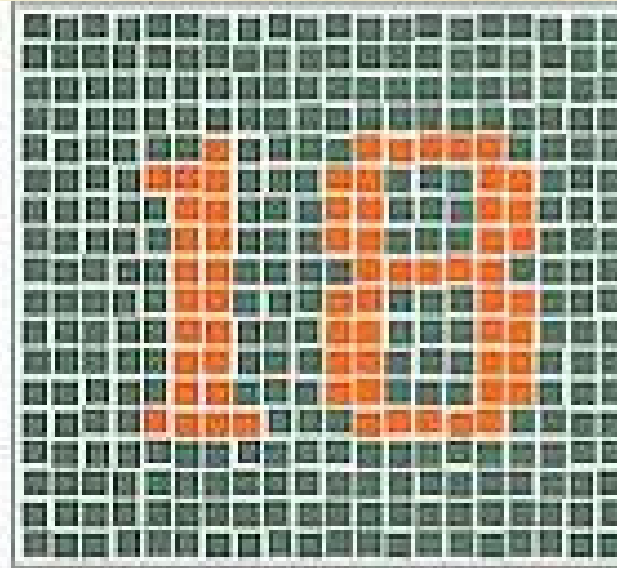
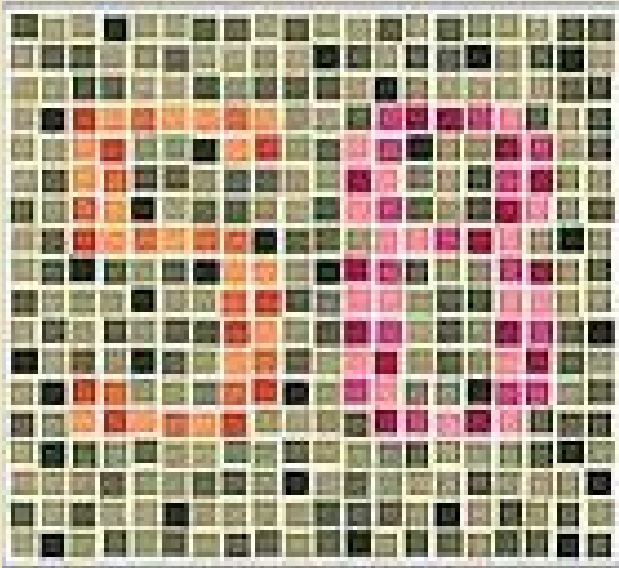
A man with normal vision marries a colorblind woman. What is the probability that they will have a colorblind **SON**?

• Cross: $\underline{X^c X^c}$ X \underline{XY}
MOM

Remember, Mom only shows if she is homozygous!



What do you see?

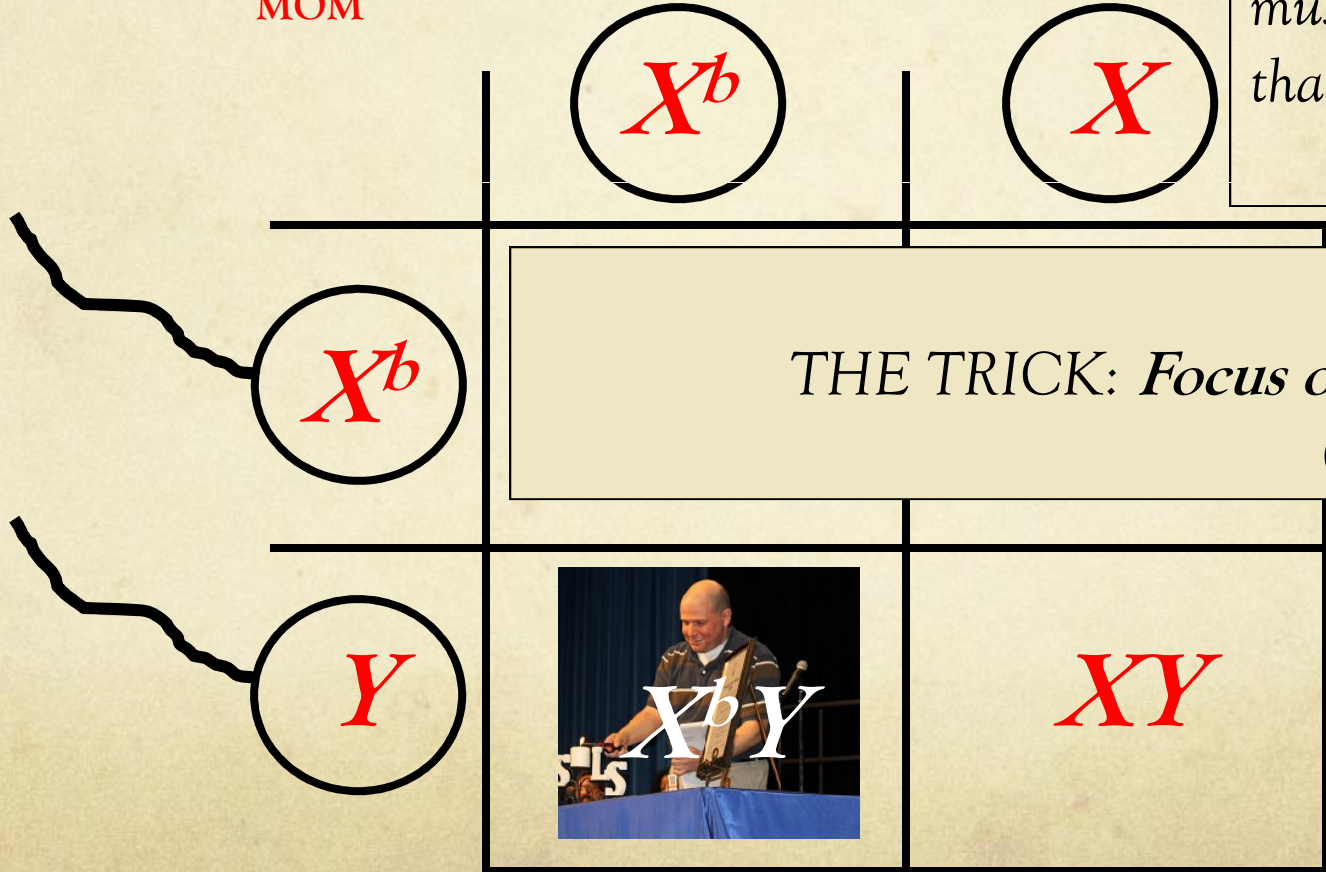


A *bald man* marries a *woman whose father was bald*.
 What is the probability that they will have a **SON** with male-pattern baldness?

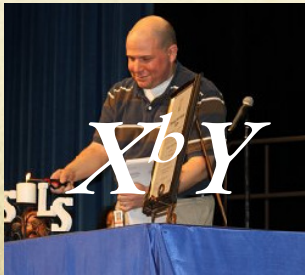


• Cross: $X^b X$ X $X^b Y$
 MOM

If Mom's father was bald, then he must have passed that X to her!



THE TRICK: *Focus only on SONS*
 (not daughters)!



50%
 (1/2) **SONS**

CSI:

No.Va.

CRIME SCENE INVESTIGATON