Genetics Notes

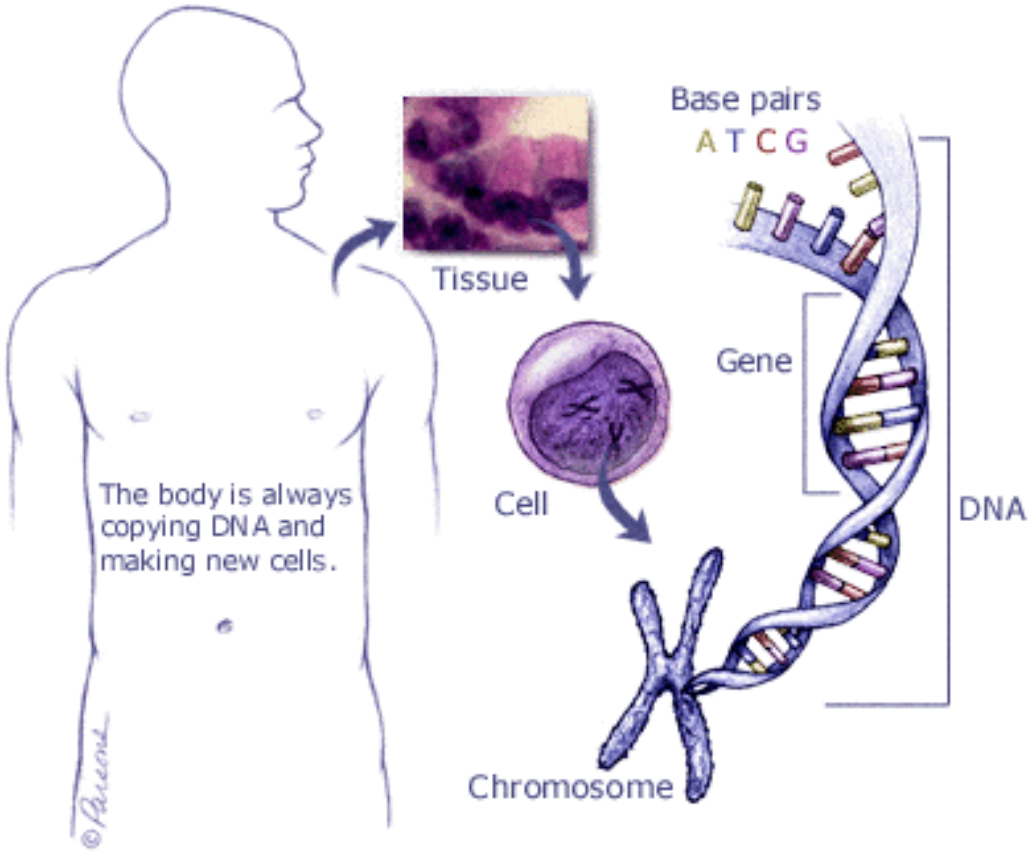
Who is Gregor Mendel? "**Father of Genetics**"

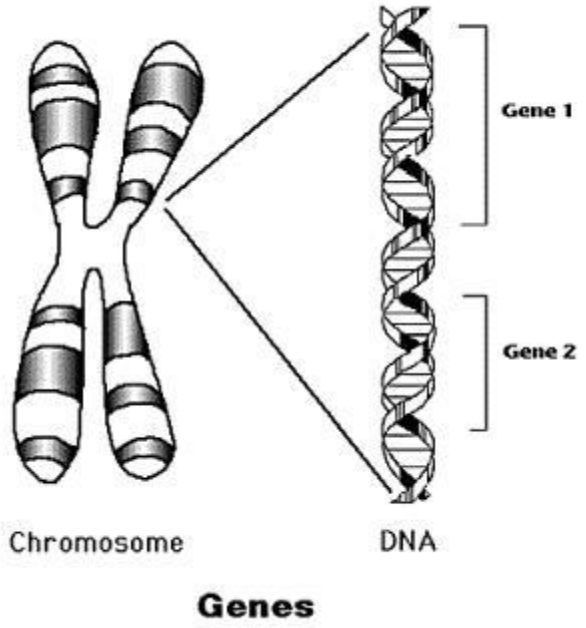
Principle of **Independent Assortment** – Inheritance of one trait has **no effect** on the inheritance of another trait

Traits

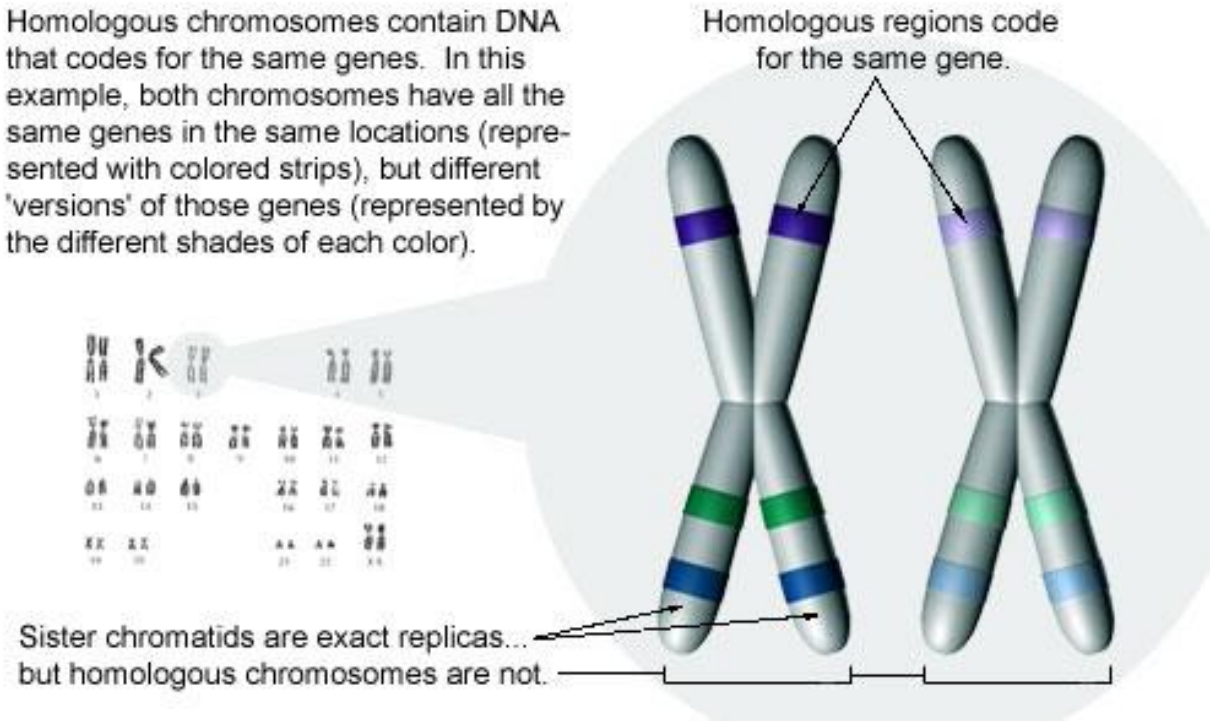
- Genetics – study of how **traits** are passed from **parent** to **offspring**

- Traits are determined by the **genes** on the **chromosomes**. A gene is a segment of **DNA** that determines a **trait**.



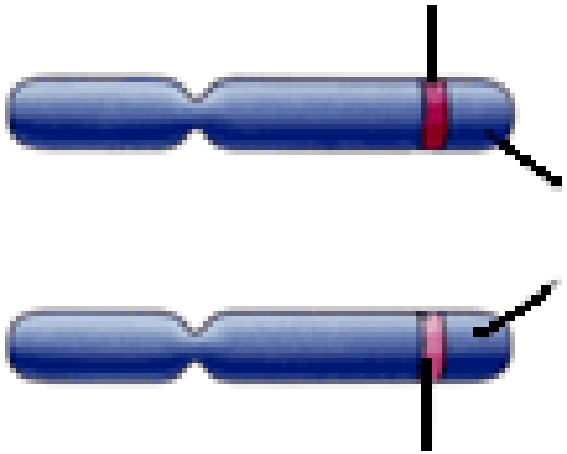


- Chromosomes come in **homologous** pairs, thus **genes** come in pairs.
  Homologous pairs – **matching** genes – one from female parent and one from male parent
- Example: Humans have 46 chromosomes or **23** pairs.
  One set from dad – 23 in **sperm**
  One set from mom – 23 in **egg**



- One pair of Homologous Chromosomes:

Gene for **eye color**
(**blue** eyes)



Homologous pair
of chromosomes

Gene for **eye color**
(**brown** eyes)

Alleles – different **genes** (possibilities) for the same **trait** –
ex: blue eyes or brown eyes

Dominant and Recessive Genes

- Gene that **prevents** the other gene from "showing" – **dominant**
- Gene that **does NOT** "show" even though it is **present** – **recessive**
- Symbol – Dominant gene – **upper** case letter – **T**
  Recessive gene – **lower** case letter – **t**

Dominant color

Recessive color

Example: Straight thumb is **dominant** to hitchhiker thumb

T = straight thumb **t** = hitchhikers thumb

(Always use the same letter for the same alleles—
No S = straight, h = hitchhiker's)

Straight thumb = TT

Straight thumb = Tt

Hitchhikers thumb = tt

* Must have **2** recessive **alleles** for a recessive trait to "**show**"

- Both genes of a pair are the same – **homozygous** or **purebred**

  TT – homozygous **dominant**

  tt – homozygous **recessive**

- One dominant and one recessive gene – **heterozygous** or **hybrid**

  Tt – heterozygous

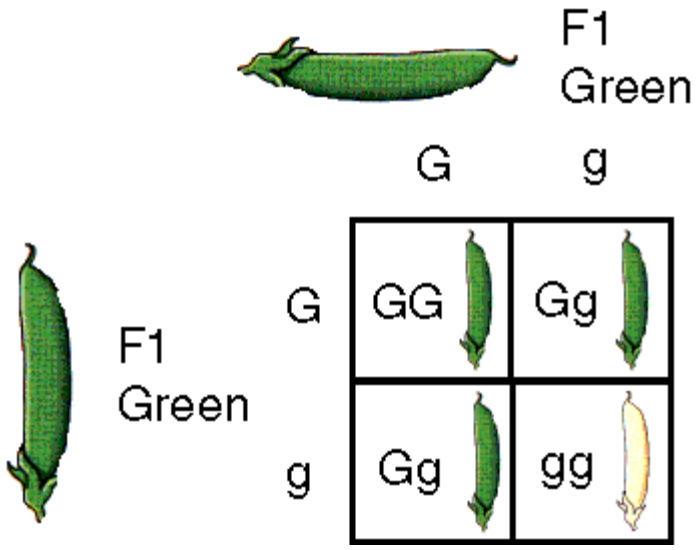
BB – Black

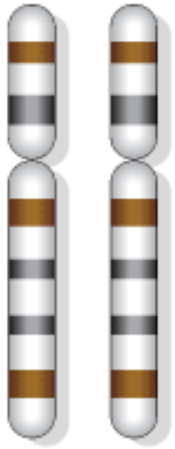
Bb – Black w/ white gene

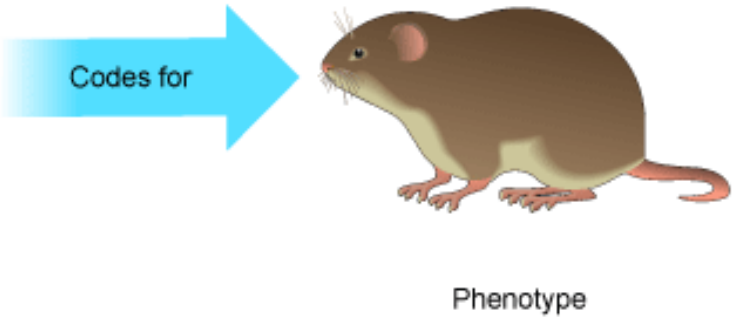
bb – White

Genotype and Phenotype

- Combination of genes an organism has (**actual gene makeup**) – **genotype**
  Ex: TT, Tt, tt
- **Physical appearance** resulting from gene make-up – **phenotype**
  Ex: hitchhiker's thumb or straight thumb



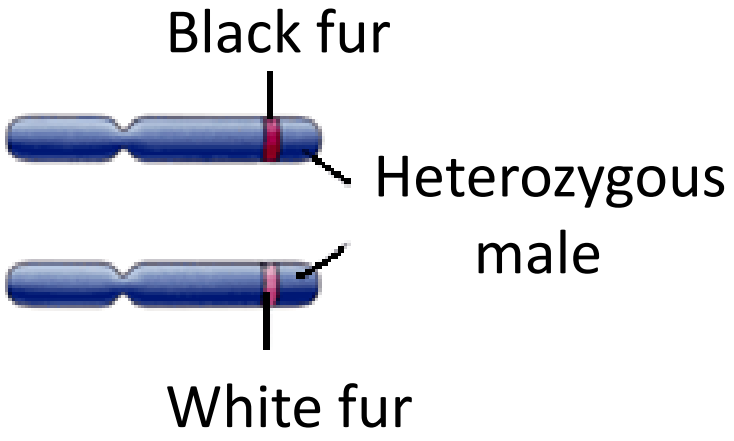


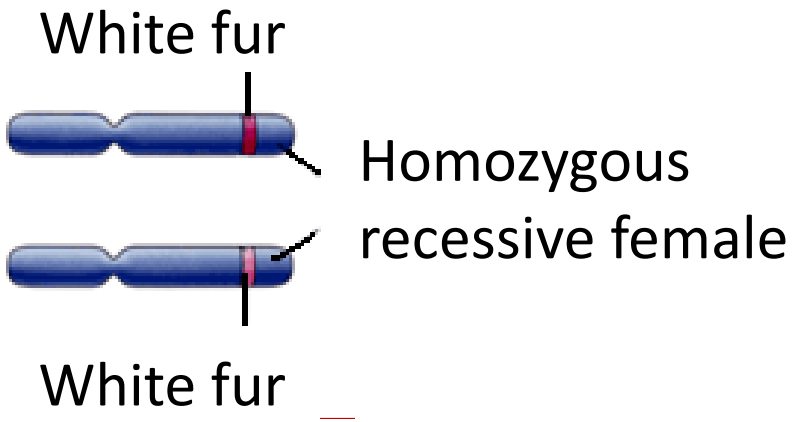


Punnett Square and Probability

- Used to **predict** the **possible** gene makeup of **offspring** – **Punnett Square**
- Example: Black fur (B) is dominant to white fur (b) in mice

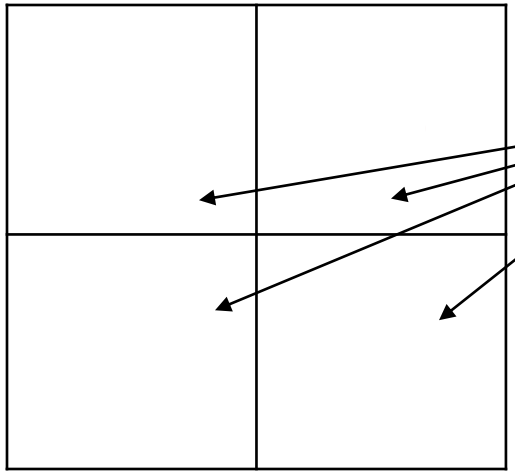
1. Cross a heterozygous male with a homozygous recessive female.





Male = **X** Female =

Female gametes – N
(One gene in egg)



Possible offspring – 2N

Male gametes - N
(One gene in sperm)

Genotypic ratio = 2 : 2
50% Bb : 50% bb

Phenotypic ratio = 2 : 2
50% black : 50% white

Write the ratios in the following orders:

Genotypic ratio

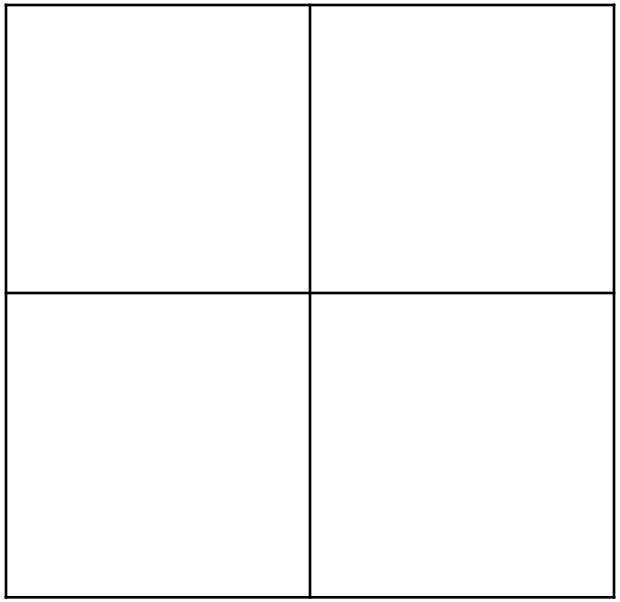
homozygous dominant : heterozygous : homozygous recessive

Phenotypic ratio

dominant : recessive

Cross 2 hybrid mice and give the genotypic ratio and phenotypic ratio.

X



typic ratio = _____ : _____ : _____

25% BB : 50% Bb : 25% bb

typic ratio = _____ : _____

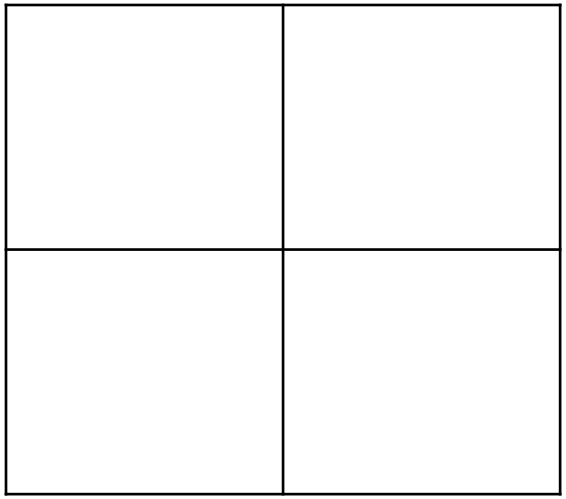
75% black : 25% white

Example: A man and woman, both with brown eyes (B) marry and have a blue eyed (b) child. What are the genotypes of the man, woman and child?

X

Man =

Woman =



- Example: In rabbits black coat (B) is dominant over brown (b) and straight hair (H) is dominant to curly (h). Cross a rabbit that is homozygous dominant for both traits with a rabbit that is homozygous dominant for black coat and heterozygous for straight hair. Then give the phenotypic ratio for the first generation of offspring.

X

Possible gametes:

← Gametes

Phenotypes:

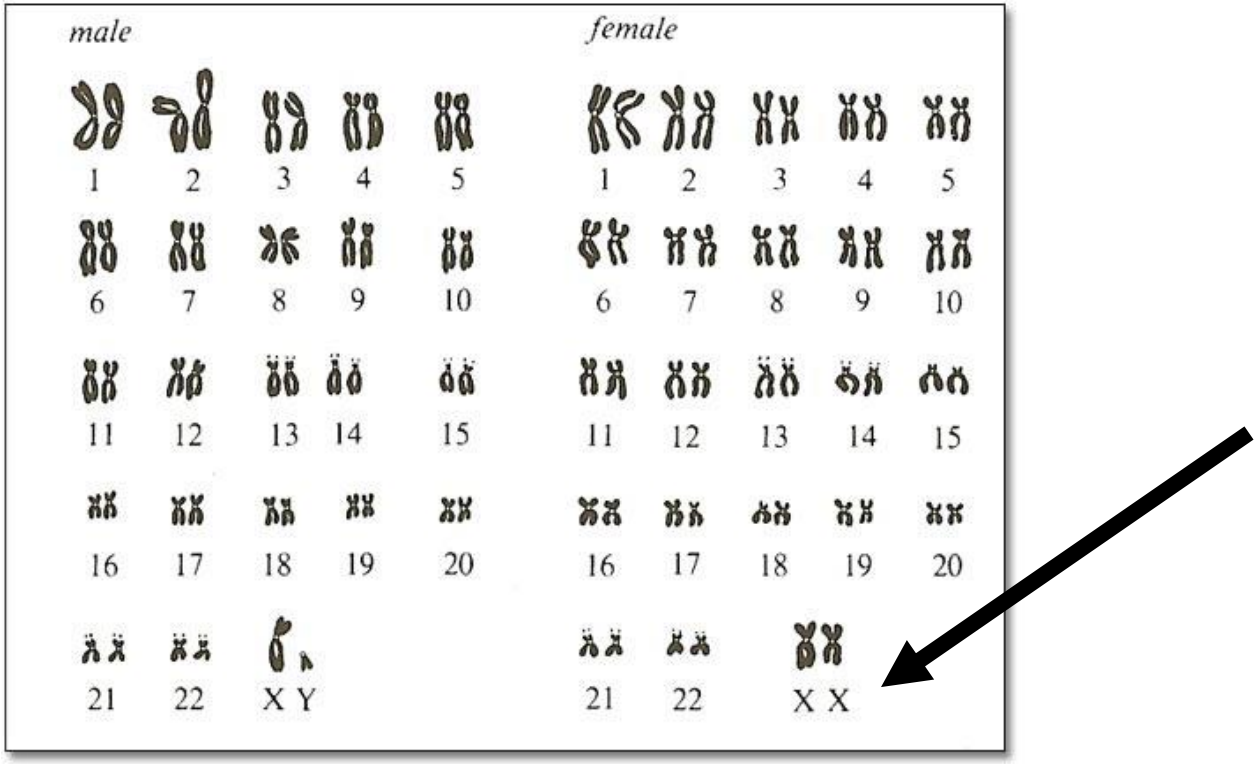
100% _____ _____

Gametes

(Hint: Only design Punnett squares to suit the number of possible gametes.)

Sex Determination

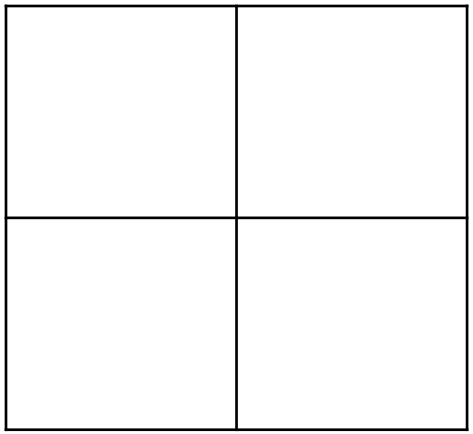
- People – **46** chromosomes or **23** pairs
- 22 pairs are **homologous** (look alike) – called **autosomes** – determine body traits
  1 pair is the **sex** chromosomes – determines sex (male or female)
- Females – sex chromosomes are **homologous** (look alike) – label **XX**
  Males – sex chromosomes are different – label **XY**



- What is the probability of a couple having a boy? Or a girl?

Chance of having female baby?

male baby?



Who determines the sex of the child?

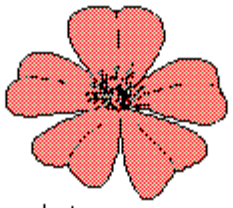
Incomplete dominance and Codominance

- When one allele is **NOT** completely **dominant** over another (they **blend**) – **incomplete dominance**

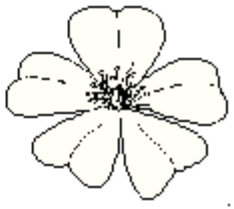
  Example: In carnations the color red (R) is incompletely dominant over white (W). The hybrid color is pink. Give the genotypic and phenotypic ratio from a cross between 2 pink flowers.

homozygous dominant

X



heterozygous



homozygous recessive

Genotypic = : :

Phenotypic = : :

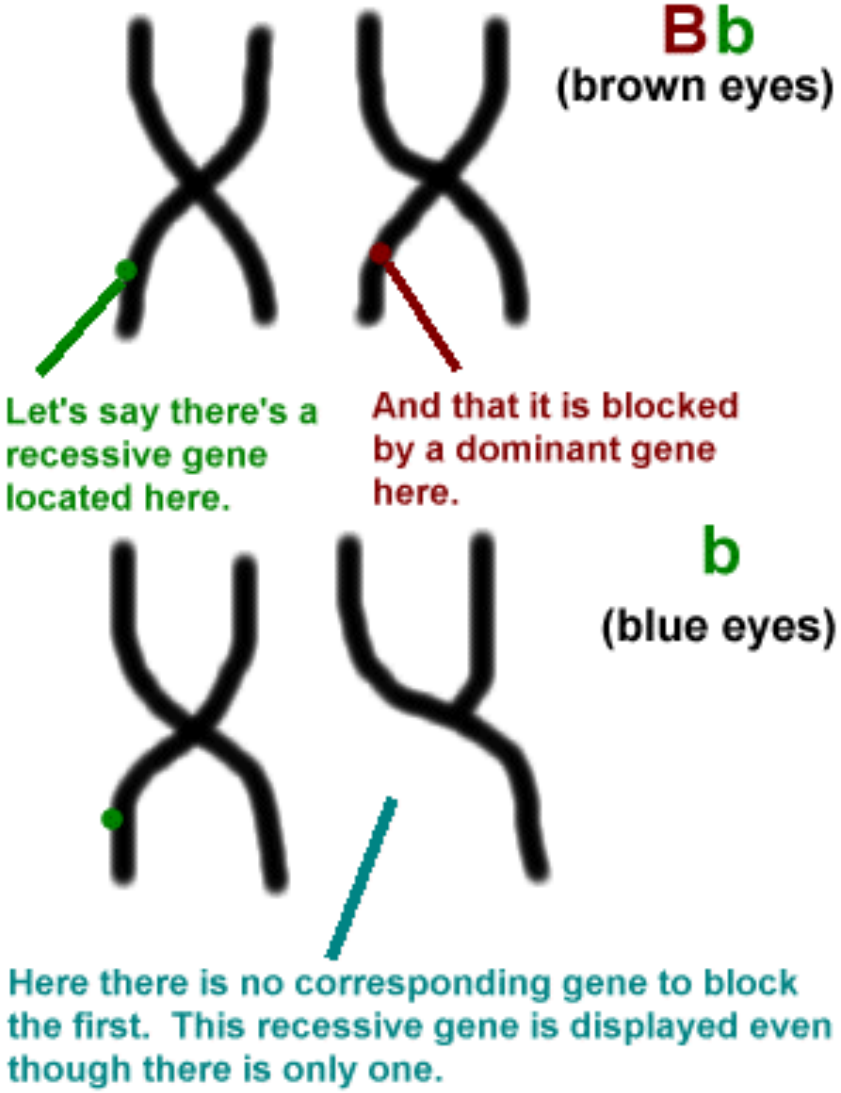
- When **both** alleles are **expressed** – **Codominance**

  Example: In certain chickens black feathers are codominant with white feathers.

  Heterozygous chickens have black and white speckled feathers.

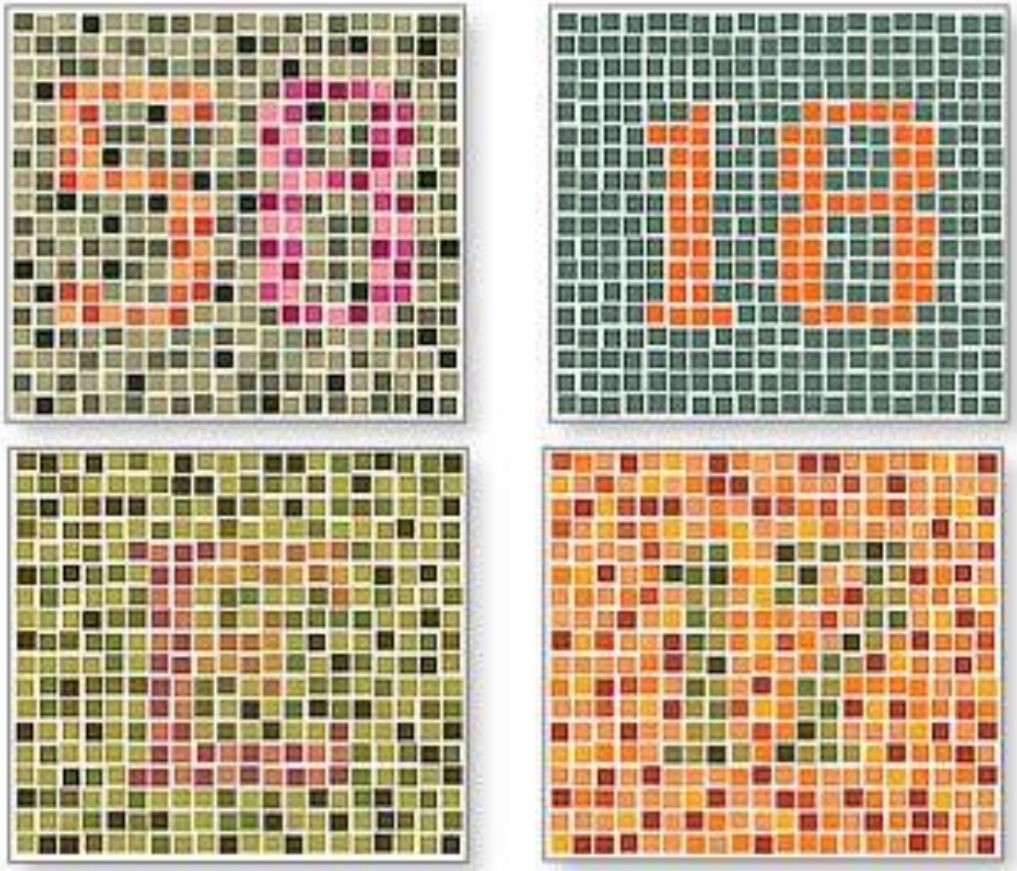
Sex – linked Traits

- **Genes** for these **traits** are located **only** on the **X** chromosome (NOT on the Y chromosome)
- X linked alleles **always** show up in **males** whether **dominant** or **recessive** because males have only **one** X chromosome



- Examples of **recessive** sex-linked disorders:

  1. **colorblindness** – inability to distinguish between certain colors

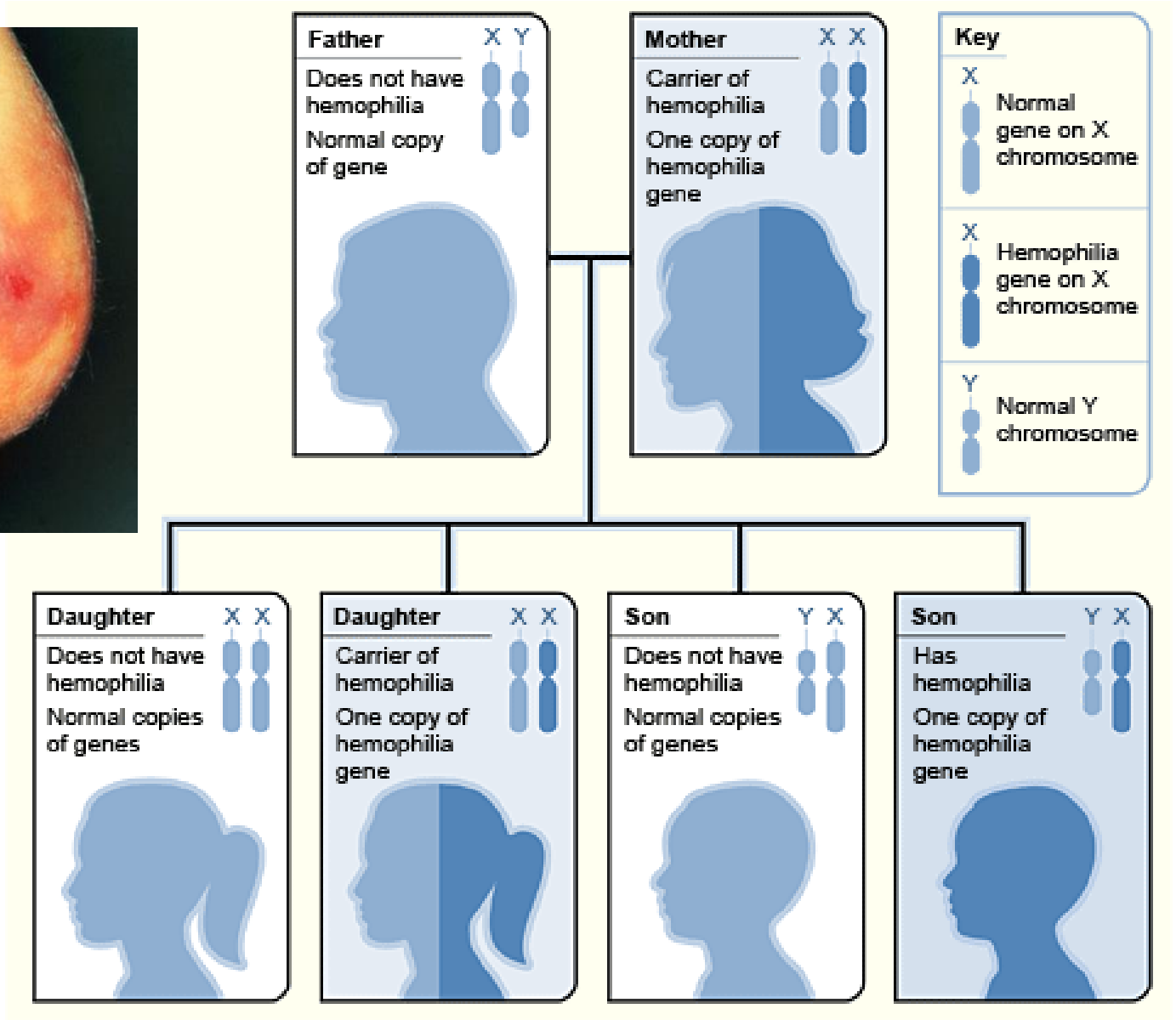


Various tests for color blindness

You should see **58** (upper left), **18** (upper right), **E** (lower left) and **17** (lower right).

Color blindness is the inability to distinguish the differences between certain colors. The most common type is red-green color blindness, where red and green are seen as the same color.

2. hemophilia – blood won't clot



- Example: A female that has normal vision but is a <u>carrier for colorblindness</u> marries a male with <u>normal vision</u>. Give the expected phenotypes of their children.

  N = normal vision

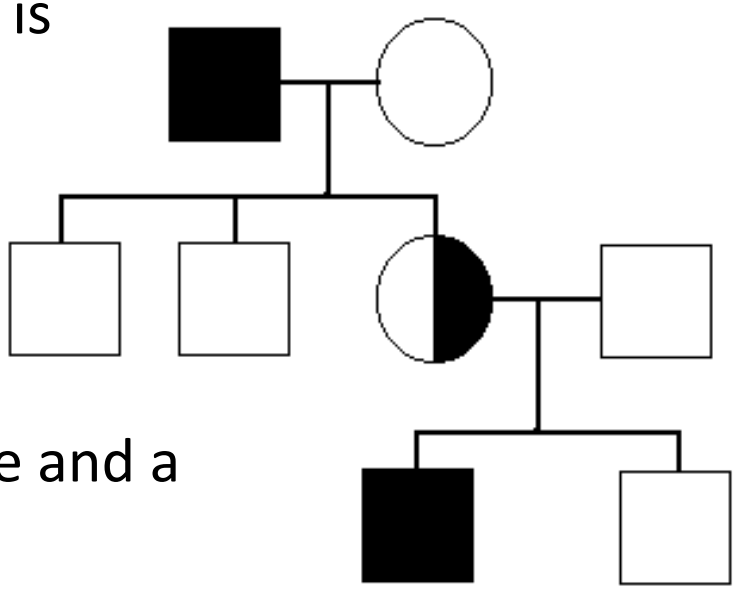
  n = colorblindness

X

Phenotype:

Pedigrees

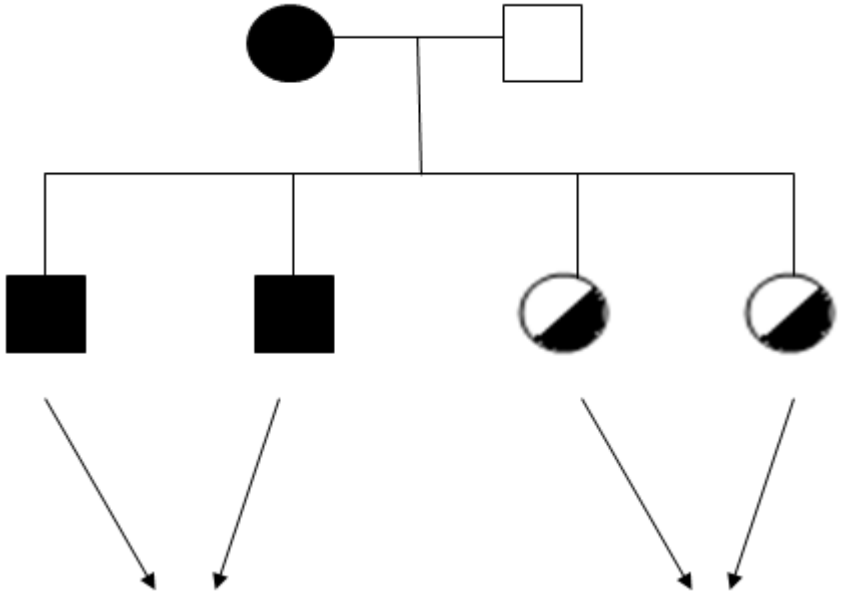
- **Graphic** representation of how a **trait** is passed from parents to **offspring**
- Tips for making a pedigree
  1. **Circles** are for females
  2. **Squares** are for males
  3. **Horizontal lines** connecting a male and a female represent a **marriage**
  4. **Vertical line** and **brackets** connect parent to offspring
  5. A **shaded** circle or square indicates a person **has** the trait
  6. A circle or square **NOT shaded** represents an individual who does NOT have the trait
  7. **Partial** shade indicates a **carrier** – someone who is **heterozygous** for the trait



- Example: Make a pedigree chart for the following couple. Dana is color blind; her husband Jeff is not.

  They have two boys and two girls.

  HINT: Colorblindness is a recessive sex-linked trait.



Has trait

Can pass trait to offspring