Patterns of Inheritance

What are the different ways traits can be inherited?

Review: Patterns of Inheritance we know already

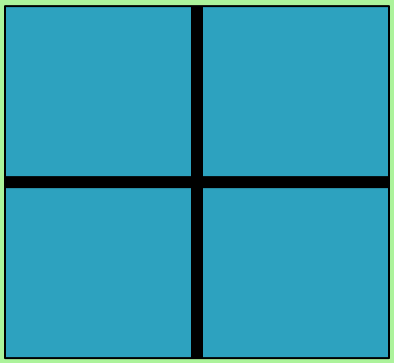
1. Autosomal dominant: If an individual is heterozygous, only one allele is active. The recessive allele is inactive (does not produce a working protein).

- **Traits with genes NOT on sex chromosomes.**

Ex:

Homozygous brown eyes x Homozygous blue eyes

- **SET UP A PUNNETT SQUARE!**



Autosomal Dominant Example

Ex: Homozygous brown eyes (BB) x

homozygous blue eyes (bb)

SET UP A PUNNETT SQUARE!

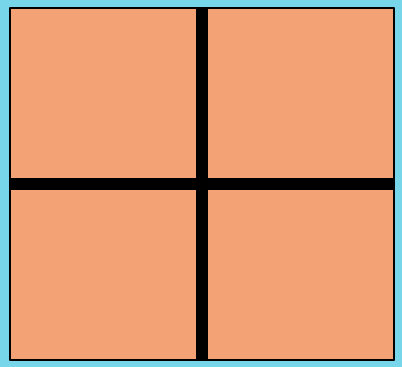
	B	B
b	Bb	Bb
b	Bb	Bb

- **What is the <u>phenotype seen</u> in the offspring?**
  - **ANSWER: Brown eyes**

Review: Patterns of Inheritance we know already

2. Autosomal recessive: If an individual is homozygous recessive both alleles are inactive; therefore, the recessive trait is seen as the phenotype. Both alleles are inactive.

- **Traits with genes NOT on sex chromosomes.**
  - **Ex: Cross 2 parents heterozygous for brown eyes. SET UP A PUNNETT SQUARE!**



Autosomal Recessive Example

- **Ex: Cross 2 parents heterozygous for brown eyes. SET UP A PUNNETT SQUARE!**

	B	b
B	BB	Bb
b	Bb	bb

  - **Will any of the offspring have the blue eyes for a phenotype?**
    - **ANSWER: Yes! bb = blue eyes**

3. Incomplete Dominance:

One allele is not dominant over the other allele for a trait.

- You know a trait follows the incomplete dominance pattern when:
  - There are 3 possible phenotypes instead of 2.
  - The 3rd phenotype is a **blend** of the other 2 phenotypes.

Incomplete Dominance Example: Carnations

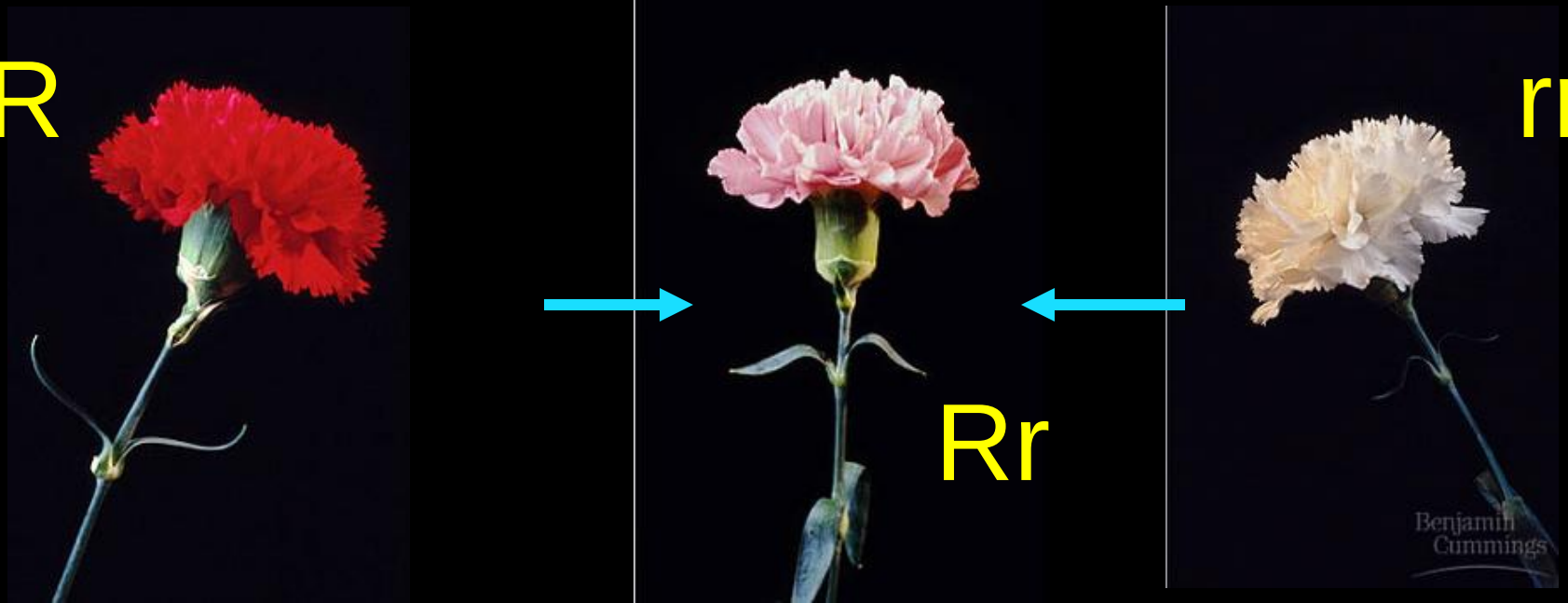
Ex: red carnation x white carnation produces pink carnations

Alleles: R = red, r = white

Genotypic cross = RR x rr

SET UP A PUNNETT SQUARE!

	R	R
r	Rr	Rr
r	Rr	Rr



4. Codominance: The alleles for a trait are different & both are active.

- <u>Both alleles are seen</u> in the phenotype of heterozygous individuals.

White cow (WW)

X

Red cow (RR)

Red & White (RW) offspring

Show this cross with a Punnett Square!

4. Codominance:

Show this cross with a Punnett Square!

White cow (WW)

X

Red cow (RR)

Red & White (RW) offspring

	W	W
R	RW	RW
R	RW	RW

Codominance (with a twist)... Blood Types!

- Blood type alleles follow different patterns of inheritance

→ There are **3** alleles for human blood type: ***A***, **B**, ***O***.

→ A and B alleles are **codominant**

→ O allele is **recessive**

- Blood type depends on genotype:

Blood Type	Genotype
Type A	I^AI^A or I^Ai^O
Type B	I^BI^B or I^Bi^O
Type AB	I^AI^B
Type O	i^Oi^O

if your blood type is . . .

Type	You Can Give Blood To	You Can Receive Blood From
A+	A+ AB+	A+ A- O+ O-
O+	O+ A+ B+ AB+	O+ O-
B+	B+ AB+	B+ B- O+ O-
AB+	AB+	Everyone
A-	A+ A- AB+ AB-	A- O-
O-	Everyone	O-
B-	B+ B- AB+ AB-	B- O-
AB-	AB+ AB-	AB- A- B- O-

Example: What are possible genotypes & phenotypes of the children born to a mother having the genotype I^Ai^O and a father with the phenotype AB?

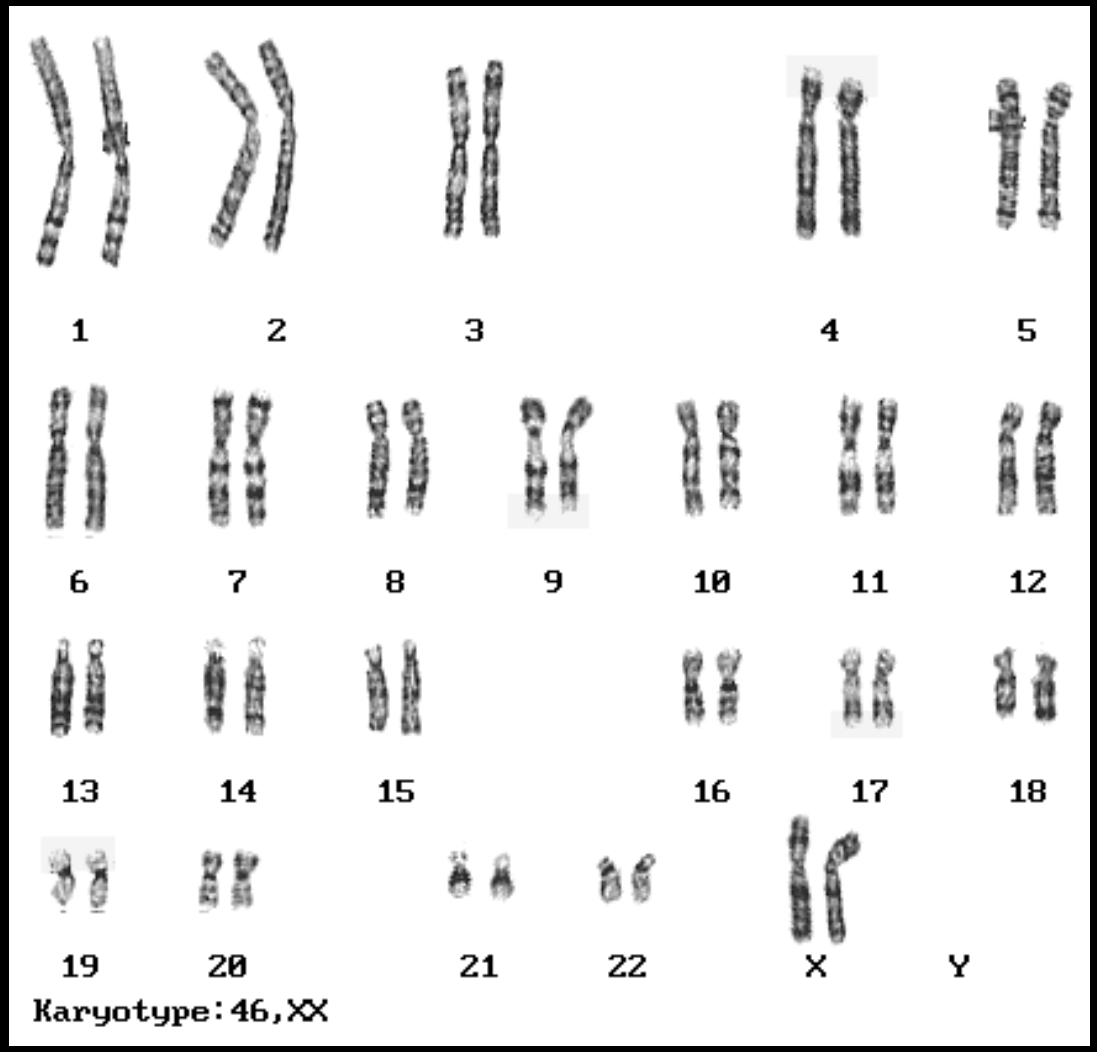
- Set up a Punnett Square!
- Genotypes?
  - **I^AI^A, I^Ai^O, I^AI^B, I^Bi^O**
- Phenotypes?
  - **Type A, Type AB, Type B**

	I^A	i^O
I^A	I^AI^A **Type A**	I^Ai^O **Type A**
I^B	I^AI^B **Type AB**	I^Bi^O **Type B**

A new vocabulary term before we move onto determining Gender and Sex-Linked Traits…

Karyotype: map of an individual's chromosomes.

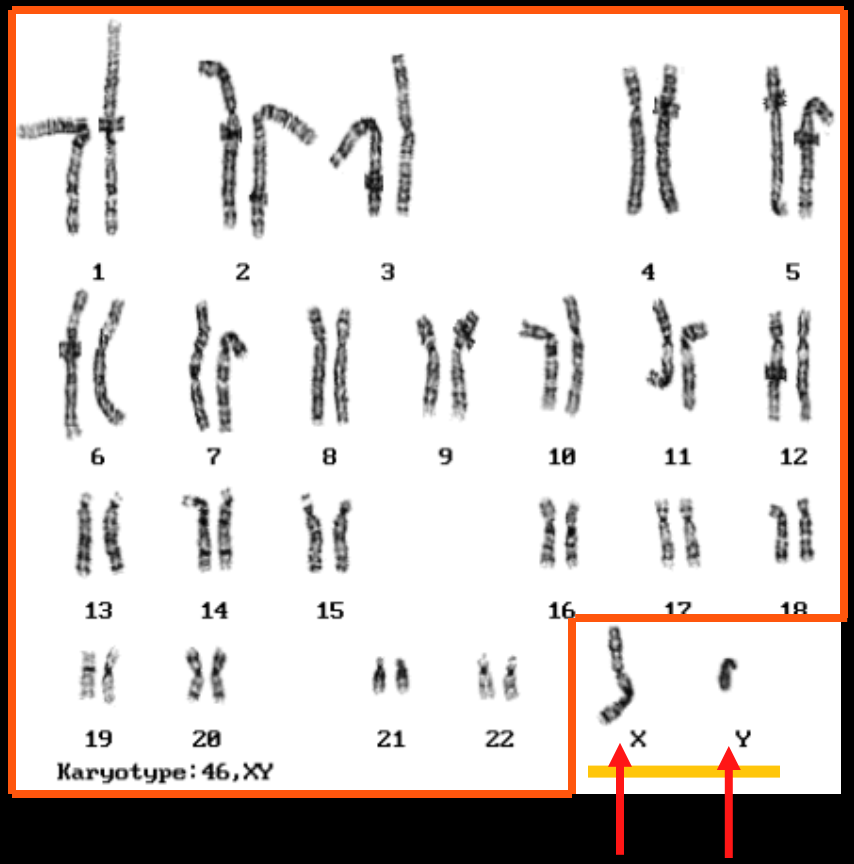
- Pictures of homologous chromosomes are arranged and numbered by size, from largest to smallest.



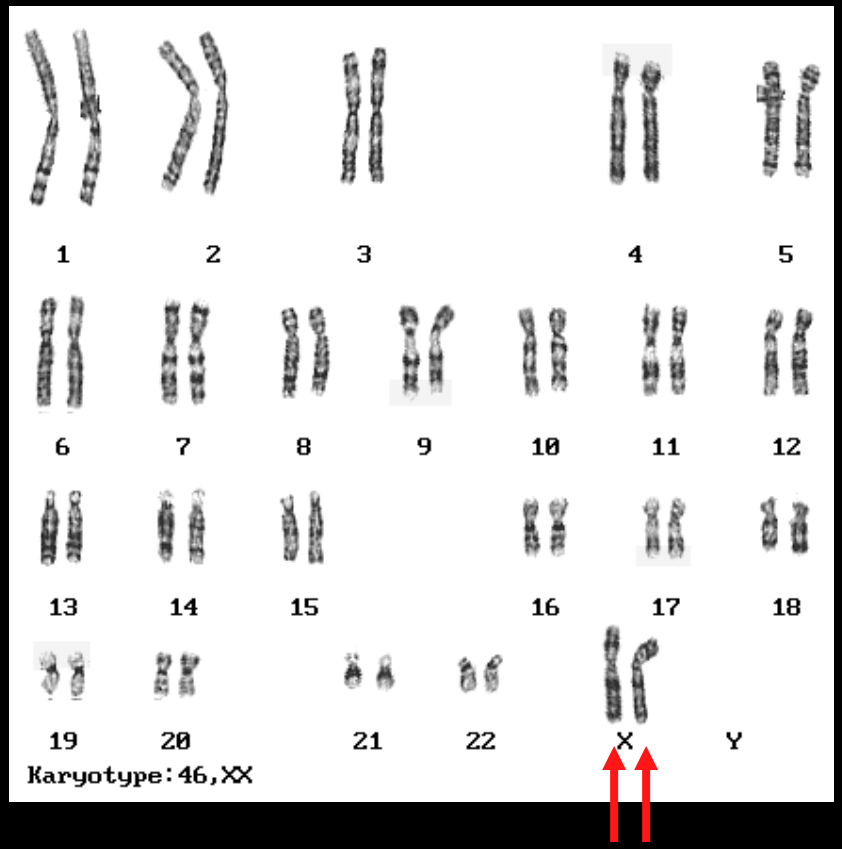
In humans, how is gender determined?

Gender is determined by the sex chromosomes!

- *Chromosome Pair #23 are the* ***"sex chromosomes"***



For pair 23, MALES have one X chromosome and one Y chromosome

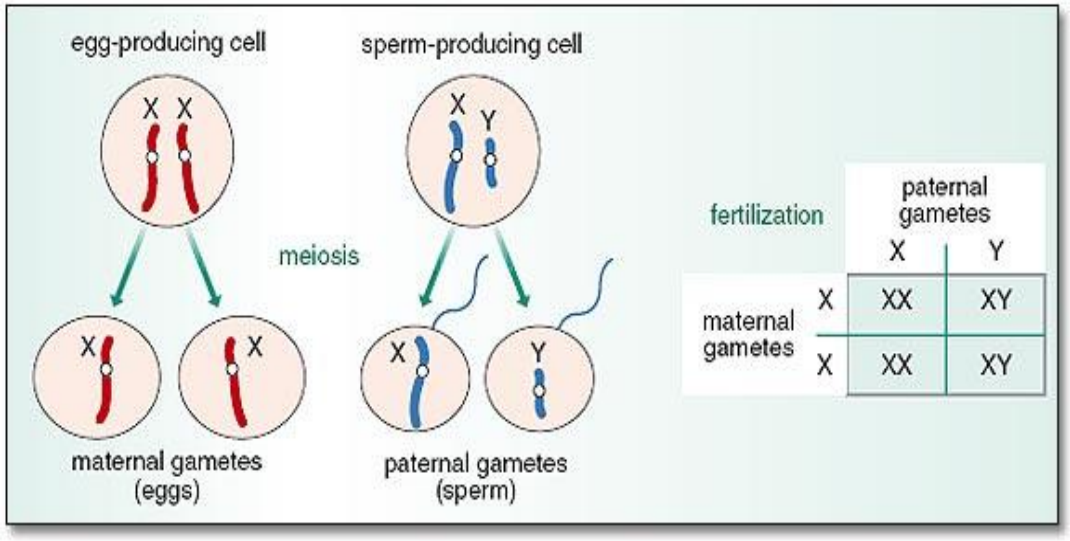


FEMALES have two X chromosomes

Determining Gender:

I. All eggs carry **X** chromosomes but **1/2** of sperm carry **X**'s and 1/2 carry **Y**'s. *The father determines gender of the baby!*

II. **Y** is smaller than **X**. Some traits on **X** have no matching gene on **Y**. *Males have only one gene for those traits, not two* (as they do for all other traits).



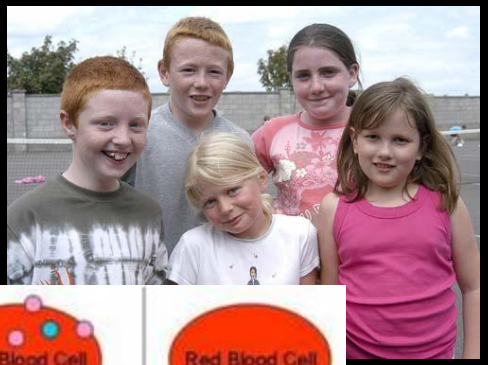
What are the chances of any couple having a baby girl?

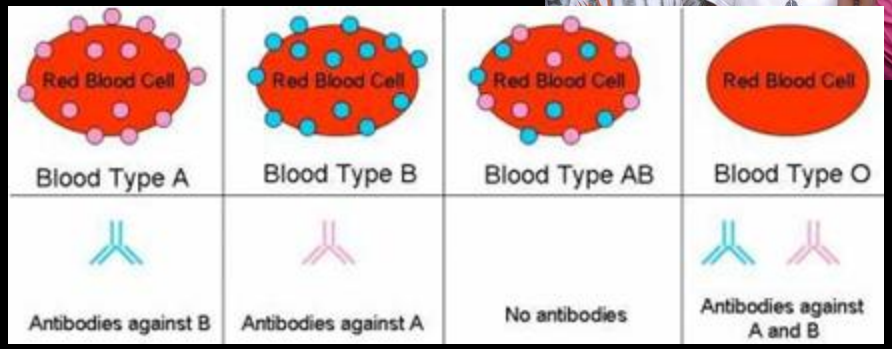
½ or 50%

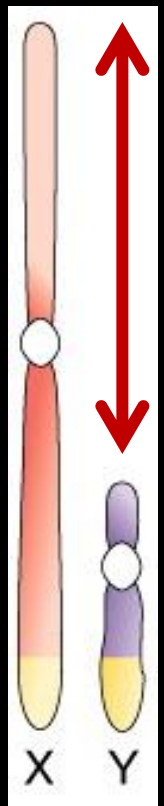
No matching gene for traits found here in males.

Autosomal traits: traits with genes on chromosomes 1-22.

Ex: Blood type, hair color.







5. Sex-linked (X-linked) traits: traits with genes on the part of the X that has no matching gene on the Y.

Ex: Color blindness, hemophilia, muscular dystrophy.

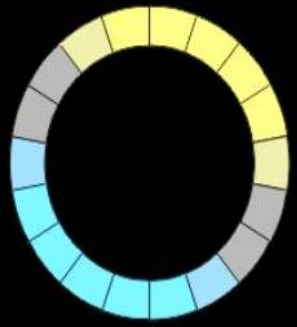
There are many kinds of color-blindness. The sex-linked form is **red-green** color blindness.

Trichromatic Vision

Spectrum with normal color vision…

and as it appears with red-green colorblindness.

Dichromatic Vision



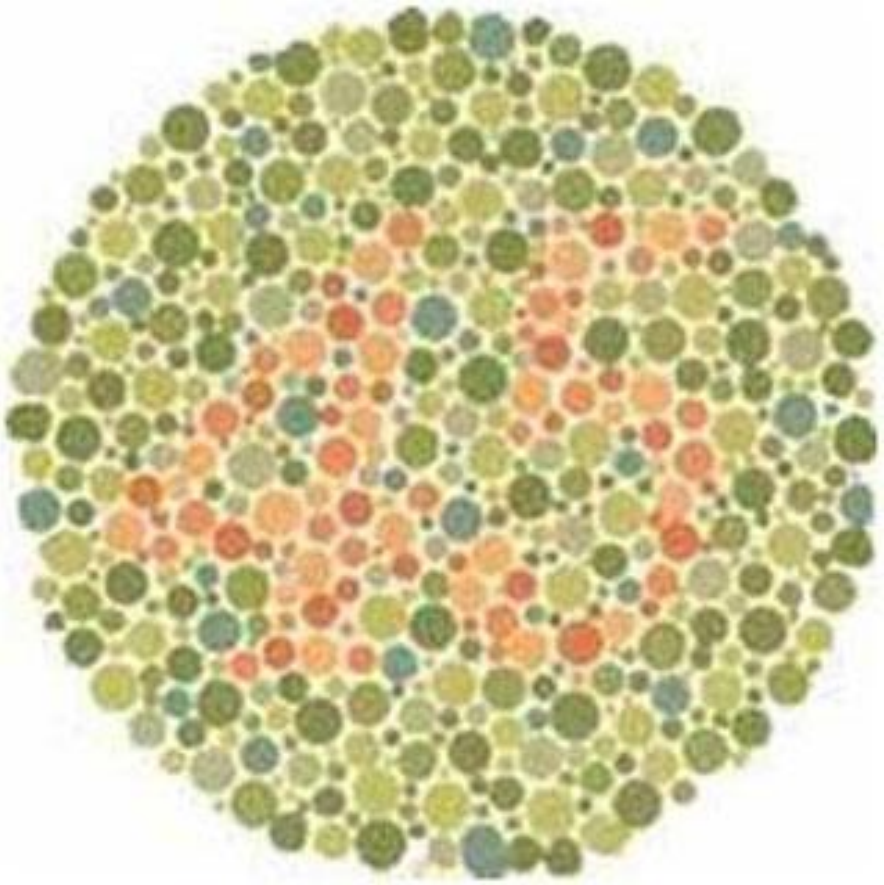
Normal

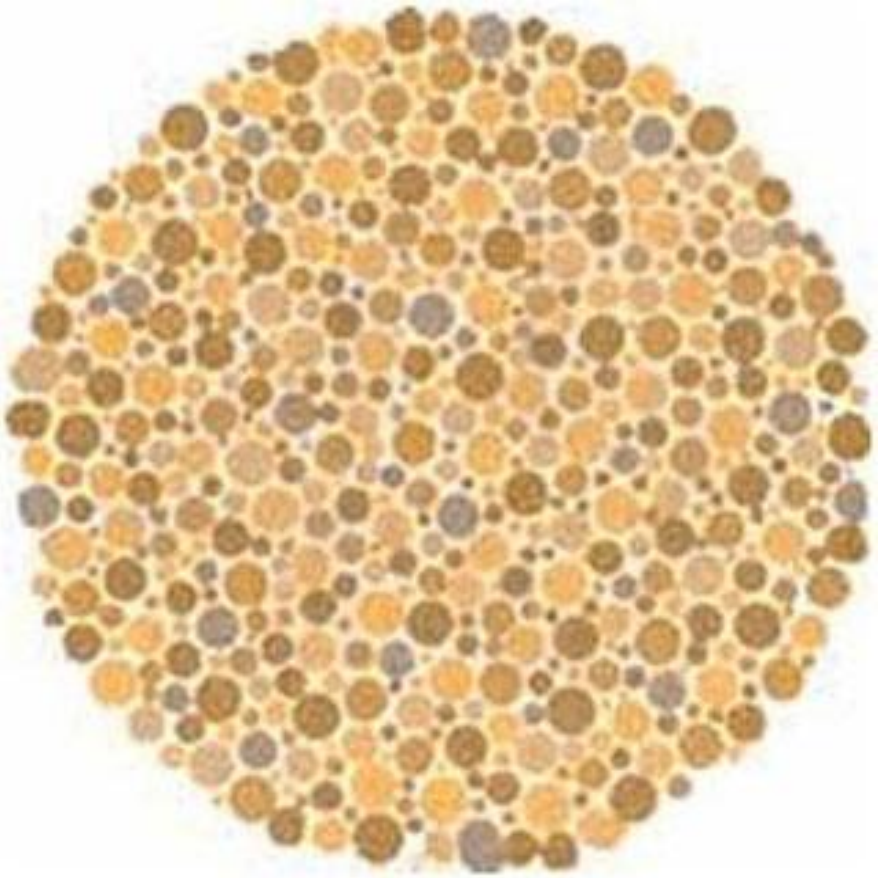
R-G colorblind

Normal

R-G colorblind

Take the test…what do you see?





This is what the test looks like to a person who is red-green colorblind.

X-Linked Dominant*: *DOMINANT trait on the X chromosome.

Females more affected because they have two X chromosomes… more chances to receive the dominant allele.

Example: X'X mom crossed with X'Y dad

X' carries the trait. Set up a Punnett Square:

	X'	X
X'	X'X' Affected female	X'X Affected female
Y	X'Y Affected male	XY Normal male

X-Linked Recessive: ***RECESSIVE*** trait on the X chromosome.

MALES more affected because they only have one X chromosome… no chance of receiving the dominant allele to hide the recessive trait.

Example: Colorblindness…

X'X mom crossed with XY dad

Both parents have NORMAL vision.

	X'	X
X	X'X Carrier female	XX Normal female
Y	X'Y Colorblind male	XY Normal male

What is the probability of a colorblind male?

¼ = 25% X'Y

What is the probability of a colorblind female (X'X')?

0%