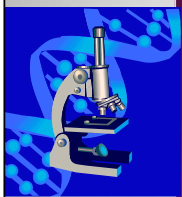
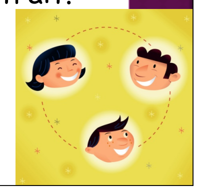


PATTERNS OF HEREDITY

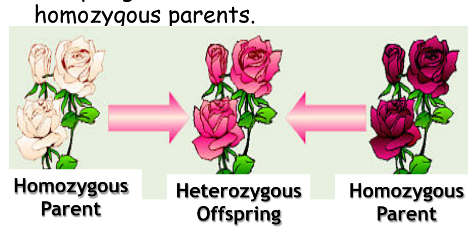
- **<u>Not</u>** all traits are simply inherited by dominant and recessive alleles (Mendelian Genetics).
- In some, neither allele is dominant or many alleles control the trait.



5 DIFFERENT MODES OF INHERITANCE

1. INCOMPLETE DOMINANCE

- *Definition:*
  - Neither allele for a gene **<u>dominates</u>**
  - Phenotype of the heterozygous offspring will be a **<u>BLEND</u>** of the 2 homozygous parents.



INCOMPLETE DOMINANCE

- Ex: A **<u>homozygous</u>** white flower crossed with a **<u>homozygous</u>** red flower will produce all **<u>heterozygous</u>** pink flowers.

INCOMPLETE DOMINANCE

- *Notation:*
  - Alleles are all capital letters because NEITHER one **<u>dominates</u>** the other. So one of the alleles has a **<u>prime</u>** (') on it to represent an alternate expression of the gene.

- Always make a **KEY** to show the genotypes and the resulting phenotypes.

- Still supports Mendel's Law of Independent Assortment

- *Ex. 1) In a certain species of flowers,* ***snapdragons****, the combined expression of both alleles for flower color produces a new phenotype- pink.*
- *A red snapdragon is homozygous and is crossed with a homozygous white snapdragon. What are the genotypic and phenotypic ratios of this cross?*

Key:
Red = RR
White=R'R'
Pink = RR'

P cross = RR x R'R'

	R	R
R'	RR'	RR'
R'	RR'	RR'

G: 100% RR'

P: 100% PINK

- *Ex. 2) Then cross the F_1 generation and what are the genotypic and phenotypic ratios of this cross?*

Key:
Red = RR
White=R'R'
Pink = RR'

P cross = RR' x RR'

	R	R'
R	RR	RR'
R'	RR'	R'R'

G: 1RR:2RR':1R'R'

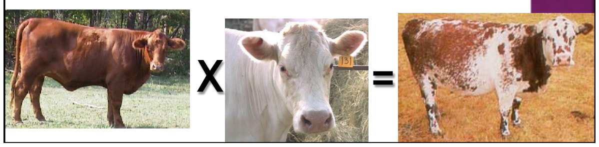
P: 1Red:2Pink:1white

2. CODOMINANCE

- *Definition:*
  - Both **alleles** are expressed **EQUALLY**

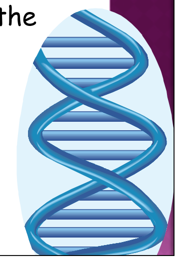
CODOMINANCE

- Phenotypes of heterozygous offspring are showing both traits!
  - Ex: red cows crossed with white will generate roan cows. **Roan** refers to cows that have red coats with white blotches.



CODOMINANCE

- *Notation:*
  - 2 **different** alleles (capital letters) are used
  - Always make a **KEY** to show the genotypes and the resulting phenotypes



- *In chickens, black-feathered is not wholly dominant over white-feathered, so heterozygous chickens are black and white checkered. Cross two heterozygous chickens. What would the appearance of their offspring be?*

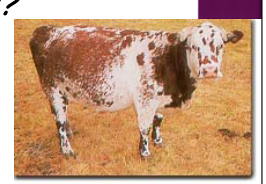
Key:
Black= BB
White= WW
Checkered= BW

P cross = BW x BW

	B	W
B	BB	BW
W	BW	WW

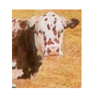
Phenotype:
1Black:
2 Checkered:
1white

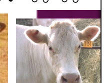
- *In shorthorn cattle, the hybrid between red and white is called a roan. What phenotypes would result in the cross of a roan and a white?*



Key:
Red= RR
White= WW
Roan= RW

P cross= RW x WW





	R	W
W	RW	WW
W	RW	WW

Phenotype:
2 Roan: 2 white

3.MULTIPLE ALLELES

- *Definition:*
  - **More than <u>2 alleles</u>** for a single gene can control a trait.
- Multiple alleles must be studied by looking at the entire population of species.

MULTIPLE ALLELES

- Each individual carries only 2 alleles for any gene (one on each homologous chromosome).
  - In this form of inheritance, a trait can have 1 gene, but **<u>100 alleles</u>** for that gene.

MULTIPLE ALLELES

- Ex: The human blood group can be any combination of A, B, and O

MULTIPLE ALLELES

- The alleles are I^A, I^B, and **i**
  - Alleles <u>**A**</u> and <u>**B**</u> are <u>**CODOMINANT**</u>
  - Alleles <u>**i**</u> ("O") is <u>**RECESSIVE**</u>

- *Notation:*
  - The possible genotypes/phenotypes:

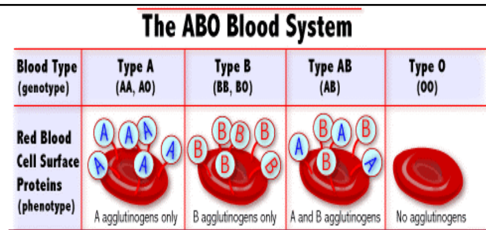
<u>GENOTYPES</u>		<u>PHENOTYPES</u>
Homozygous type A	I^AI^A	type <u>A</u> blood
Heterozygous type A	I^Ai	type <u>A</u> blood
Homozygous type B	I^BI^B	type <u>B</u> blood
Heterozygous type B	I^Bi	type <u>B</u> blood
Codominant type AB	I^AI^B	type <u>AB</u> blood
Recessive type O	**ii**	type <u>O</u> blood

MULTIPLE ALLELES

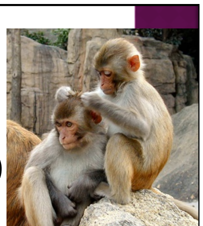
- *<u>NOTE:</u>* the "**i**" is dropped from the genotype of A and B when the **<u>phenotype</u>** is written.
- (Genotype I^Ai is type <u>A</u> blood)

INTERESTING FACT:

- In the U. S., about 45% of the population is type O, 42% type A, 10% type B, and only 3% type AB.



- The positive and negative of a blood type is called the **Rh factor**, it is a totally separate ***gene*** with Rh^+ (RR or Rr) and Rh^- alleles (rr)
  - If you have the protein = Rh +
  - If you DO NOT have the protein = Rh –



- In the U. S., about 85% of the population is Rh^+ and 15% Rh^-.
- Thus the chances of someone being O- [having both ii and rr] would be 45% × 15% = 6.75%.

- The most rare blood type would be **AB-**, about 0.45% of the population.
  - **O** is the universal donor
  - **AB** is the universal receiver

- *1) If a person of blood group AB marries one belonging to group O, what could be the possible genotypes and phenotypes* of their offsprings' blood types?

- P cross = I^AI^B x ii

	I^A	I^B
i	I^Ai	I^Bi
i	I^Ai	I^Bi

Genotypes:
2 I^Ai : 2 I^Bi

Phenotypes:
2 Type A: 2 Type B

- *If a father is homozygous blood type A and the mother is heterozygous blood type B. What could be the possible genotypes and phenotypes of their offspring's blood types?*

- P cross = I^AI^A x I^Bi

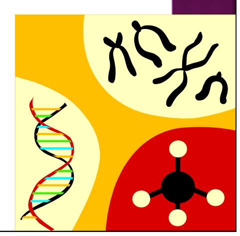
	I^A	I^A
I^B	I^AI^B	I^AI^B
i	I^Ai	I^Ai

Genotypes:
2 I^Ai : 2 I^AI^B

Phenotypes:
2 Type A: 2 Type AB

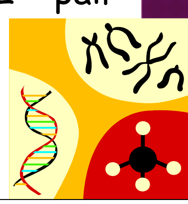
2 Types of Chromosomes:

1. **Sex chromosomes**- last pair of chromosomes—23rd pair for humans
   XX = **female**
   XY = **male**



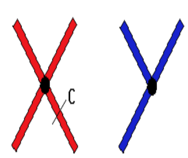
2. **Autosomal chromosomes** or **Autosomes**

- All other pairs of chromosomes – 1 -22nd pair in humans



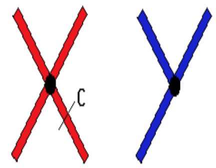
4. SEX-LINKED TRAITS (X-LINKED)

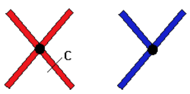
- Other genes besides the alleles for sex are located on the sex chromosomes.



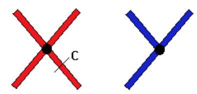
- *Definition:*
- These traits will occur **MORE** frequently in males than females, such as color blindness and hemophilia.

- ***WHY?***
  - Alleles for a gene may be present on the X chromosome but **absent** on the Y. These are called sex-linked genes.

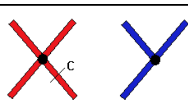




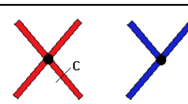
- This means that **males** may inherit just **one** allele for a characteristic and that allele will be expressed, whether it is dominant or recessive, because it is the **only** allele present on their X chromosome.



- X-linked traits most likely will be **RECESSIVE** to the normal condition and the Y chromosome lacks the gene for a trait, so males have a higher chance of having the disorder.

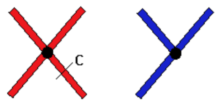


- These traits *generally* do NOT show up in **females** since females have genes on both their X chromosomes.

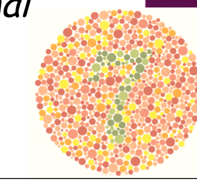


- *Notation:*
  - The alleles for these traits are written as **superscripts** on the **X** chromosome ONLY.

- **No** alleles are written on the Y chromosome!
  - Ex: Colorblind male = X^bY and Normal male = X^BY
- **Heterozygous** FEMALES are known as **carriers**, X^BX^b



- *Ex.1) Color blindness is a sex-linked trait that is caused by a recessive allele. A colorblind man marries a woman that is homozygous for normal vision.*



- P cross X^NX^N x X^nY

	X^N	X^N
X^n	X^NX^n	X^NX^n
Y	X^NY	X^NY

What possible types of vision could be found if they had boys? ***Normal***

What possible types of vision could be found if they had girls? ***Normal***

- *Ex.2) A girl of normal vision, whose father was colorblind, marries a colorblind man. What types of vision could be found in their children?*

- P cross = X^NX^n x X^nY

What types of vision could be found in their children?

	X^N	X^n
X^n	X^NX^n	X^nX^n
Y	X^NY	X^nY

50% Normal vision and 50% colorblindness

5. POLYGENIC INHERITANCE

- Traits are determined by ***MANY genes***
- They may or may not be found on the same chromosome
- Each gene may have more than 2 alleles

- The phenotypes may vary depending on the number of dominant and recessive alleles in the genotype

- Traits that show **great variability** are a result of polygenic inheritance

  - Ex: eye color, skin color, height, facial features

ENVIRONMENT & GENES

- The **environment** can determine whether or not a gene is fully expressed or expressed at all.

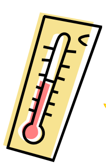
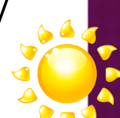
- Internal and external environments can affect phenotypes:

1. Influence of ***internal environment:***

~ **Hormones** based on sexes (testosterone, estrogen)

2. Influence of ***external environment:***

~Temperature
~Light
~Infectious agents (viruses, bacteria)
~Chemicals
~Nutrition



- All of these can influence the expression of genes.