SPECIAL CASES

REVIEW OF MENDELIAN GENETICS

- **In the simplest version of Mendelian genetics, every trait as at least two genes (one version of the gene contributed by each parent).**
  - These genes can either be dominant or recessive.
  - Dominant traits are always expressed as long as at least one of the genes is dominant.
  - Recessive traits are only expressed if both versions of the gene (or both alleles) are recessive.

- **We use Punnett squares to determine what types of offspring are possible from different types of parents.**
  - For example, if both parents are heterozygous (or have both a dominant and a recessive gene), their offspring could have any possible combination of genes.
  - If both parents were homozygous recessive, they could only have offspring that are homozygous recessive. Ditto if they are both homozygous dominant.

- **The Punnett square uses the parents' genotypes (the combination of genes they have) to determine the offspring's genotypes and phenotypes (the physical characteristics they will have due to the combination of genes they inherit).**

MULTIPLE ALLELES

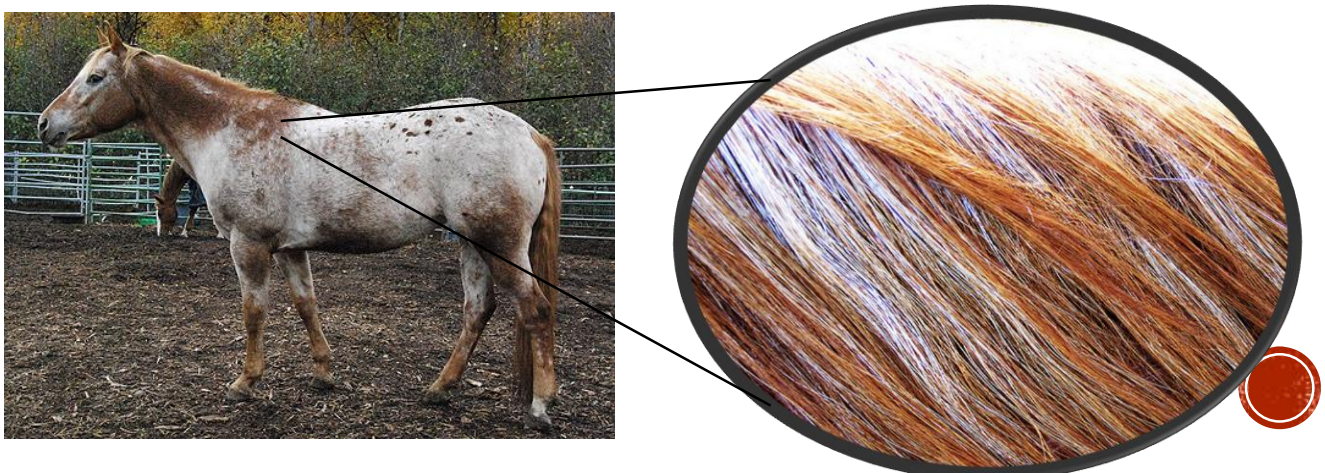
- **In earlier examples, we used simple traits, which only have two alleles. In reality, there can be more than two alleles of some traits.**

- **Ex: there are 3 possible alleles for human blood – A, B, and O.**
  - Different genotype combinations of these types of blood result in different blood type phenotypes.
    - *If both of your parents gave you A alleles, you would have Type-A blood.*
    - *If one parent gave you an A allele and one gave an O allele, you would still have type A blood.*
    - *If one parent gave you an A allele and one gave a B allele, you would have type AB blood.*
    - *If one parent gave you an B allele and one gave an O allele, you would still have type B blood.*

- **The fact that there are 3 alleles of blood means that our simple version of Mendelian genetics is not sufficient to explain this phenomena.**
  - Some genes are a mixture of dominant and recessive, and sometimes more than one gene can be dominant.

CO-DOMINANCE

- **Sometimes two different versions of a gene can *both* be dominant at the same time.**
  - When two different genes are co-dominant, - both genes are dominant and will be equally expressed if they are passed on to offspring.
- **Ex: horses can have what is called a "roan" color.**
  - Roan horses have a co-dominant trait – both the red color and the white color are *equally* dominant.
  - Because both the red color and the white color are equally dominant, they are equally expressed, resulting in a horse that has both red and white hair.

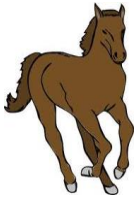


CO-DOMINANCE AND PUNNETT SQUARES

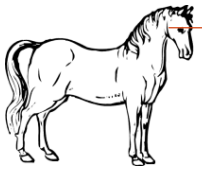
- **Because multiple traits are dominant in co-dominance, each trait needs a capital letter when we use a Punnett square.**
  - Because both traits need a capital letter, we need to use two *different* letters when we are filling in a Punnett square.

- **For example, the white horse below is the father of the foal. The red horse on the right is the mother and the roan foal (baby horse) is on the far right.**
  - Both the white father and the red mother have dominant colors.
  - Because both colors are dominant, they both need capital letters.
  - The Punnett square below shows how we would portray these traits.

Source: http://meadowsranchinc.com/sm06red.jpg



	R	R
W	RW	RW
W	RW	RW



BLOOD TYPE

- **Co-dominance helps to explain why you can have Type-AB blood but <u>not</u> Type-AO or Type-BO blood.**
  - In blood, both Type-A and Type-B blood are dominant.
  - Type-O blood is recessive.

- **The only way to have Type-O blood is to have both recessive Type-O alleles (see the Punnett square below).**
  - If the O allele is paired with an A allele or a B allele, you will have either Type A or Type B blood.

- **Because both A and B are dominant, they are co-dominant.**
  - This means that if both A and B alleles are inherited, that individual will be Type AB.
  - If a heterozygous Type A parent has offspring with a heterozygous Type B parent, they could have offspring with any kind of blood type.

	A	o
B	AB	B
o	A	O

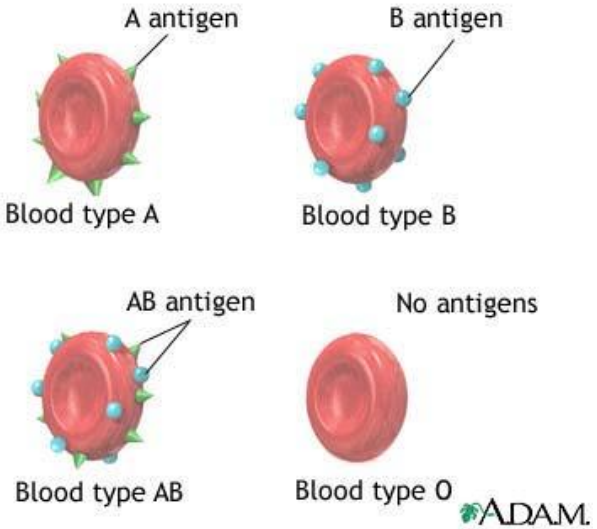
BLOOD DONORS

- **Blood type has a major impact who can donate or receive blood.**
  - Blood type is a reflection of the protein coat found on blood cells.
  - There are three variations of this protein coat:
    - *Type A protein coat.*
    - *Type B protein coat.*
    - *Type O = no protein coat*

- **Blood is kind of "territorial" – if your blood senses that a different kind of blood is present, your body will try to destroy that other kind of blood.**
  - For example, if you have Type-A blood but are given a donation of Type-B blood, your body will try to destroy that donation of blood because it is different.

- **Anyone can receive Type-O blood because it doesn't have a protein coat and is "undetectable" by your body.**
  - However, Type-O patients can only receive Type-O blood – they cannot receive Type A, Type B, or Type AB blood or their body will try to fight it.

- **Type AB blood can receive any kind of blood – A, B, O, or AB.**
  - However, an AB person can only donate to another AB person.

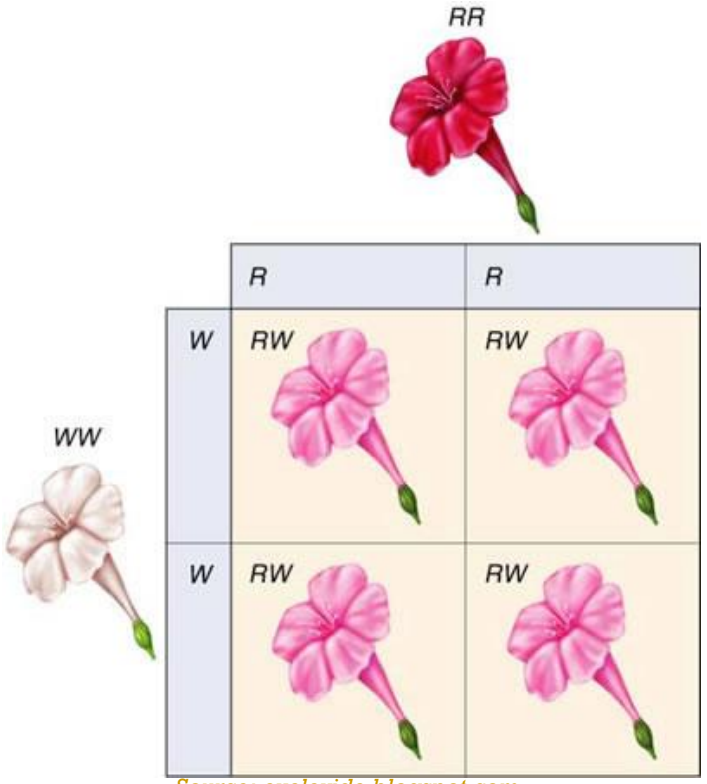


Source: health.kernan.org

INCOMPLETE DOMINANCE

- **Sometimes we can have two traits where *neither* of the traits is completely dominant.**
  - If *neither* of the traits are dominant, both will sort of *blend* with each other to create a mix of the two traits.
  - Incomplete dominance is when neither trait is fully dominant, resulting in a mixture of the two traits.

- **For example, if a tulip flower is red and the other flower is white, they may have offspring that have a mix of both of their traits – pink.**
  - If red and white parents have offspring, neither parent will contribute a gene that is dominant.
  - As a result, the red and white traits will "mix" to create pink offspring.

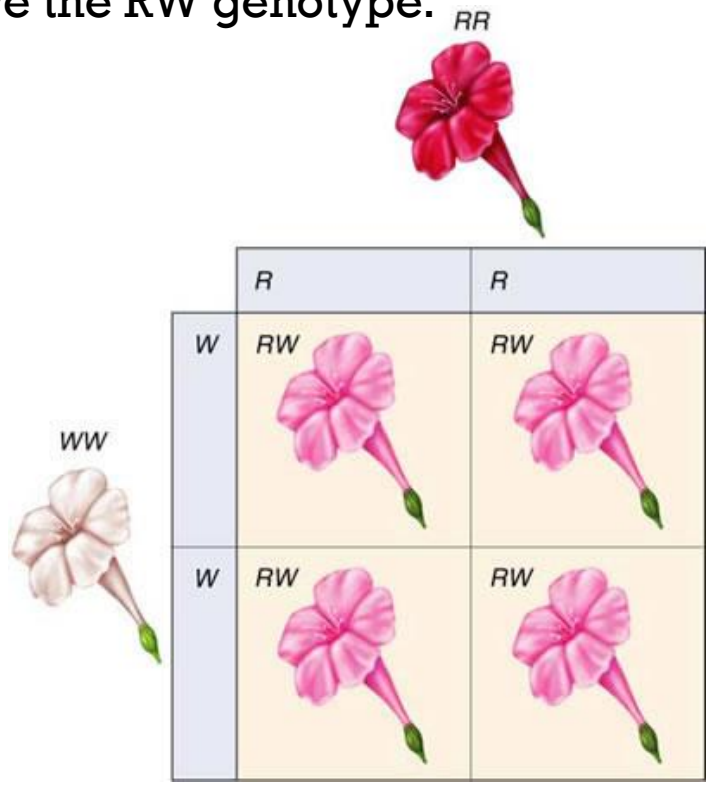


Source: ayalavida.blogspot.com

INCOMPLETE DOMINANCE & PUNNETT SQUARES

- **In Incomplete Dominance, the Punnett square will again involve two different letters.**
- **In this case…**
  - White flowers have the genotype WW (but are not totally recessive).
  - Red flowers have the genotype RR (but are not totally dominant).
  - The pink heterozygous offspring have the RW genotype.

	R	R
W	RW	RW
W	RW	RW



Source: ayalavida.blogspot.com

CO-DOMINANT VS. INCOMPLETE

- **Co-dominance and incomplete dominance can be easy to mix-up (they even kind of sound and look the same).**

- **An easy way to remember which is which is by using the following mnemonic:**
  - Co-Dominant: Both dominant.
    - *A black parent and a white parent will have black and white offspring →*
    - *Both black and white will be expressed because both are dominant.*

  - Incomplete is In-Between
    - *A black parent and a white parent will have gray offspring.*
    - *Gray is expressed because it is "in-between" the two incompletely dominant traits.*

Source: www.reddit.com