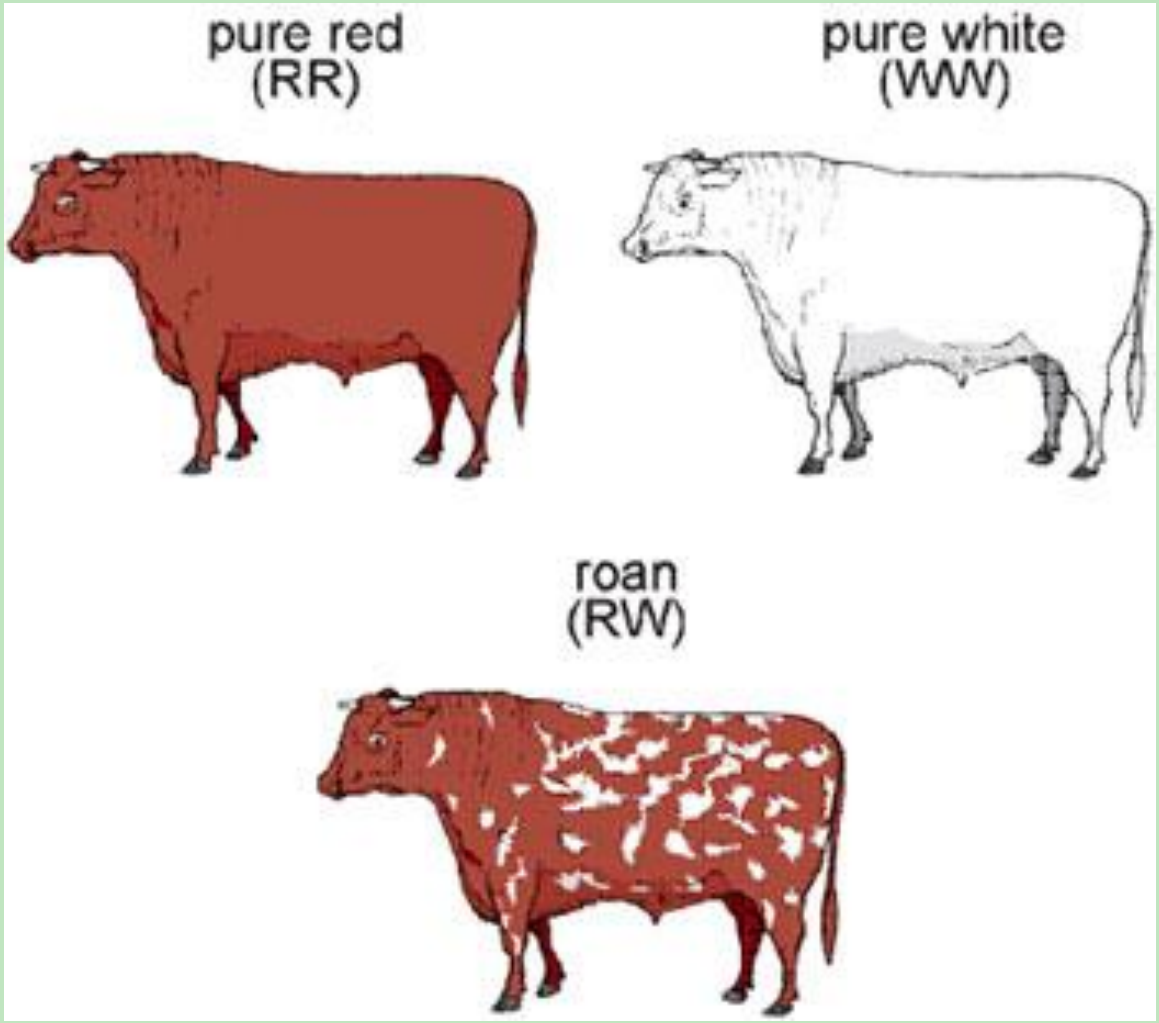
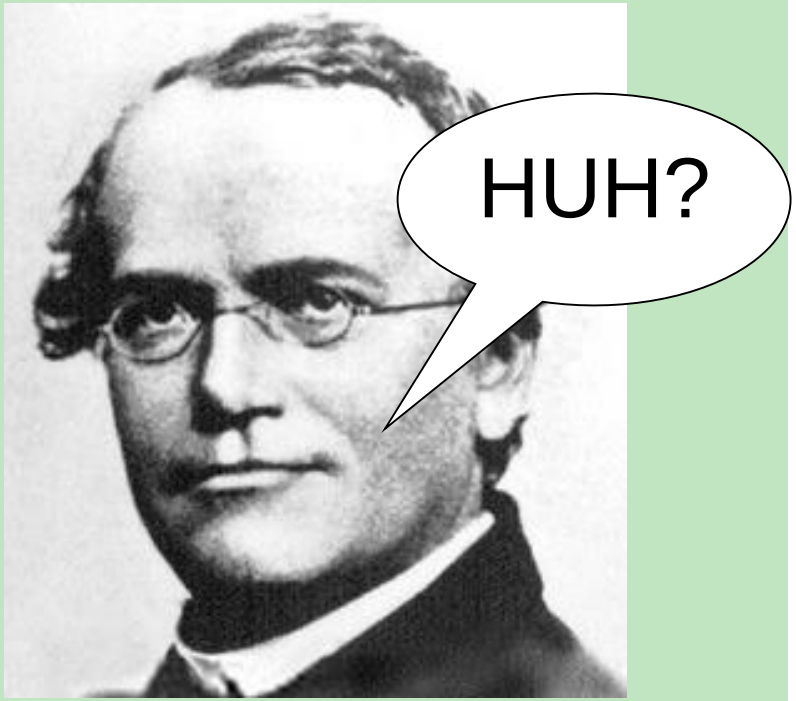
Genetics beyond Mendel



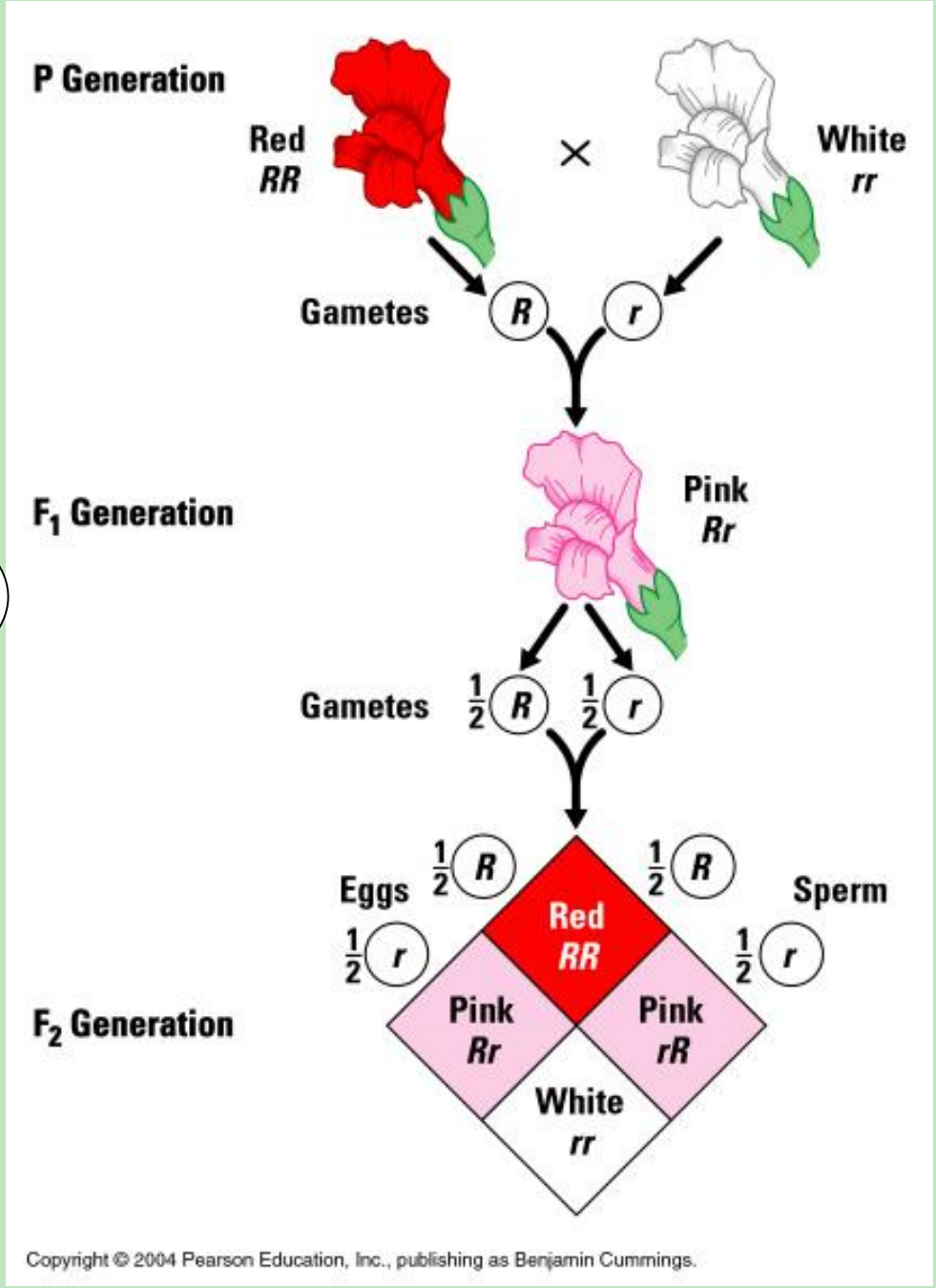
Some exceptions to Mendel's principles:

- Some alleles are **neither** dominant nor recessive.
- Many traits are controlled by **more than one gene** (polygenic traits)

- Snapdragons



http://www.dobermann-review.com/info/genetics/mendels_genetic_laws/Gregor%20Mendel.jpg



http://faculty.pnc.edu/pwilkin/incompdominance.jpg

Today's Goal:

Explain the difference:

incomplete dominance	co-dominance

Incomplete Dominance

- Neither allele is dominant
- When two different alleles are present → a new - intermediate phenotype which is a mixture (blending) of the two
- (Straight hair + curly hair → wavy hair)

Incomplete Dominance

Neither allele is dominant

When two different alleles are present → an intermediate phenotype which is a mixture (blending) of the two

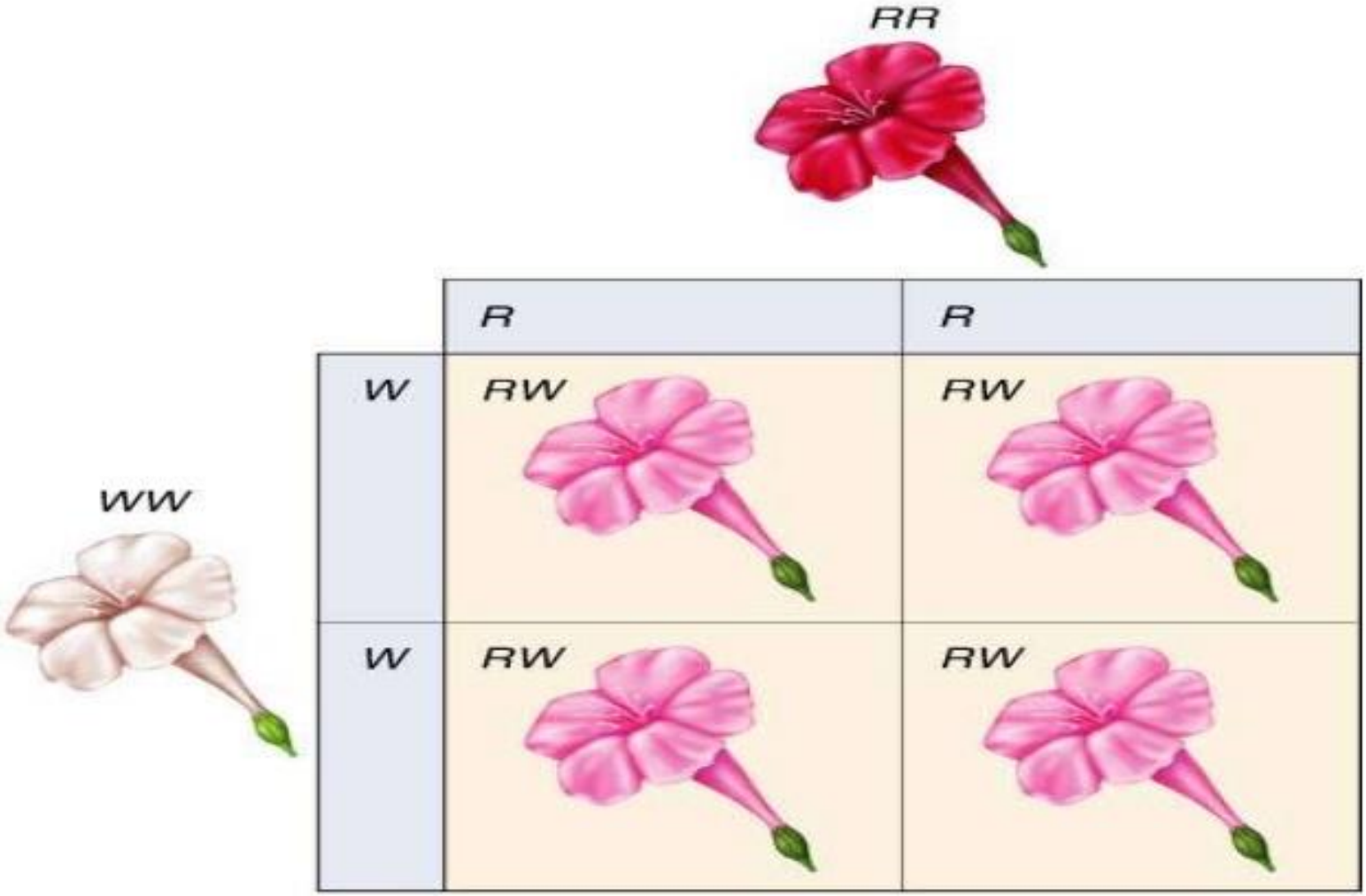
Four-o’ clock flowers

- Incomplete dominance
- Neither Red (R)
- or White (W) is dominant

When a homozygous red flower (RR)

Mix with a homozygous white flower (WW), the alleles blend in the hybrid (RW) to produce pink flowers - so they have 3 phenotypes

Incomplete Dominance



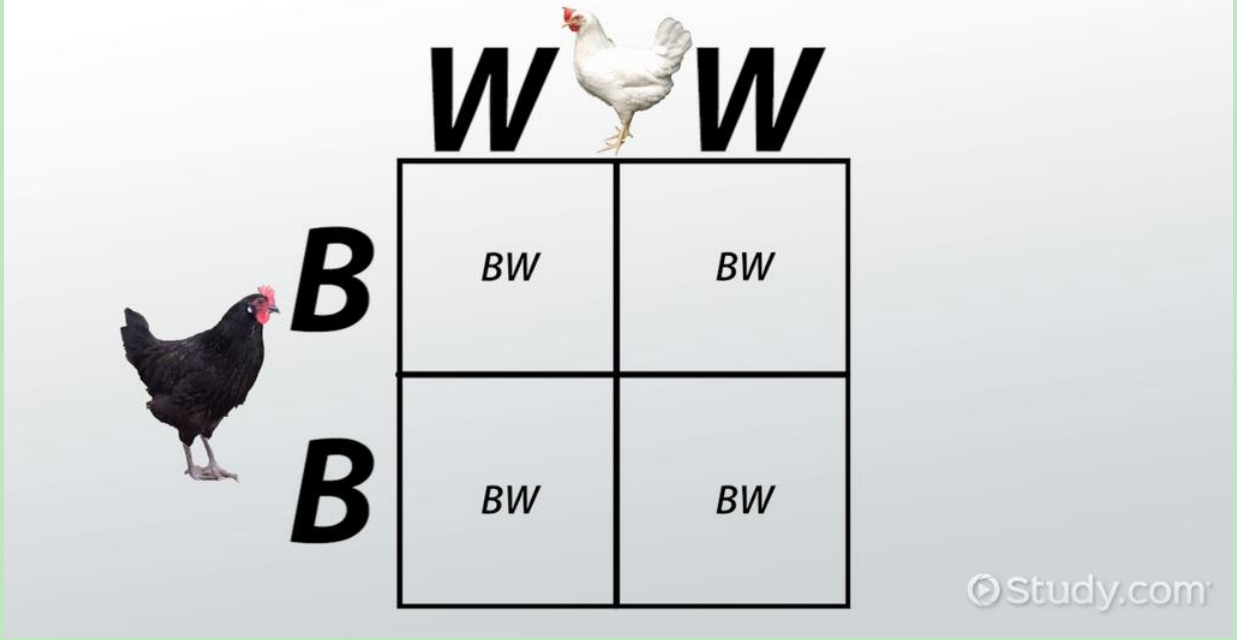
Andalusian Chickens

- Incomplete dominance
- Neither Black (B) or

White (W) are dominant

The offspring of a black feathered chicken (BB) and a white feathered chicken (WW) are blue (BW)

EXAMPLES



			
Phenotype	White	Black	Speckled
Genotype	WW	BB	BW

Codominance

- Two alleles both are present in the phenotype
- Usually signified using superscripts.
- example: color of hair coat in cattle.
- $c^r c^r$ = red hairs
- $c^w c^w$ = white hairs
- $c^r c^w$ = roan coat (mixture of both colors)
- heterozygous phenotype (e.g. RW) you will see both phenotypes clearly visible (will see red and white)

Shorthorn Cattle

- Co- dominance
- Homozygous red (RR)
- Homozygous white (WW)

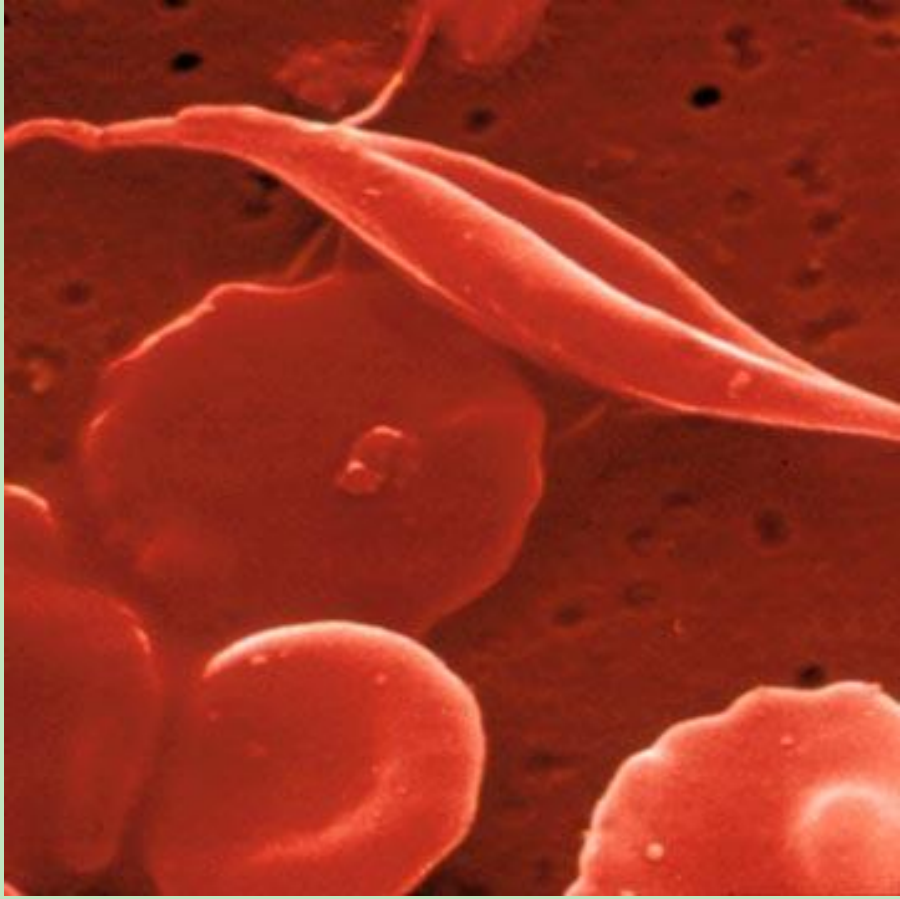
The offspring of will have red hairs and white hairs (RW) (sometimes called Roan)

Roan Horse : Note – both red and white hairs

Codominance in flowers

Note:
Both Pink and white petals can be seen

Sickle- Cell Anemia



- Co- dominance
- Caused by an abnormal

Hemoglobin, the protein that red blood cells use to carry oxygen

Normal hemoglobin is (RR)

Sickle Cell shaped blood cells (SS)

People who are carriers (heterozygous) for the disease there is a mixture of both normal and sickle cell (RS)

Problem: Codominance

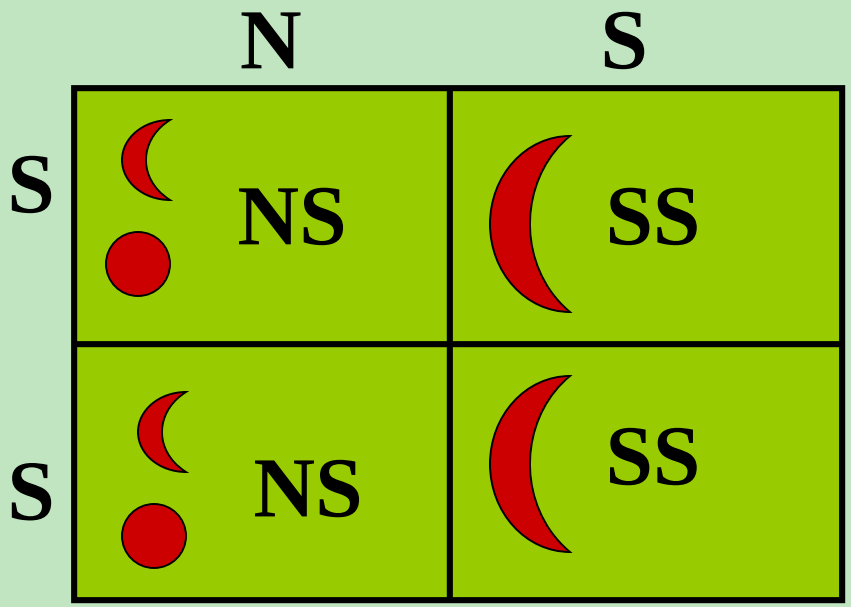
- Show the cross between an individual with sickle-cell anemia and another who is a carrier but not sick.

GENOTYPES:

- NS (2) SS (2)
- ratio 1:1

PHENOTYPES:

- carrier (2); sick (2)
- ratio 1:1



Let's Stop and Think…

- Let's say there are two alleles for the hair color trait- red and blue

  - What would be the resulting phenotype of a heterozygous pair if the alleles showed <u>incomplete</u> <u>dominance</u>?
    - A. Red
    - B. Blue
    - C. Purple
    - D. Red and Blue patches

    - Answer - purple

Let's Stop and Think…

- Let's say there are two alleles for the hair color trait- red and blue

  - What would be the resulting phenotype of a heterozygous pair if the alleles showed codominance?
    - A. Red
    - B. Blue
    - C. Purple
    - D. Red and Blue patches
    - **Red and Blue patches**

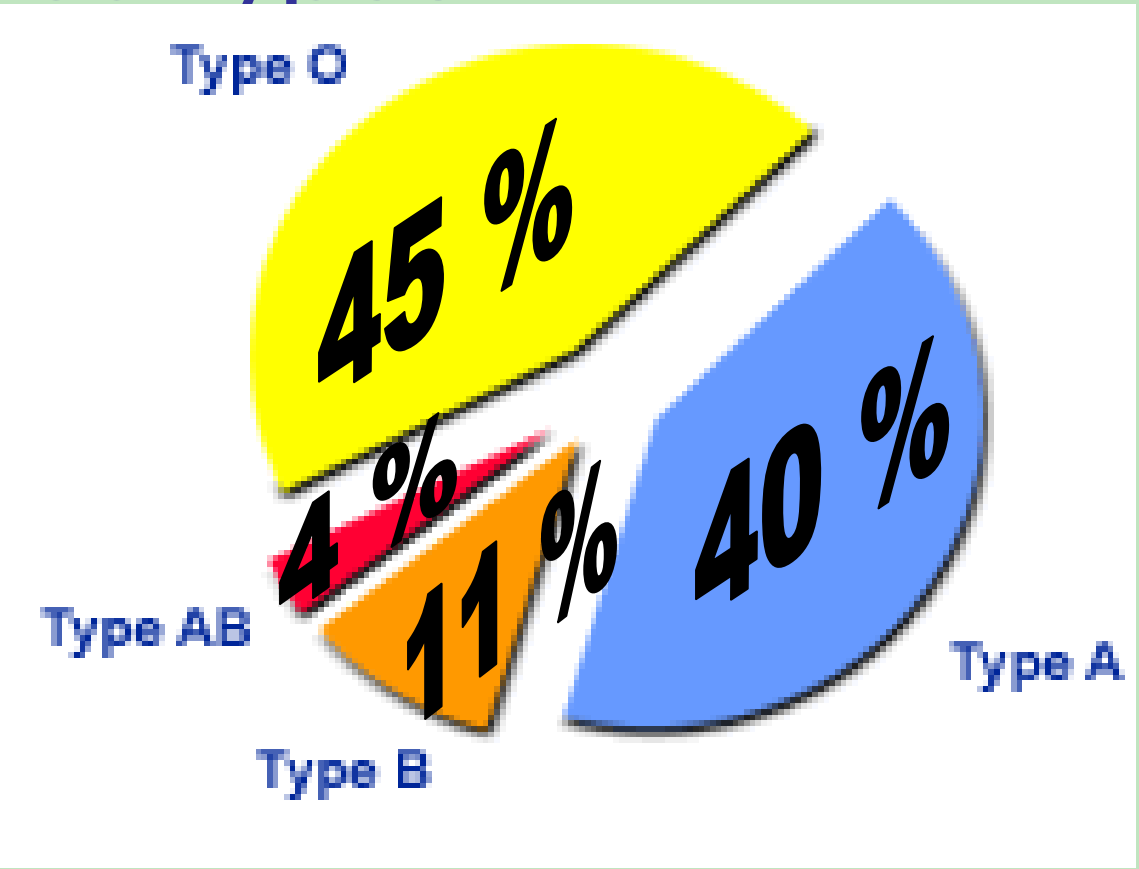
MULTIPLE ALLELISM

- When there is more than 2 alleles possible for a given gene.
- Allows for a larger number of genetic and phenotypic possibilities.
- Human blood types: A,B,O and AB

How common are the different blood types?

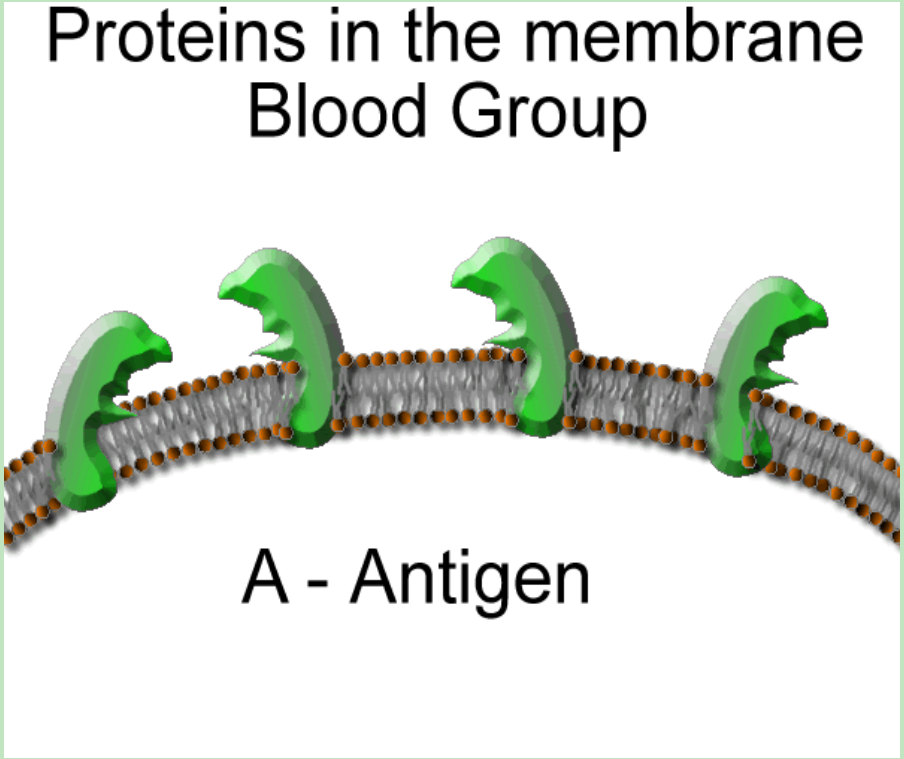
A and B are codominant to each other.

Both A and B are dominant over O.

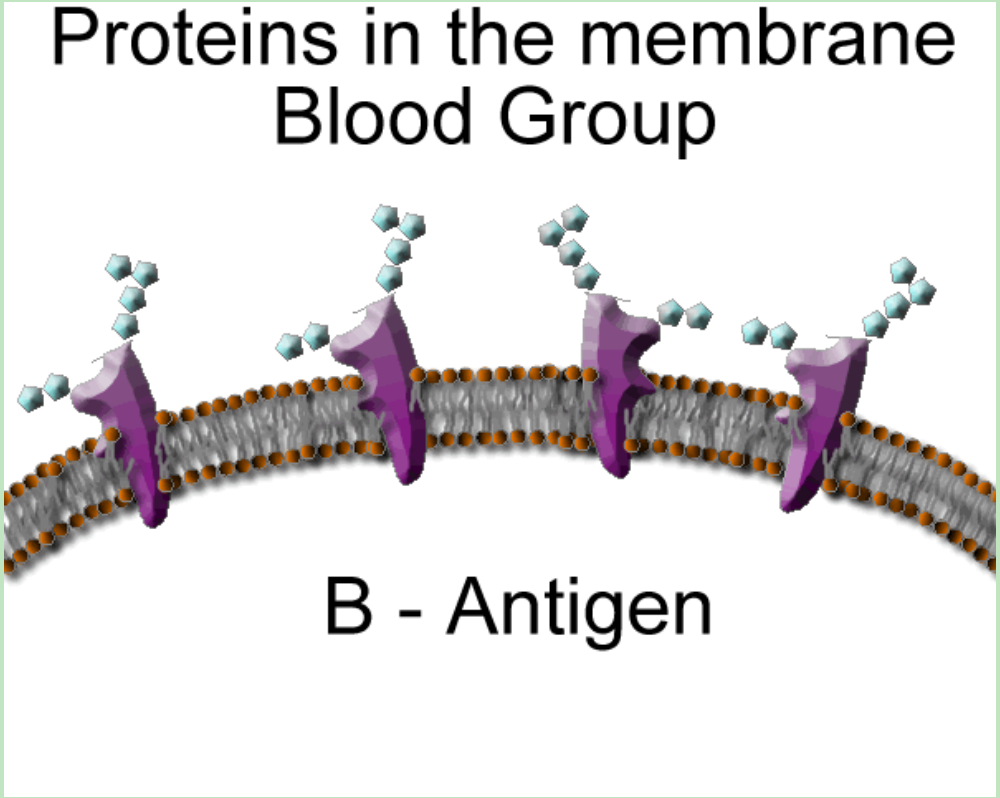


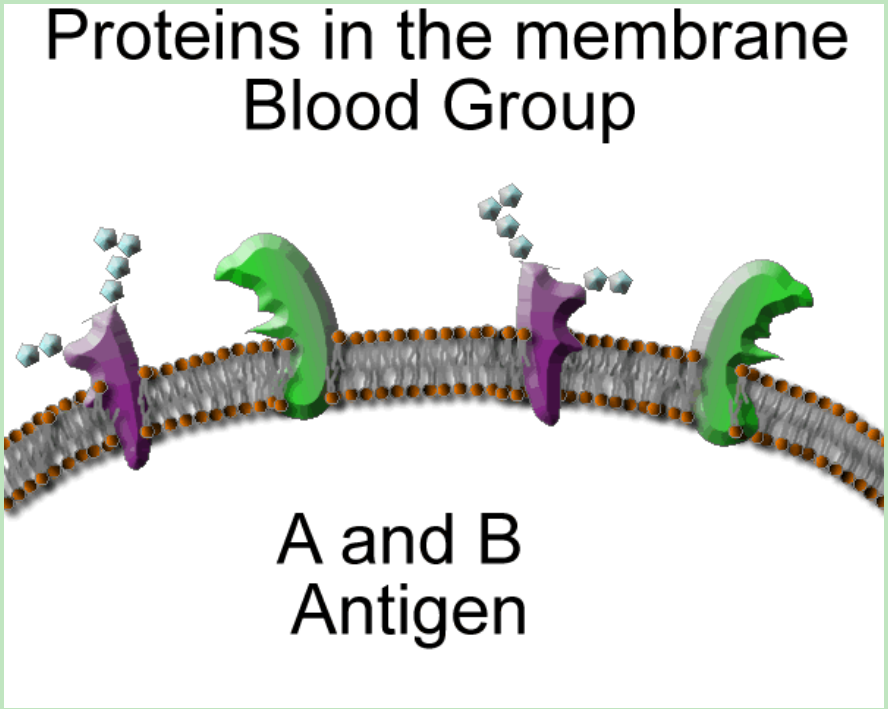
Human Blood types:

- TYPE A
- Allele = I^A
- Red Blood cells have type A antigens (proteins) on the surface.

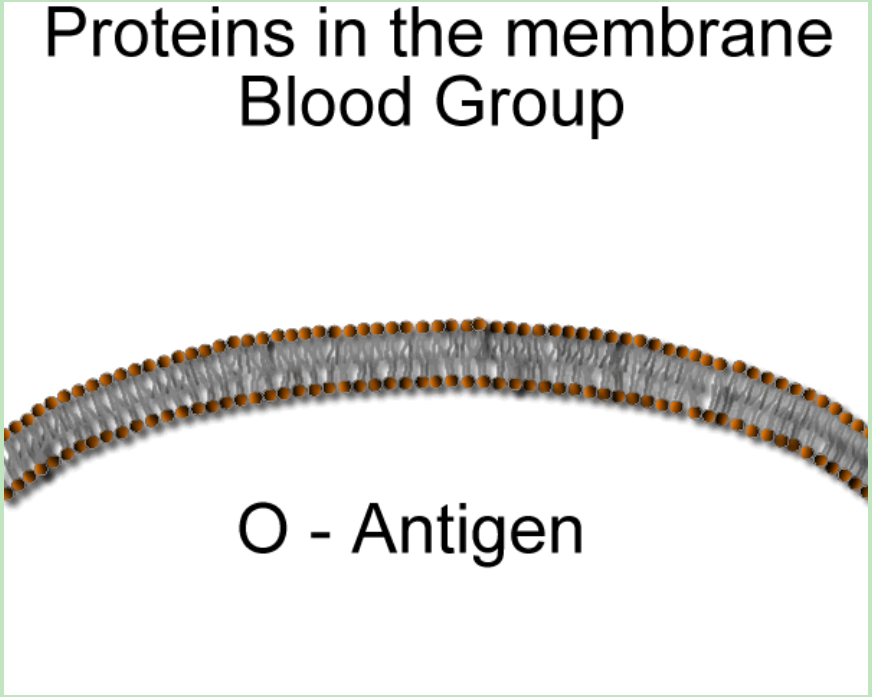


- TYPE B
- Allele = I^B
- Red Blood Cells have type B antigens (proteins) on their surface



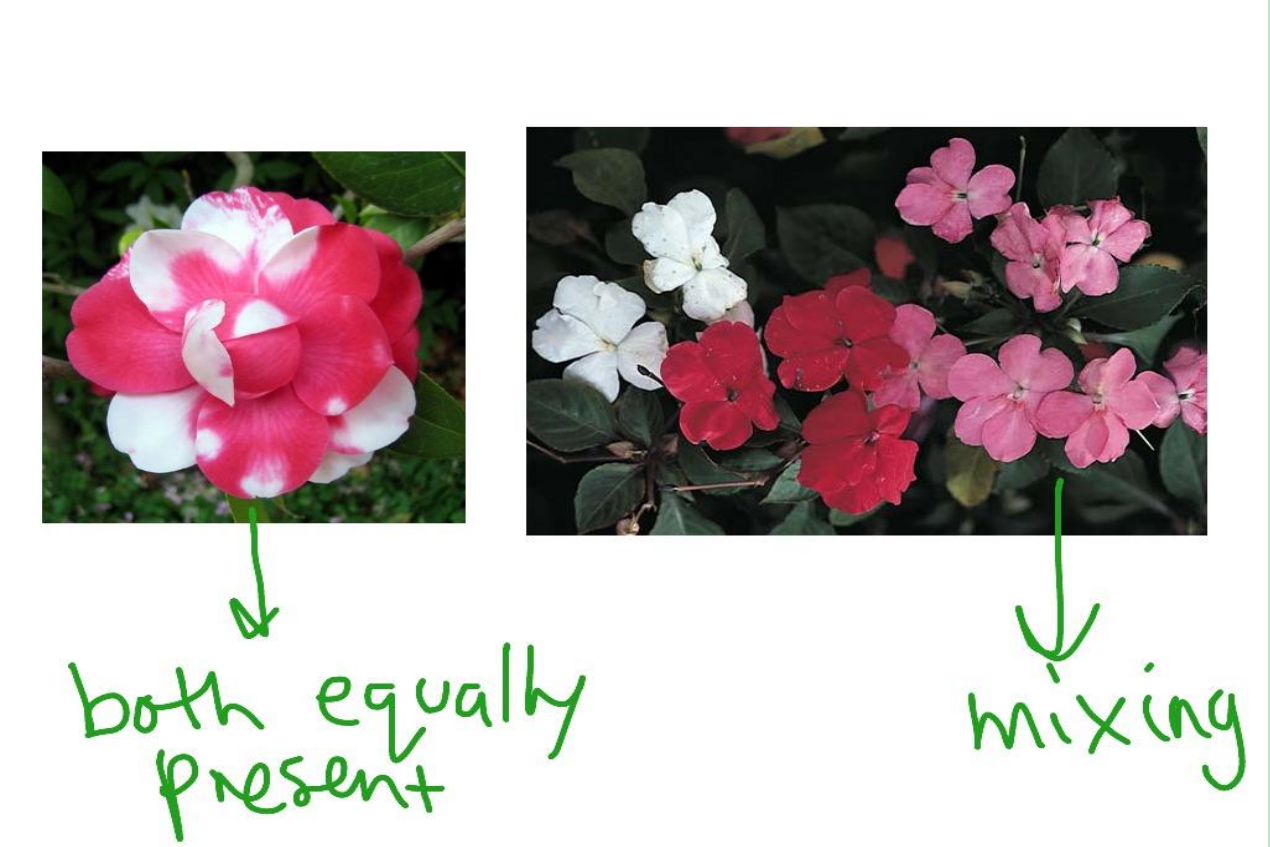


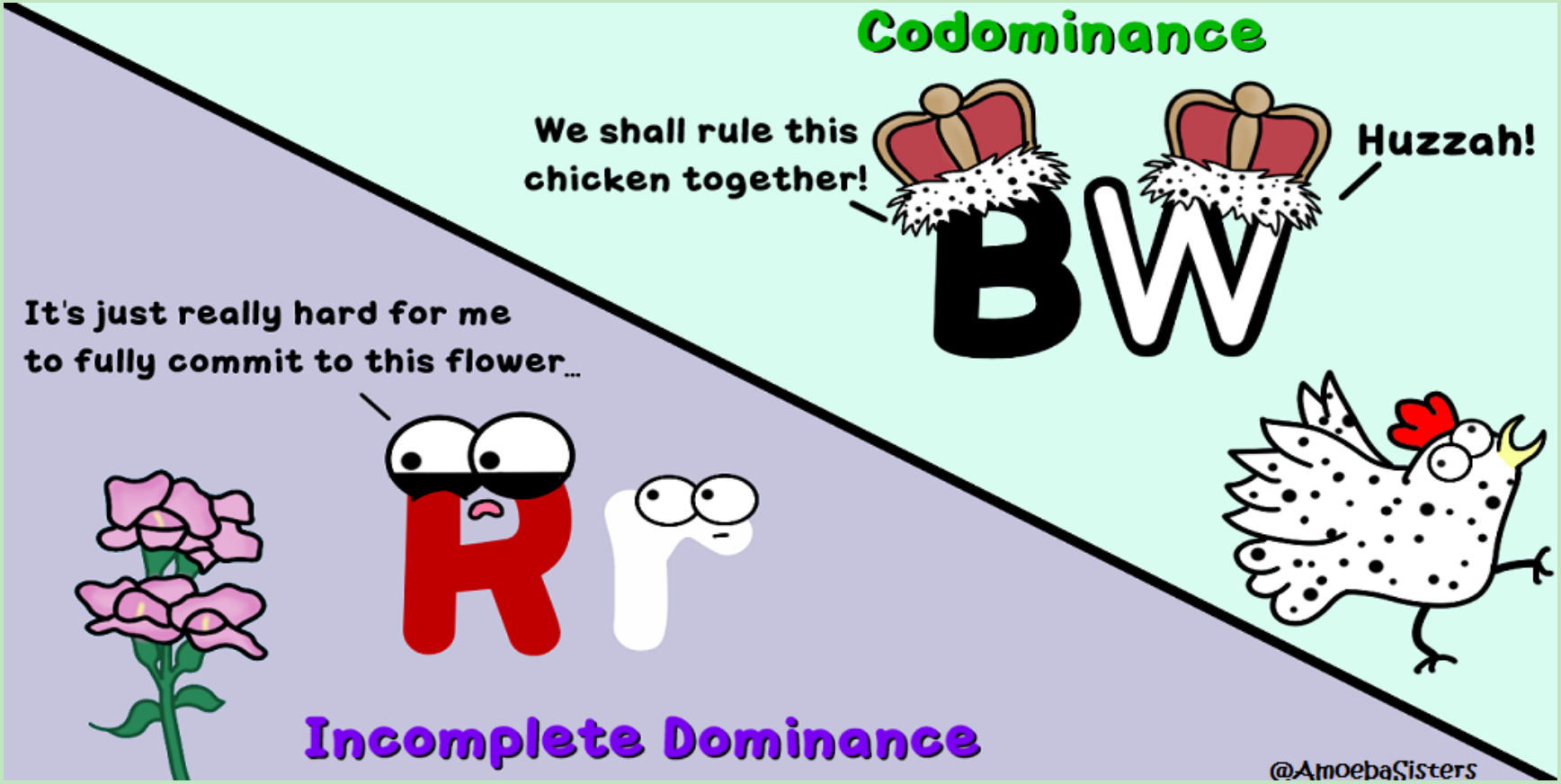
- TYPE AB
- genotype = $I^A I^B$
- Blood cells contain both types of antigens (proteins)
- A and B are ….
- Codominant



- TYPE O
- Allele = i
- No antigens (proteins) on the surface of the blood cells
- i is recessive to A and B

Which is co-dominance?
Which is incomplete dominance?




Codominance
We shall rule this chicken together!
Huzzah!
B W
It's just really hard for me to fully commit to this flower...
R r
Incomplete Dominance
@AmoebaSisters

PRACTICE QUESTIONS

1. In a certain case a woman's blood type was tested to be AB. She married and her husbands blood type was type A. Their children have blood types A, AB, and B. What are the genotypes of the parents?

Mom - $I^A I^B$

Dad – $I^A i$

2. In a certain breed of cow the gene for red fur, ***R***, is **codominant** with that of white fur, ***W***. What would be the genotypes and phenotypes of the offspring if you breed a red cow and a white bull?

Genotypes – all red and white

Phenotypes – all roan (some red and some white hairs

What would they be if you breed a red & white cow with a red & white bull?

Genotypes – 1 red, 2 red and white, 1 white

Phenotypes -1 red, 2 roan (red and white), 1 white

3. A rooster with grey feathers is mated with a hen of the same phenotype. Among their offspring 15 chicks are grey, 6 are black and 8 are white. What is the simplest explanation for the inheritance of these colors in chickens?

As there are three phenotypes, this is likely incomplete dominance, with the grey rooster being a blend of the black and white – genotype BW

b. What offspring would you expect from the mating of a grey rooster and a black hen?

50% of young will be BB (black) and 50% of the young would be BW (grey)

- A man with type AB blood marries a woman with type B blood whose father has type O blood. What are the chances that they have a child with type A blood?
- 50% chance of A type blood (1 AO and 1 AA)
- Type AB?
- 25% chance of AB blood