# Fundamentals of Genetics

Genetics- the science of heredity.

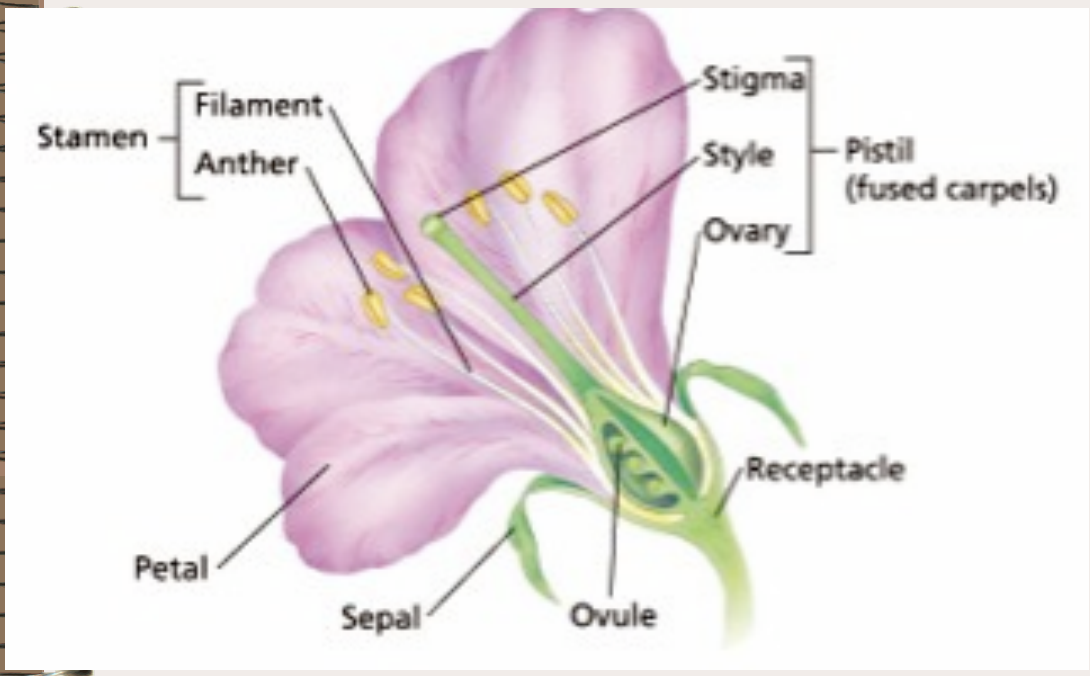
Gregor Johann Mendel- "Father of Genetics"




1. Heredity -the passing of traits from parents to offspring

a. Gregor Mendel- mid 1800's Austrian monk studied *Pisum sativum* - inherited traits.

b. Crossed plants that were "pure" for different traits- offspring were hybrid

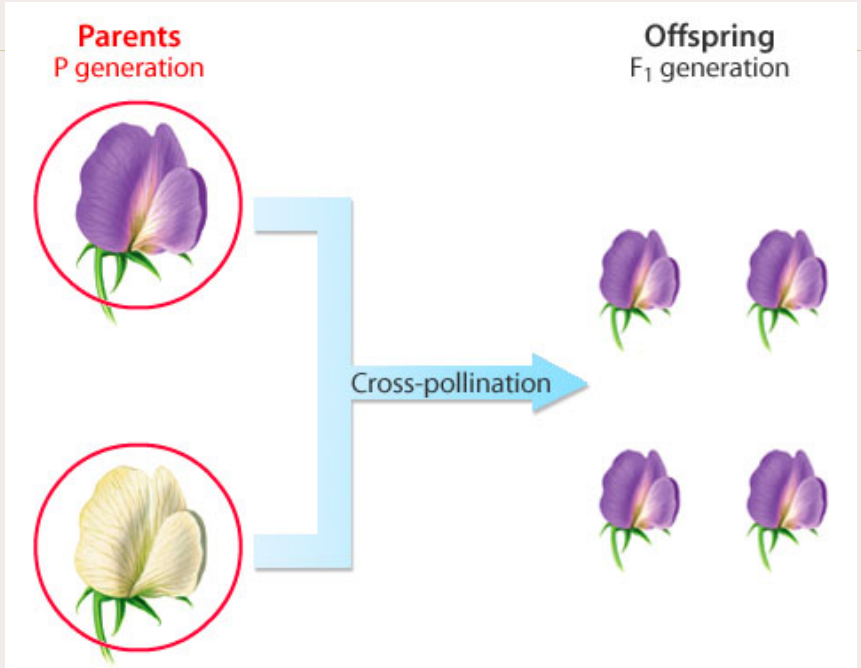




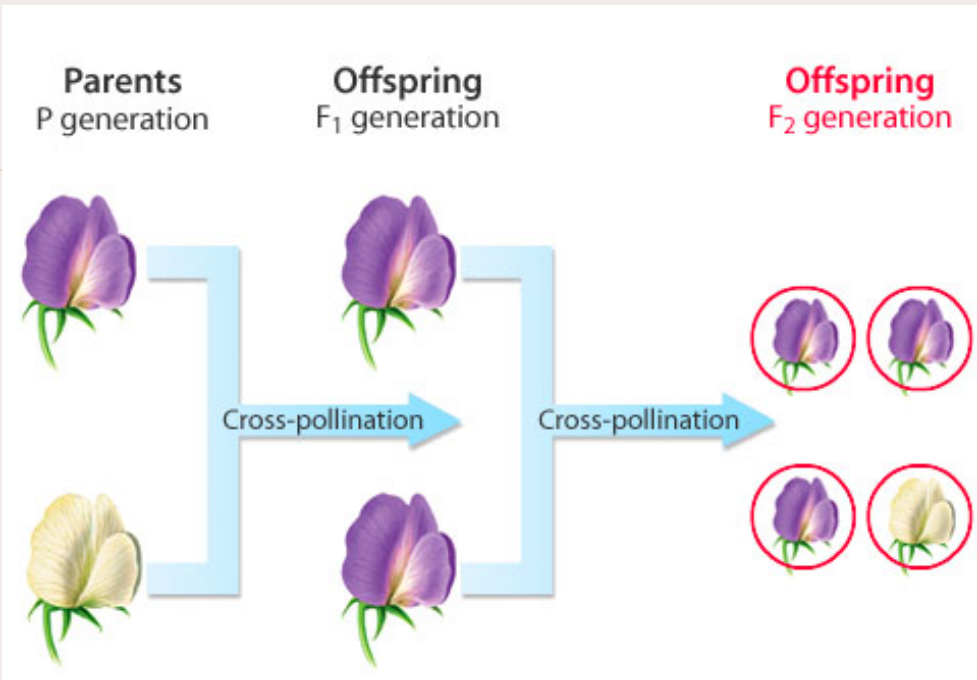

# 2. Sexual Reproduction in plants (book page 696-697)

a. Male parts- stamen (filament & anther)
b. Female parts- pistil (stigma, style, ovary)

# P generation






$F_1$ and $F_2$ Generations

## 3. Generations

a. P=Parental / purebred.

b. $F_1$ =filial (son) - produced from P x P "pures" with opposing traits.

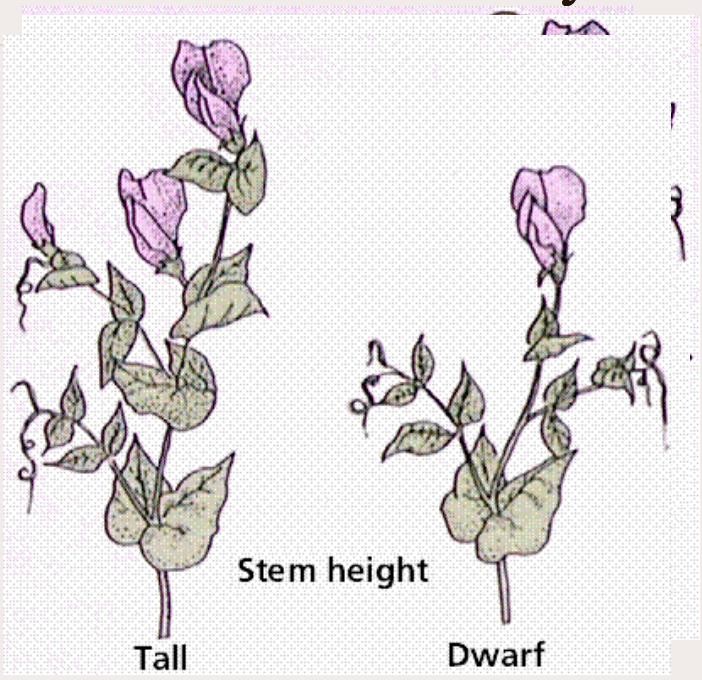
c. $F_1$ plants – showed dominant trait only

d. $F_2$ plants- from $F_1$ cross

showed a 3:1 ratio of dominant to recessive traits



## Other traits observed by Mendel



## 4. Mendel's Hypotheses.

a) For each trait, 2 copies of alleles; one from each parent.

b) Allele ("factors")- different form of a gene

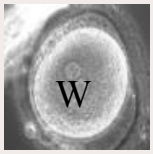


## 4. Mendel's Hypotheses, continued

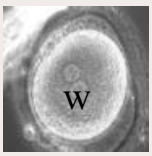
c) If 2 different alleles occur, one may be dominant over the other- Principle of dominance

d) gametes carry one allele for each trait

Ww




OR



b. homozygous

c. heterozygous

## 5. Representing Alleles

Allele-

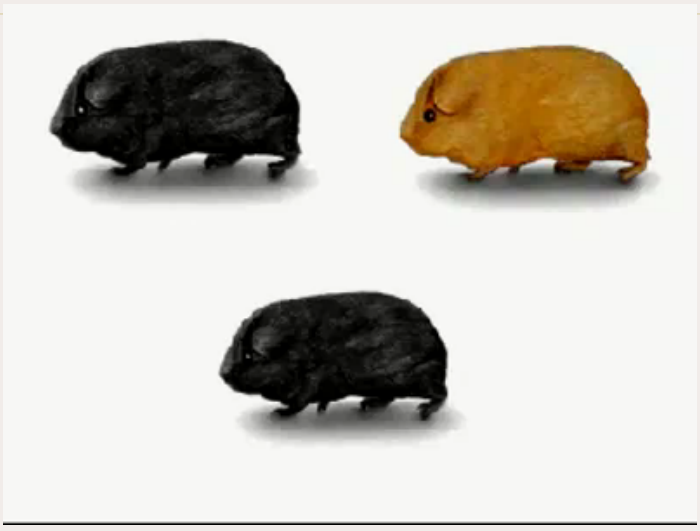
a. define

d. Genotype & genome

e. phenotype



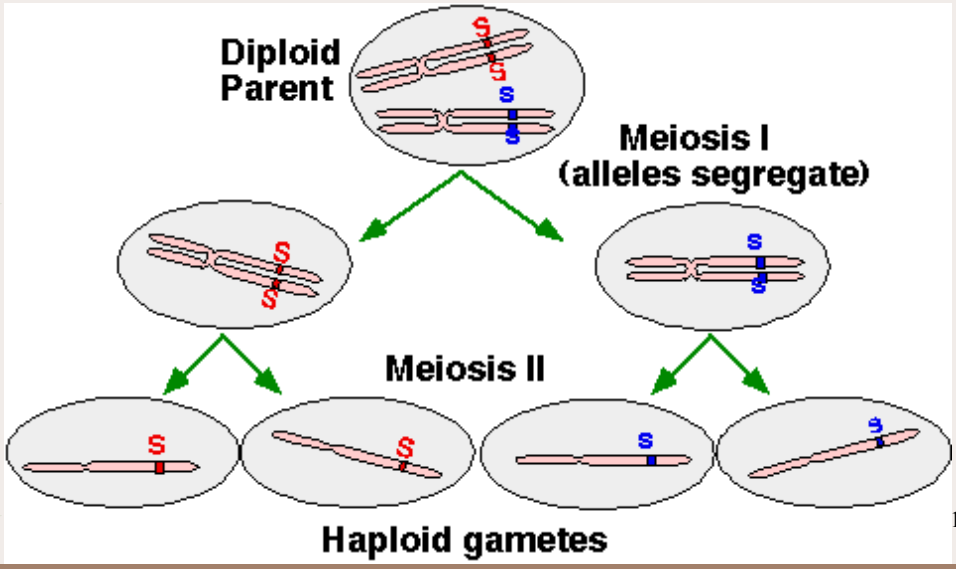
# Genotype



Q. What is the phenotype of the offspring?

6. Two laws of heredity.

a. The Law of Segregation - alleles separate when gametes are formed.

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6. Laws, continued

b. Law of Independent Assortment- alleles for different traits will separate without influencing each other when gametes are formed

Visual Concept

# Mendel Factors

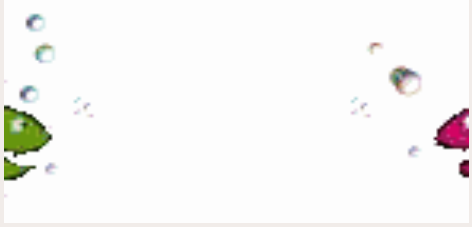
Visual Concept



7. Punnett square - diagram that predicts the outcome of a genetic cross.

a) one trait (4 boxes)

b) two traits (16 boxes)

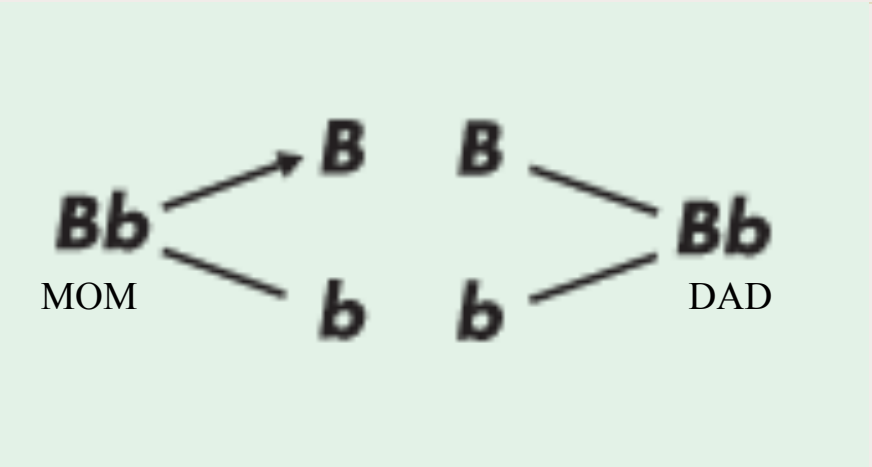


# How To Make a Punnett Square for a One-Factor Cross Page 316

- Write the genotypes of the two organisms that will serve as parents in a cross.
- In this example we will cross a male and female osprey that are heterozygous for large beaks. GIVEN: They each have genotypes of *Bb.*
- ***Bb AND Bb***



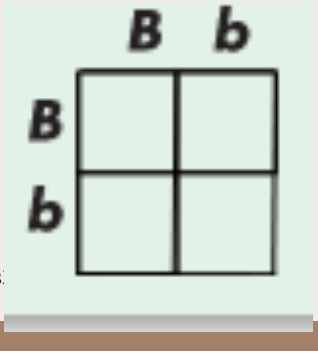
# Determine the alleles that the parents could contribute




No need to write it, it's on page 316

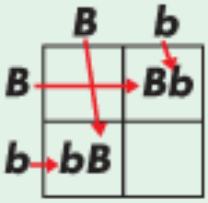
Draw a table with enough squares for each pair of gametes from each parent. In this case, each parent can make two different types of gametes, "B" and "b". Enter the genotypes of the gametes produced by both parents on the top and left sides of the table.

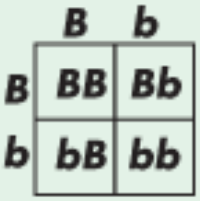
TIP for understanding: consider the top, the male parent's gametes, the side the female parent's gametes.






Fill in the table – this shows how the gametes can combine to make offspring



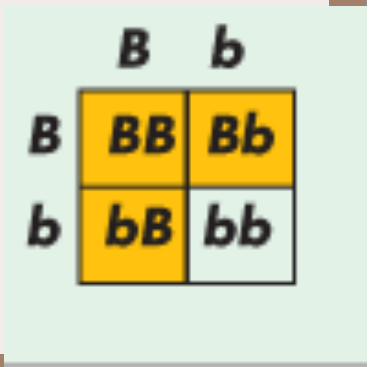




TIP for Understanding: It's conventional to put the capital letter first: Bb (not bB), though it means the same thing

Question: Whose alleles are inside the box?

# INTERPRET!

Determine the genotypes and phenotypes of each offspring.
Calculate the percentage of each. In this example, three fourths of the chicks will have large beaks, but only one in two will be heterozygous.
(How many are pure?)
(How many are recessive?)






**Example**
Cross two pea plants: one homozygous for purple flower with one homozygous for white flowers

**Monohybrid Cross**

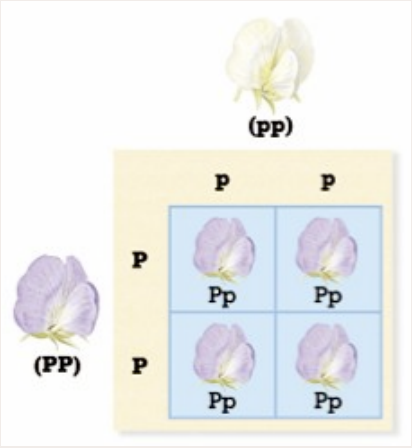
**PP x pp**

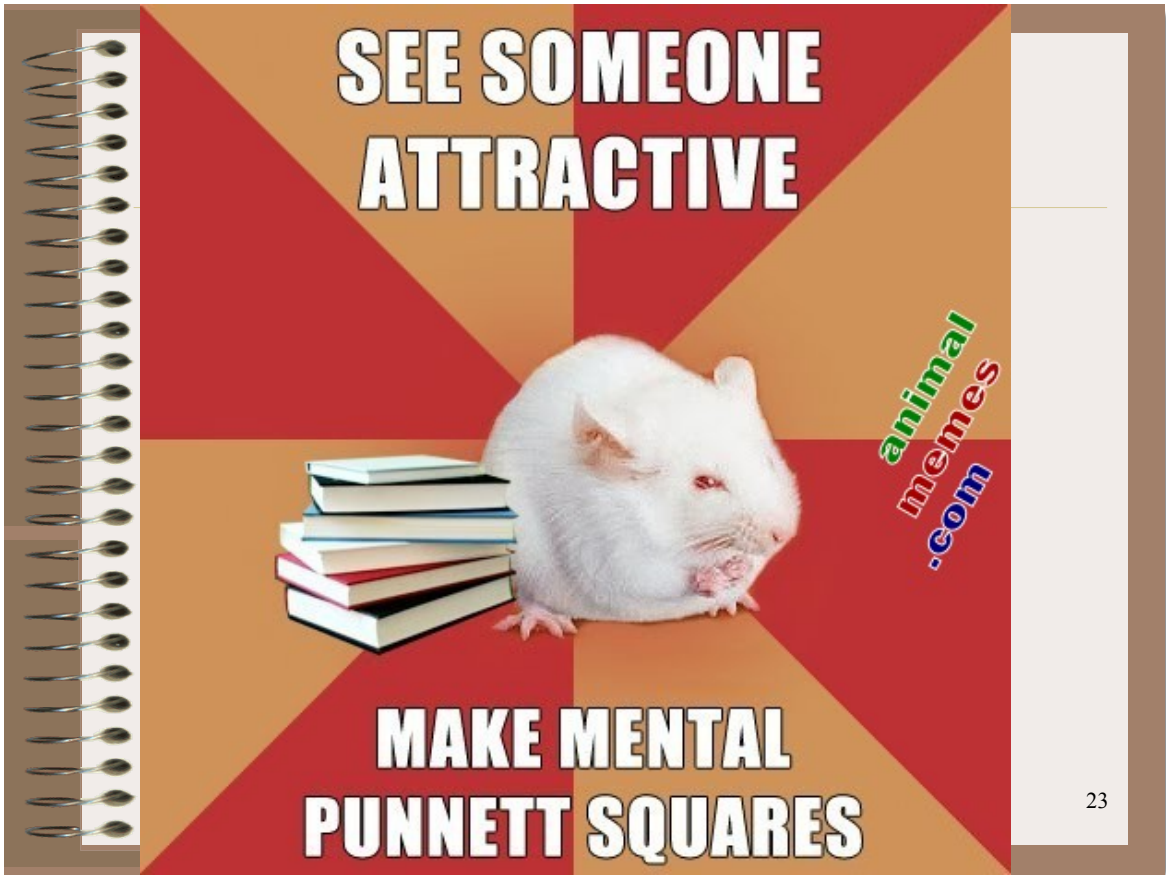
**Homozygous plants**

**What generation is outside the box?**

**How about inside the box?**

**When, if ever, does white come back?**








# Test Cross

- This yellow pea seed….is it Yy or YY?

Visual Concept

## 8. Dihybrid crosses involve two pairs of contrasting traits (see page 316 textbook)

a) Start with the parents genotypes & figure out possible gametes.

b) Be sure that each gamete combination has only one allele from each trait.

c) Set up a Punnett square with spaces for 16 offspring.

d) Be sure that each offspring predicted has two copies of each allele for both traits.

e) Interpret results



## Q. List gamete combinations possible for each of the genotypes listed below:

| Two traits A&B | Sex cell (gamete) contains: |
|---|---|
| AaBB | AB or AB or aB or aB |
| aaBB | aB or aB or aB or aB |
| AaBb | AB or Ab or aB or ab |

## Dihybrid Cross – Cross 2 pea plants heterozygous for size (Tall T- short t) and pod color Green G and Yellow g) TtGg & TtGg

| | TG | tG | Tg | tg |
|---|---|---|---|---|
| TG | TTGG | TtGG | TTGg | TtGg |
| tG | TtGG | ttGG | TtGg | ttGg |
| Tg | TTGg | TtGg | TTgg | Ttgg |
| tg | TtGg | ttGg | Ttgg | ttgg |

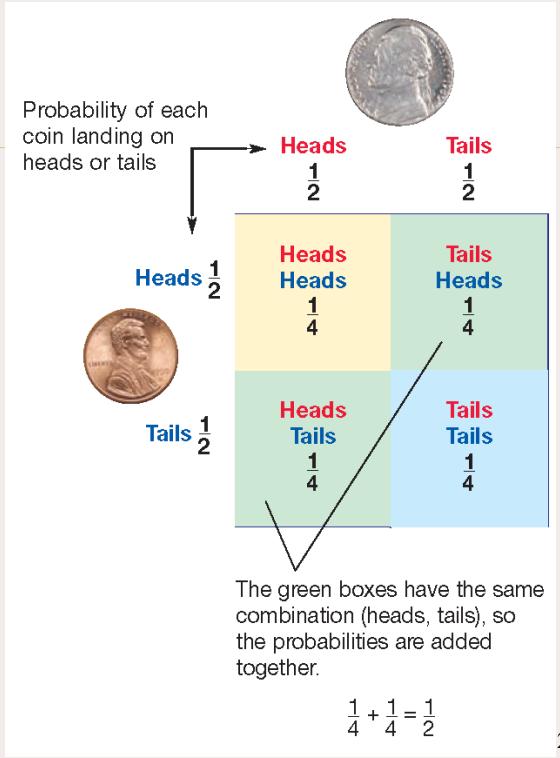


## 9. Probability- the likelihood that a specific event will occur

a. Use a coin to think of 2 possible chances- every gene has two potential alleles

Fyi…Mendel was a mathematician and used probability to explain the results of his genetic crosses.

The probability of 2 separate events is the product of the probability of each one.

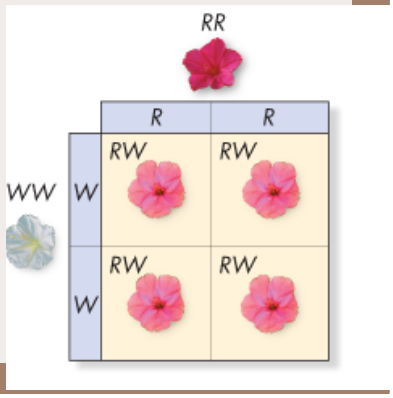




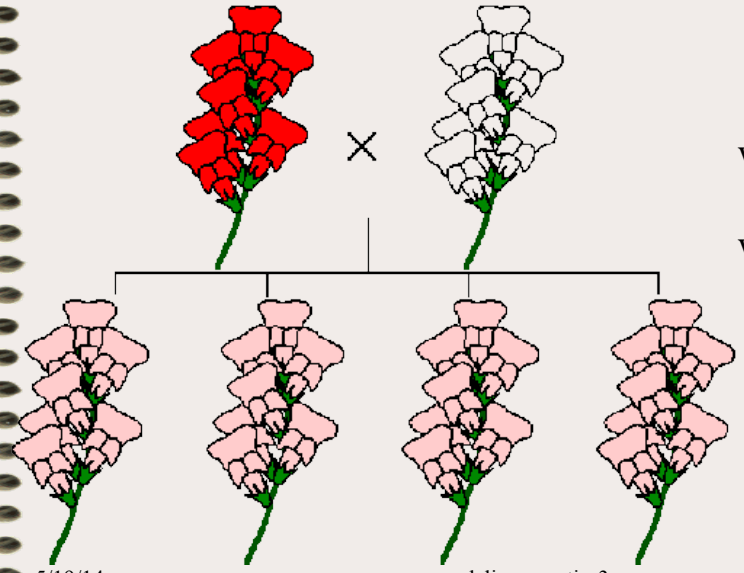

10. Incomplete dominance occurs when neither allele takes a fully dominant role.

a) Two very different phenotypes blend together to produce the heterozygous phenotype.

- Ex: Red and white flowers combine to make pink



# Incomplete dominance in flowers
# rr x ww (OR RR x WW)



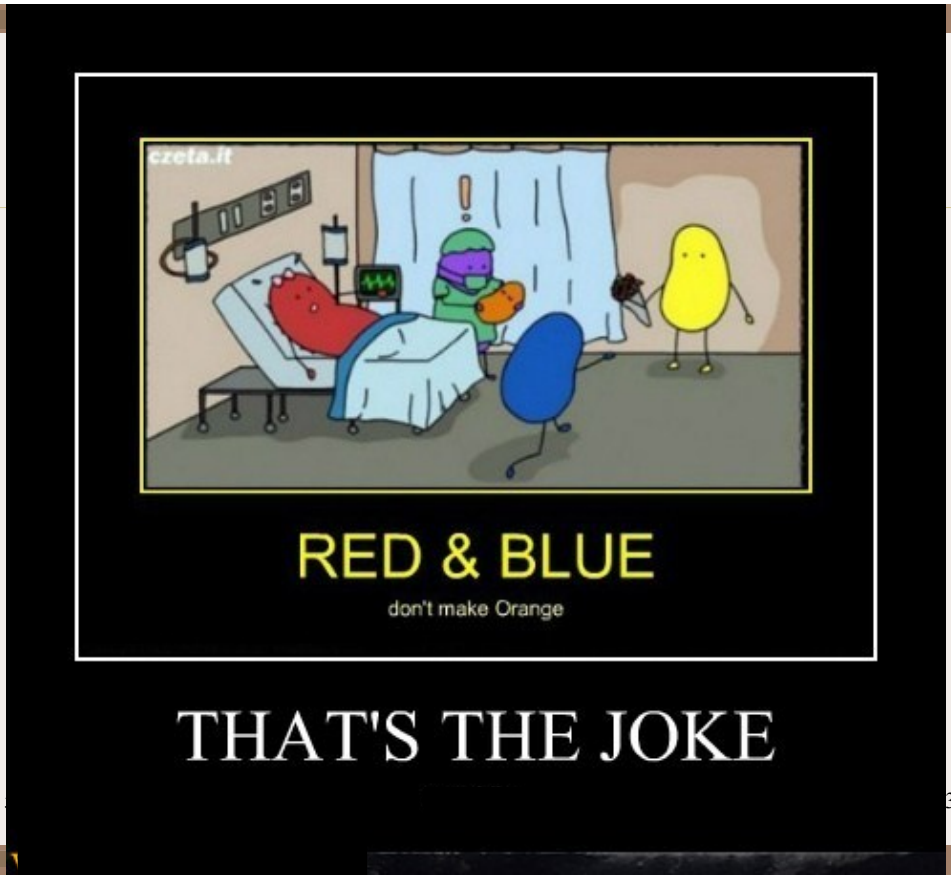
| | r | r |
|---|---|---|
| w | rw | rw |
| w | rw | rw |



11. <u>Codominance</u> occurs when two alleles are expressed normally, but at the same time.

a) Two different phenotypes are expressed together in the heterozygous genotype.

- Ex: Erminette chickens (white plus black feathers)


czeta.it
RED & BLUE
don't make Orange
THAT'S THE JOKE




MARIO
135300
×68
WORLD
8-4
TIME
000
THANK YOU MARIO!
THE KINGDOM IS SAVED!
NOW TRY A MORE DIFFICULT QUEST...
THE END
PUSH START

FYI You should have figured out:
(5) Representing alleles

a. Each trait is given a letter
b. Same "case" letter= homozygous / pure
c. One upper & one lower "case"= heterozygous / hybrid
d. Genotype - the set of alleles / letters (Eg: TT, Tt, or tt). Genome =entire set of genetic information
e. Phenotype -physical appearance (Tall or dwarf).