Genetics and Mendel

Gregor Mendel – Father of Genetics

Gregor Mendel

- First person to trace characteristics of living things
- Augustinian Monk
- Lived and worked in an Austrian monastery in the mid-1800s
- Parents were farmers in Moravia
- High school teacher

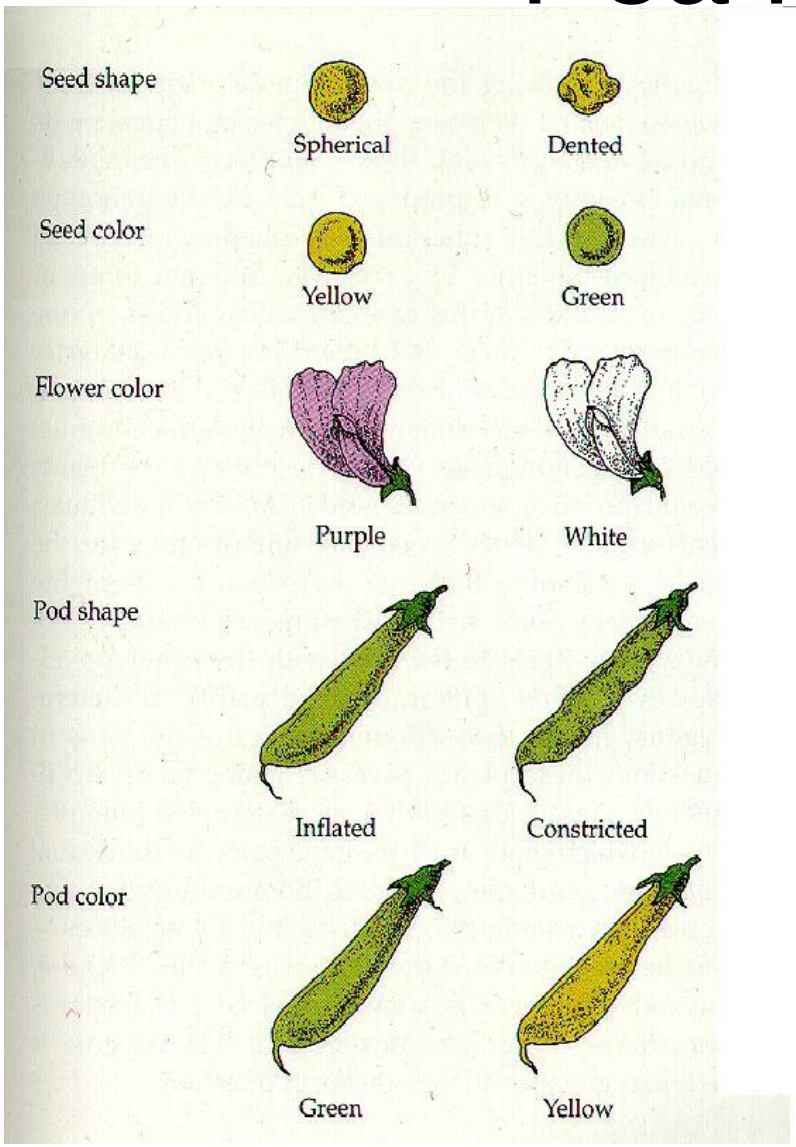
Gregor Mendel

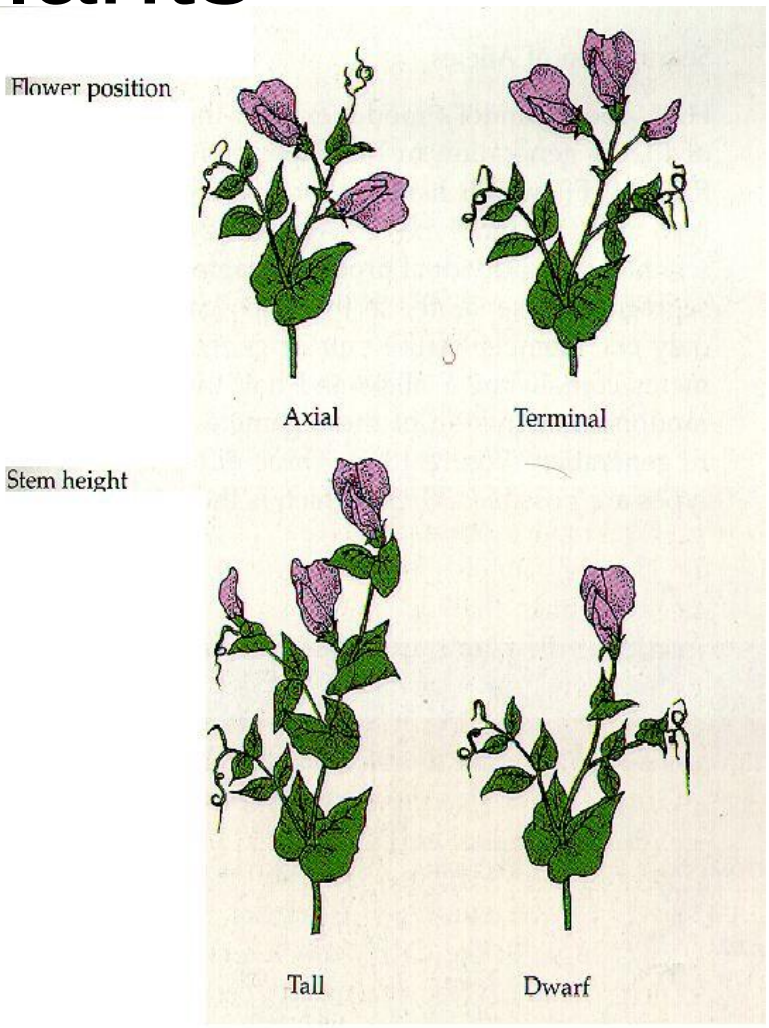
- Very methodical
- Kept good records
- Worked with pea plants (garden peas)
- Carried out first important studies of heredity
- Heredity – passing of traits from parent to offspring
- Father of Genetics

Genetics

- Branch of biology that studies heredity
- Traits – characteristics that are inherited from parents
- Ex. – hair color, eye shape, ability to roll your tongue, height,

Pea Plants


Seed shape
Spherical
Dented
Seed color
Yellow
Green
Flower color
Purple
White
Pod shape
Inflated
Constricted
Pod color
Green
Yellow


Flower position
Axial
Terminal
Stem height
Tall
Dwarf

Pea Plants

- Mendel chose pea plants because …
- Reproduce sexually
- Both male and female gametes are in the same flower
- Male gamete = pollen grain on anther
- Female gamete = ovule on pistil
- Normally reproduce by self-pollination
- Tightly closed flower prevents cross-pollination from other plants

Mendel

- Studied one trait at a time to control variables (only height or color not both)
- Analyzed his data using math
- Tall pea plants were true breeding – only produced tall plants for many generations
- Short pea plants were true breeding – only produced short plants for many generations

- Hybrid – name Mendel gave to the offspring of parents that have different forms of a trait (such as tall dad crossed with short mom)
- Monohybrid – offspring where parents differ by a single trait ex- height

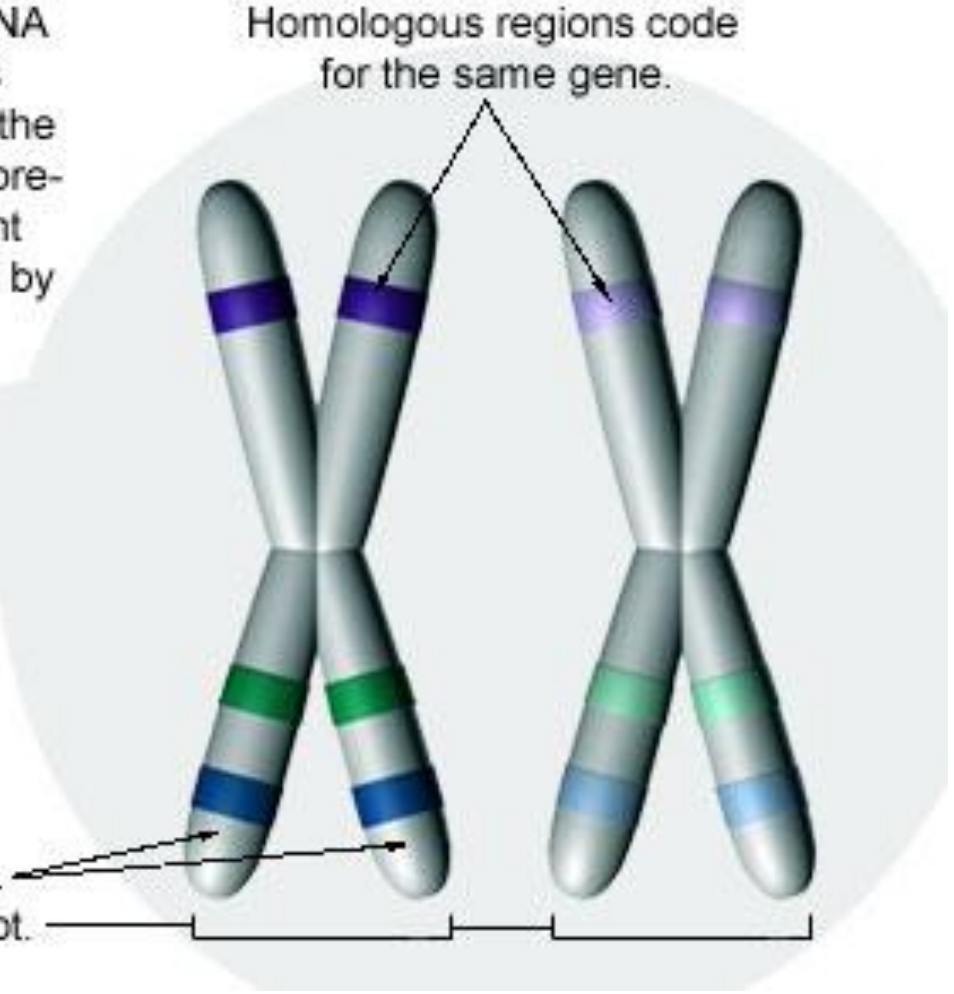
- **P_1** – Parent generation (parents)
- **F_1** – First Filial generation (kids)
- Mendel crossed 6 foot pea plants with 2 foot pea plants. Kids were all 6 foot.
- **F_2** – Second Filial generation (grandkids)
- Allowed tall kids to self-pollinate. Grandkids results → 3 tall to 1 short

Rule of Unit Factors

- Each organism has two factors that control each of its traits
- Factors = genes
- **Genes** = factors (short pieces on DNA) that control traits
- Genes exist in alternative forms → examples: short/tall green/yellow round/wrinkled
- **Alleles** – name given to different gene forms for a trait ex. T for tall t for short

Figure B-11: Homologous Chromosomes

Homologous chromosomes contain DNA that codes for the same genes. In this example, both chromosomes have all the same genes in the same locations (represented with colored strips), but different 'versions' of those genes (represented by the different shades of each color).



Rule of Dominance

- **One gene may prevent the expression of another**
- One form of a trait shows up, the other form is covered up.
- **Dominant** allele– gene that can cover up another: the trait that shows

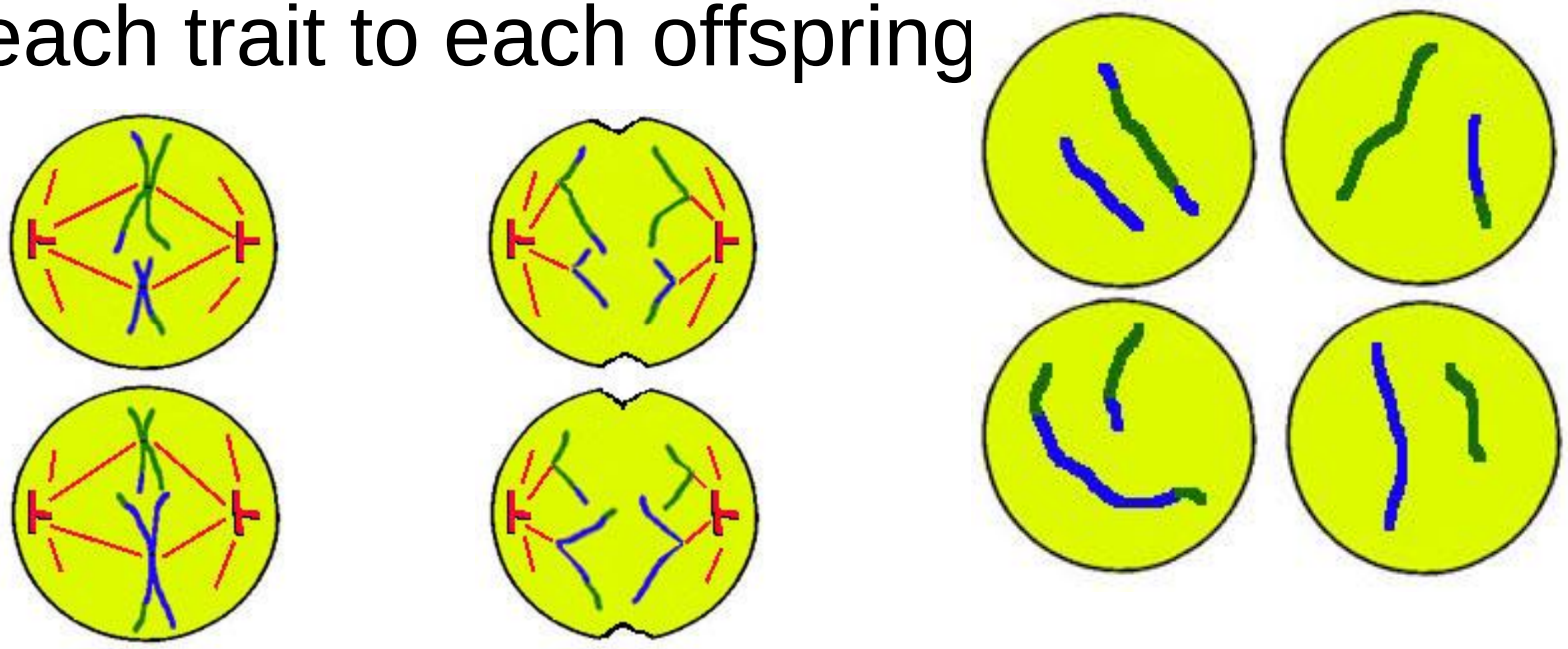
  (represented by a capital letter – T, Y, P)

  Ex. Brown hair covers up blonde
- **Recessive** allele – the trait that is covered up

  (represented by a lower case letter – t, y, p)

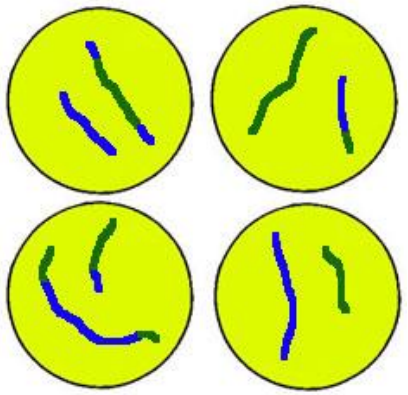
Law of Segregation

- **Pair of genes for each trait must separate when gametes are formed**
- A parent can pass on only one allele for each trait to each offspring



Law of Independent Assortment

- Genes for different traits – seed shape and seed color – are inherited independently of each other.
- RrYy – when gametes are produced, R and r will separate into different eggs or sperm. Y and y will separate too.



- ♂ = **male**
- ♀ = **female**
- **XX = female**
- **XY = male**
- **Homozygous** = the two alleles for a trait are the same RR, rr
- **Heterozygous** = the two alleles for a trait are different Rr
- **Purebred** = another name for homozygous
- **Hybrid** = another name for heterozygous

- **Dominant** = observed trait of an organism that masks the recessive form of a trait
- Rr – even though there is an allele for wrinkled peas, these peas will be round because the round allele is dominant and masks the wrinkled allele
- **Recessive** = trait of an organism that can be masked by the dominant form.

- **Phenotype** = what something looks like, appearance regardless of its genes

  TT and Tt will both look tall

  tt will look short
- **Genotype** = combination of genes an organism contains ex. TT, Tt, tt
- If a plant is tall, you can't know if its genotype is really TT or Tt
- If it is short, genotype can only be tt

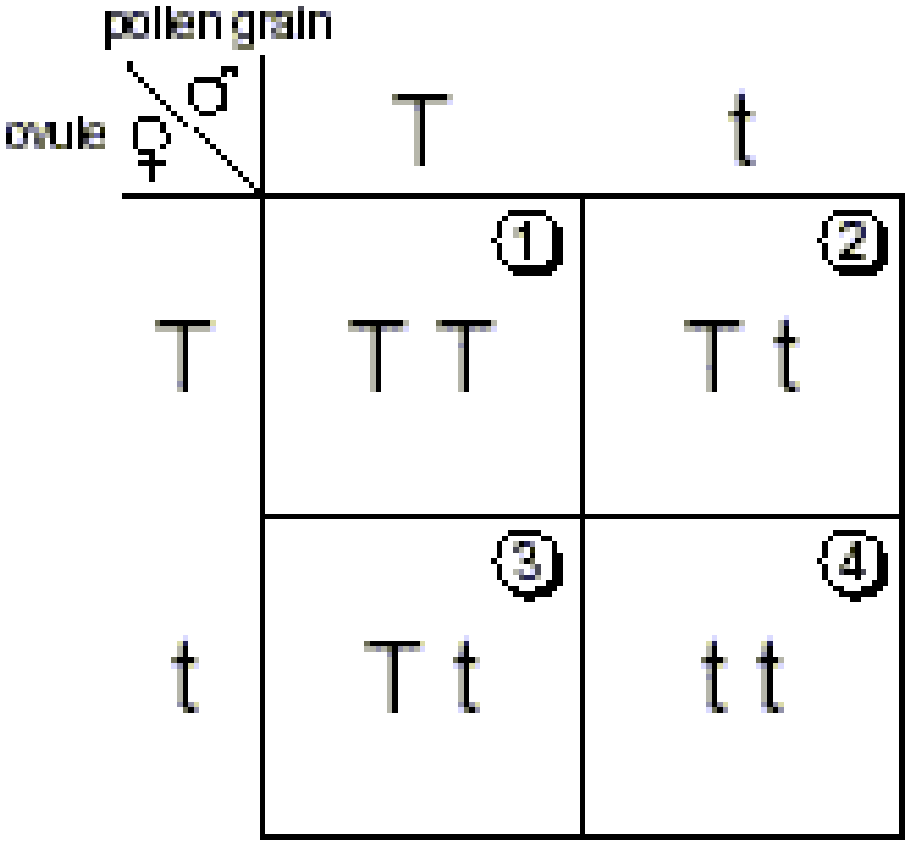
Punnett Square

- Diagram which shows the crossing of traits to predict zygotes (offspring)

- Testcross – crossing an unknown dominant with a known recessive to determine its genotype

  ex. (Rr or RR) x rr

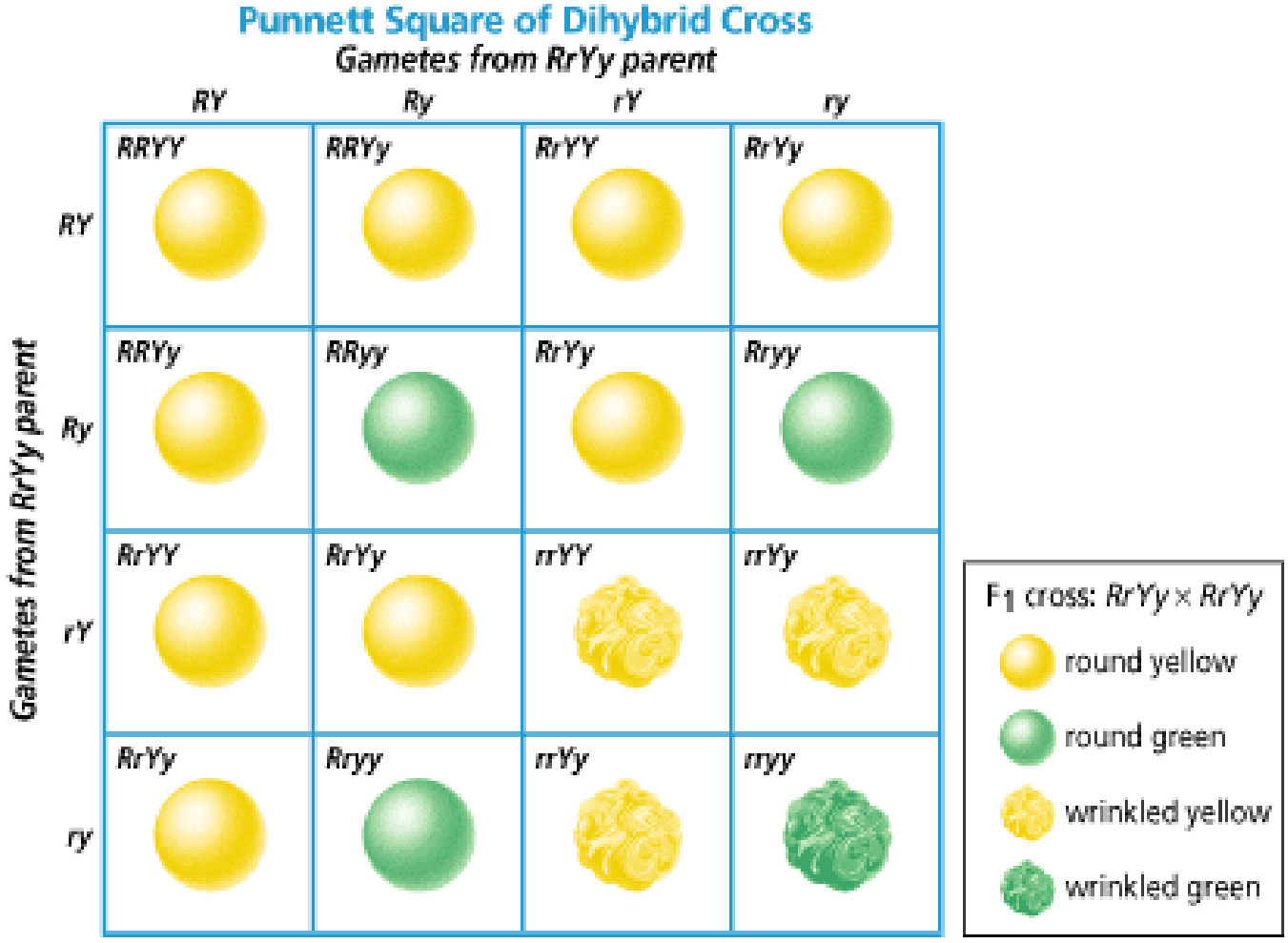
Punnett Square – Monohybrid Cross (One trait alone)



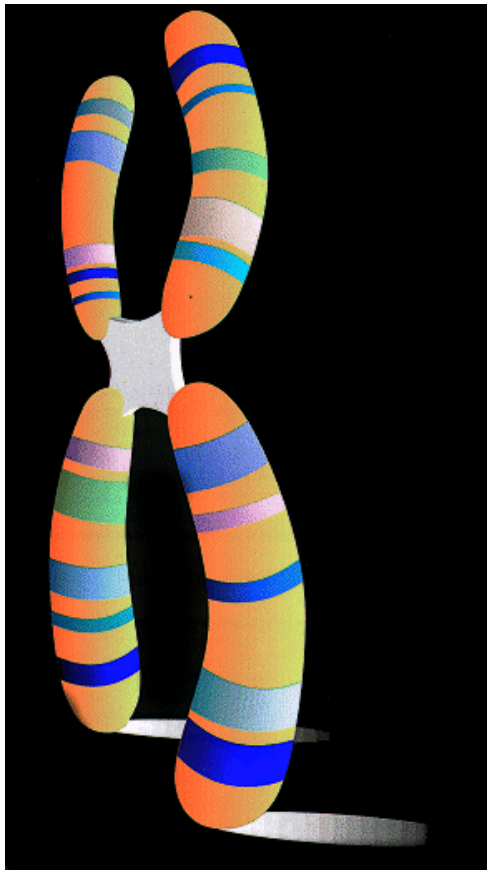
Punnett Square- Dihybrid Cross Looking at two traits simultaneously

	RT	Rt	rT	rt
RT	RRTT	RRTt	RrTT	RrTt
Rt	RRTt	RRtt	RrTt	Rrtt
rT	RrTT	RrTt	rrTT	rrTt
rt	RrTt	Rrtt	rrTt	rrtt

Punnett Square showing Genotypes and Phenotypes



- Locus – location of a trait on a chromosome



- Multiple alleles – there are more that two alleles for one simple trait but you only inherit two

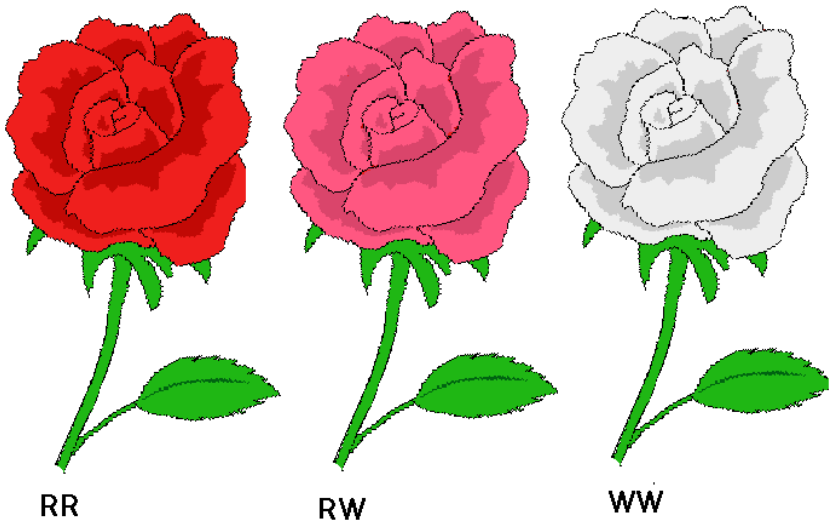
  Ex. Blood type A, B, AB, & O

- Polygenic – more than one pair of alleles for this trait in you

  Ex. Skin color, hair color, eye color

- Incomplete dominance – having a phenotype in between dominant and recessive

  ex. Crossing a red flower with a white flower can result in pink



- Co-dominance – having a phenotype that shows both dominant and recessive traits

  ex. Crossing a red flower with a white flower can result in red & white variegated

Let’s do some normal Punnett Squares first

Ex #1 & #2

Problems 1-7

Then incomplete and co-dominance

Ex #3

Problems