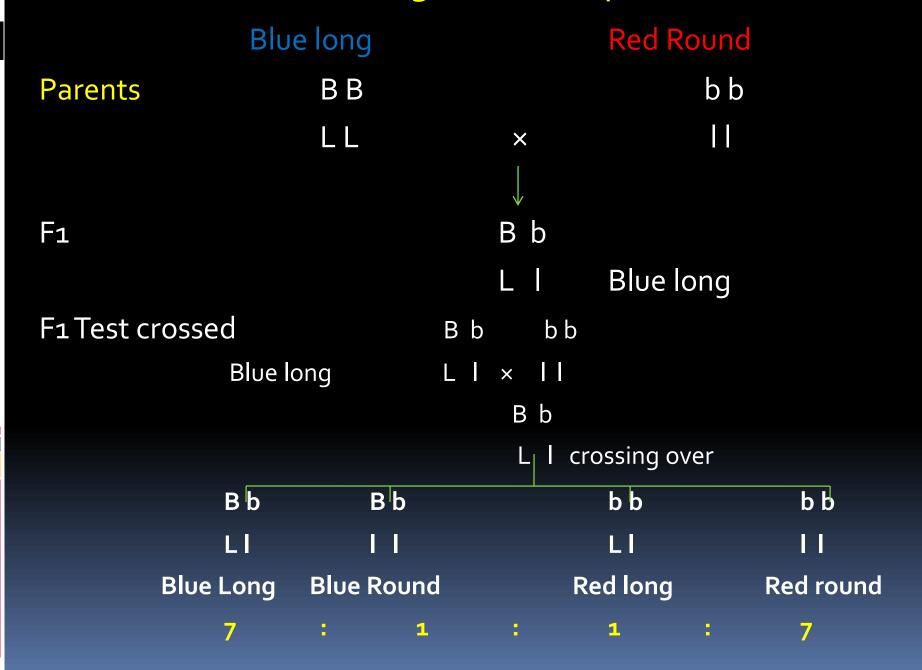
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Linkage

- Tendency of two or more genes to remain together in the original combination in the same chromosome during the process of inheritance for a number of generations
- T. H. Morgan
- Principles
 - A chromosomes contains Many genes
 - Genes are arranged in linear fashion
 - The genes present in the chromosomes are Linked
 - Linked genes are Inherited together from parents to off springs.

• Bateson and Punnet studied linkage in sweet pea (*Lαthyrus odorαtus*). In sweet pea blue flower BB is Dominant over Red flower bb. Long pollen grain is dominant LL over Round pollen grain II.

Linkage in sweat peas



- The strength of the linkage depends on the distance between the linked genes
- Closely located genes show strong linkage.
- Distantly located genes show weak linkage.
- Linkage arrangements- Two types
- 1. Cis arrangement : when dominant genes are located on one homologous chromosomes and the recessive genes on other homologous chromosome.
- 2. Trans arrangement: Dominant and recessive genes are arranged in one chromosome.

Linkage Groups

- All the linked genes of a homologous pair of chromosome constitute one group are called linkage groups.
- Example: Drosophila has 4 linkage groups and 4 pairs of chromosomes.
- Types of Groups : two types
- 1. Complete linkage: Chromosome do not break and linked genes inherited together for many generations.

Eg. F1 Male Drosophilla

2. Incomplete linkage: chromosomes break occasionally and linked genes separate due to crossing over

Eg. F1 Female Drosophilla

Complete Linkage

- These are closely associated and tend to inherit together.
- New characters do not appear.
- F1 Male hybrid

Complete Linkage in Drosophilla (Male)



Incomplete Linkage in Drosophilla (Female)

Parents		Grey Long G G			Black	Vestigial g g
		LL		X		
Gametes F	1	G				g
		L		G g		
				LI Gre	y long	
Test Cross		G g				g g
		Ll				Ш
			~			
		G G g L I L	g l	Crossin	g over	
Gametes		G (3	g	g	g
		L I		L	1	1
F ₂	G g	G g		g g		g g
	LI	- 11		LI		-11
	Grey Long	Grey Vestig	ial Bla	ack Long	Black	k Vestigial
	(41.5%)	(8.5%)	((8.5%)	(,	41.5%)

Coupling and Repulsion

- if dominant alleles or recessive alleles are present in the same plant, they tend to remain together resulting in increased parental forms.
- Thus, the two genes which inherit together are called linked genes. This aspect is called coupling.
- if dominant alleles or recessive alleles are present in the different plants, they tend to remain separate resulting in increased parental forms. This aspect is called repulsion.