

Genetics Comprehensive Study Notes

Class 12 Biology / Principles of Inheritance & Variation | Visual Diagrams

Overview: This document contains complete schematic diagrams and concepts for **Genetic Linkage** (Morgan's Drosophila Cross A & B), **Sex Determination Mechanisms** (Humans, Grasshopper, Birds, Honeybee), and **Sickle Cell Anemia** (Point Mutation & Molecular Inheritance).

1. Genetic Linkage & Basic Diagrams

Diagram A: Complete Linkage (No Crossing Over)

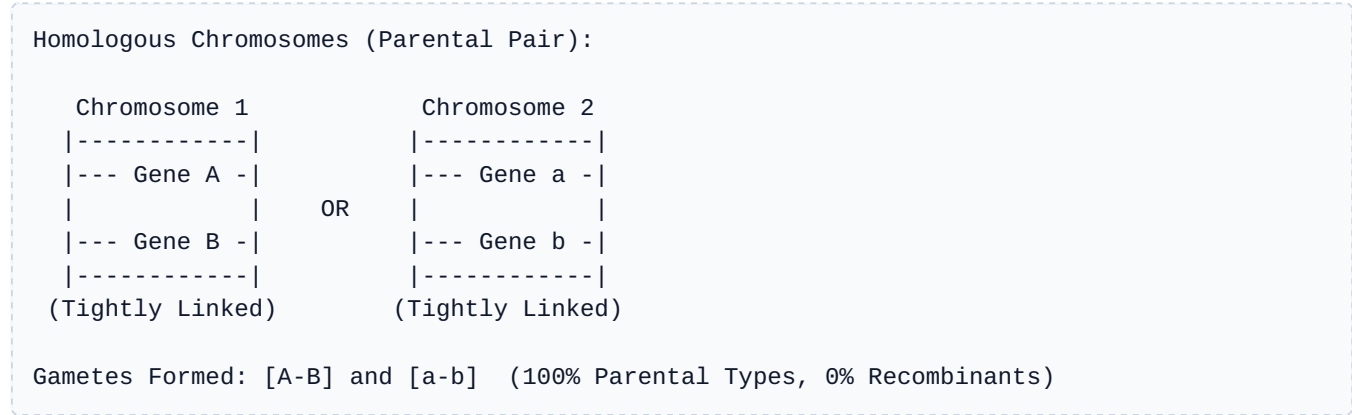
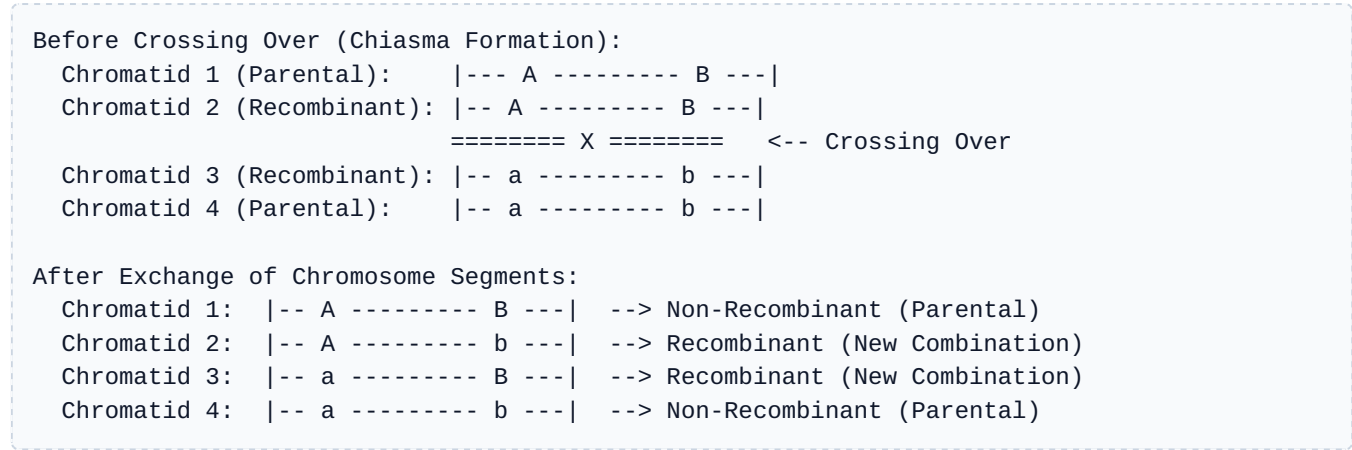


Diagram B: Incomplete Linkage (With Crossing Over)



2. T.H. Morgan's Drosophila Crosses (Cross A & Cross B)

Diagram C: Morgan's Cross A (Yellow body 'y' & White eye 'w')

[P Generation]

Female (Yellow body, White eye) x Male (Wild type: Brown body, Red eye)

X		X		Y	
---	---	---	---	(Y-Chromosome)	
-y-	-y-	-y+-			
-w-	-w-	-w+-			
---	---	---			

[F1 Generation]

- Females: Wild type (Heterozygous y w / y+ w+)
- Males: Yellow body, White eye (y w / Y)

[F2 Generation Results]

- Parental Types : 98.7% (Tightly Linked)
- Recombinant Types : 1.3% (Low Crossing Over)

Diagram D: Morgan's Cross B (White eye 'w' & Miniature wing 'm')

[P Generation]

Female (White eye, Miniature wing) x Male (Wild type: Red eye, Normal wing)

X		X		Y	
---	---	---	---	(Y-Chromosome)	
-w-	-w-	-w+-			
				(Farther Distance)	
-m-	-m-	-m+-			
---	---	---			

[F1 Generation]

- Females: Wild type (Heterozygous w m / w+ m+)
- Males: White eye, Miniature wing (w m / Y)

[F2 Generation Results]

- Parental Types : 62.8% (Loosely Linked)
- Recombinant Types : 37.2% (High Crossing Over)

3. Sex Determination Mechanisms

Diagram E: Human Sex Determination (XX - XY System)

Male Heterogamety: Males produce two types of sperms (50% X, 50% Y), while females produce only one type of egg (100% X).

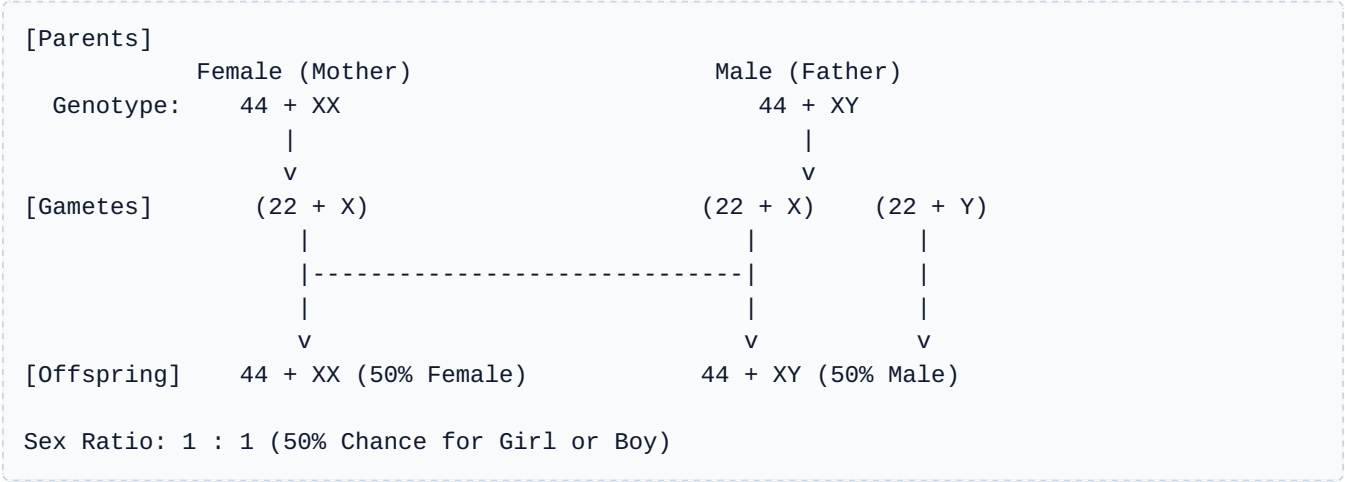


Diagram F: Birds Sex Determination (ZZ - ZW System)

Female Heterogamety: Females produce two types of eggs (Z and W), while males produce only one type of sperm (Z).

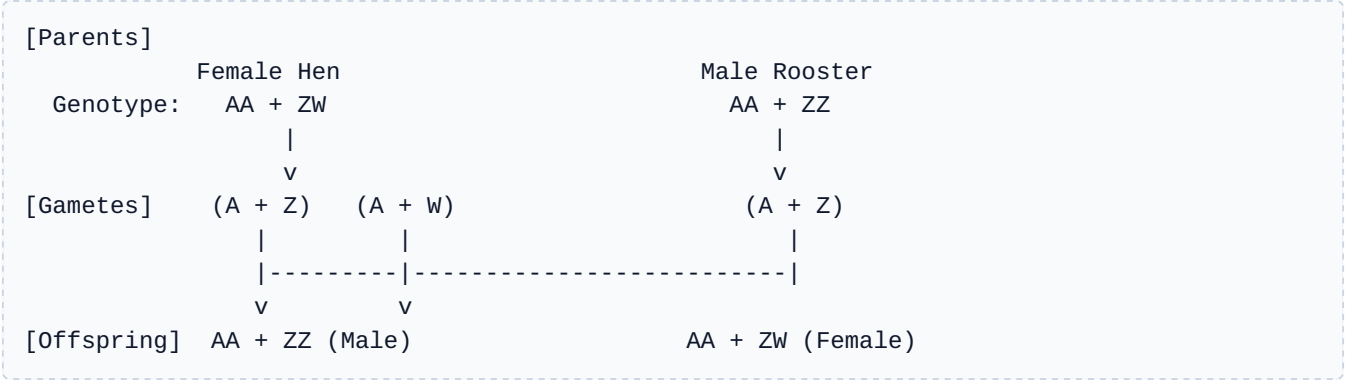
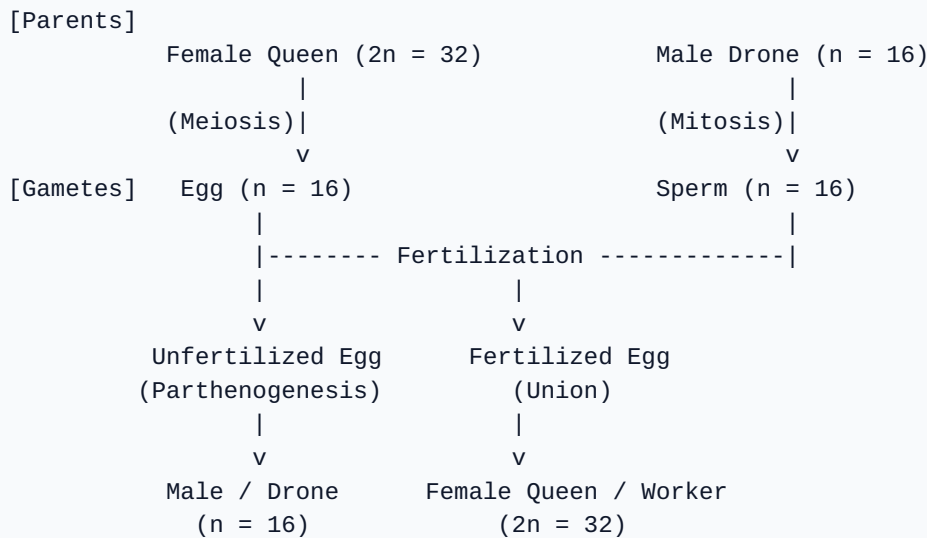


Diagram G: Honeybee Sex Determination (Haplodiploid System)

Males (Drones) develop unfertilized via Parthenogenesis (Haploid, $n=16$). Females (Queen/Workers) develop from fertilized eggs (Diploid, $2n=32$).



4. Sickle Cell Anemia (Molecular & Genetic Diagrams)

Sickle cell anemia is an **Autosomal Recessive Disorder** caused by a **Point Mutation** (Substitution of Adenine by Thymine) at the 6th codon of the β -globin gene.

Diagram H: Molecular Mechanism of Point Mutation

1. Normal HbA Gene & Beta-Chain:

DNA Strand : 5' --- CTC --- 3'
3' --- GAG --- 5'

| (Transcription)

mRNA Codon : 5' --- GAG --- 3'

| (Translation)

Amino Acid : ... Glutamic Acid (Glu) at 6th Position ...

RBC Shape : Biconcave, Flexible Disc (Normal Oxygen Carrying Capacity)

2. Sickle Cell HbS Gene & Mutant Beta-Chain:

DNA Strand : 5' --- CAC --- 3' <-- (Point Mutation: T replaces A)
3' --- GTG --- 5'

| (Transcription)

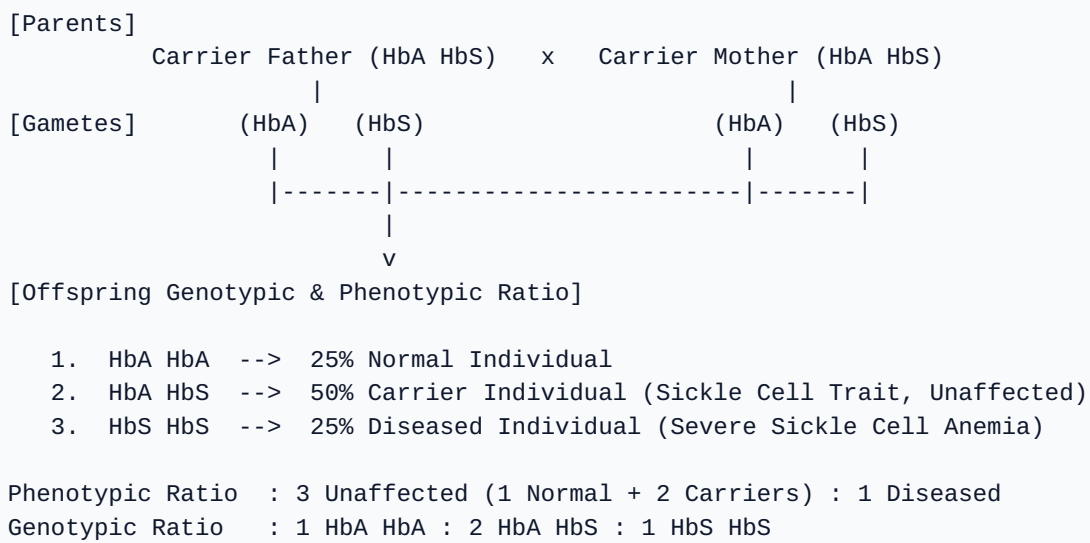
mRNA Codon : 5' --- GUG --- 3' <-- (Valine Codon)

| (Translation)

Amino Acid : ... Valine (Val) at 6th Position ...

RBC Shape : Sickle-shaped, Rigid Crescent (Low O₂, Clogs Capillaries)

Diagram I: Inheritance Cross of Sick Cell Anemia (Carrier Parents)



5. Summary Table: Sex Determination Systems

Type / System	Male Genotype	Female Genotype	Heterogametic Sex	Examples
XX - XY	XY (2 types sperms)	XX (1 type egg)	Male	Humans, Mammals, <i>Drosophila</i>
XX - XO	XO (1 X chromosome)	XX (2 X chromosomes)	Male	Grasshopper, Bugs
ZZ - ZW	ZZ (Homogametic)	ZW (2 types eggs)	Female	Birds, Fowls, Reptiles
Haplodiploidy	Haploid (n = 16)	Diploid (2n = 32)	N/A (Ploidy based)	Honeybees, Wasps, Ants