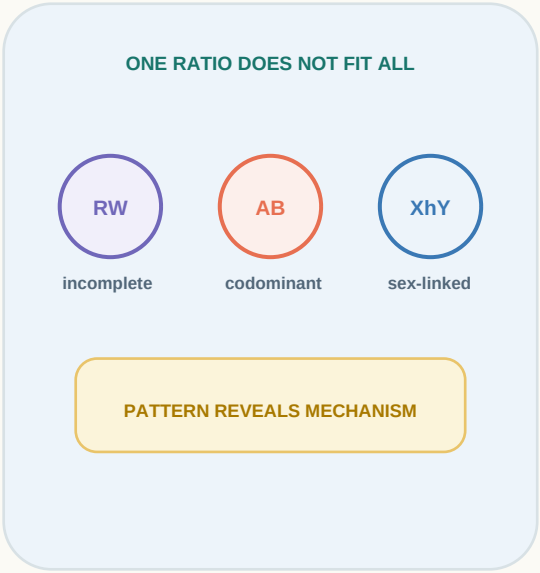
AP BIOLOGY | UNIT 5

TOPIC 5.4

Non-Mendelian Genetics

Inheritance can differ from simple dominant-recessive ratios because genes, chromosomes, and cellular inheritance behave in varied ways.



THE CORE CAUSAL CHAIN

GENE LOCATION → linked or sex-linked

ALLELE ACTION → partial or both expressed

CELL SOURCE → nuclear or organelle DNA

PATTERN → offspring ratios change

BY THE END, YOU SHOULD BE ABLE TO...

1. Compare incomplete dominance and codominance.
2. Link recombination frequency to map distance.
3. Recognize sex-linked, pleiotropic, and maternal patterns.

CENTRAL IDEA

When offspring ratios depart from a simple Mendelian model, examine allele interaction, gene location, recombination, and the cellular source of inherited DNA.

1 Allele interaction and linkage alter ratios

Heterozygote phenotypes reveal how alleles interact, while recombination frequency reveals how closely genes are linked.

HOW HETEROZYGOTES ARE EXPRESSED

COMPLETE DOMINANCE

Aa

A

same phenotype as AA

INCOMPLETE DOMINANCE

RW

PINK

intermediate phenotype

CODOMINANCE

C^R C^W

R+W

both phenotypes visible

GENE LINKAGE AND MAP DISTANCE

LINKED GENES



Genes on the same chromosome tend to travel together. Crossing over can separate their alleles.

closer genes -> fewer recombinants

RECOMBINATION FREQUENCY = recombinant offspring / total offspring x 100

1% recombination = 1 map unit (centimorgan); values approach a maximum of 50%

KEY DISTINCTION

Incomplete dominance blends the heterozygote phenotype between the two homozygotes. Codominance displays both allele products distinctly in the heterozygote.

2

Chromosome location and cell source shape inheritance

Sex chromosomes, one-gene-many-effect relationships, and organelle DNA create recognizable inheritance patterns.

RECOGNIZE THE PATTERN

X-LINKED RECESSIVE

XhY

DIFFERENT SEX FREQUENCIES

A male has one X chromosome, so one recessive allele on X can determine the phenotype.

PLEIOTROPY

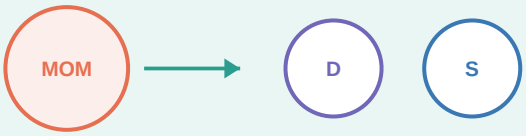
1 -> 3

ONE GENE, MANY EFFECTS

One gene product influences multiple traits or systems, creating several linked phenotypic effects.

DNA OUTSIDE THE NUCLEUS

MATERNAL ORGANELLE INHERITANCE



In animals, the egg supplies most mitochondria, so mitochondrial traits usually follow the maternal line.

NUCLEAR GENE LOCATION -> AUTOSOMAL OR SEX-LINKED PATTERN

ORGANELLE DNA SOURCE -> MATERNAL-LINE PATTERN IN MANY ANIMALS

FINAL MAP

Ask four questions: How does the heterozygote look? Are the genes linked? Is the gene on a sex chromosome? Is the DNA nuclear or organelle-based? The answers reveal the inheritance model.