Module 2: Blueprint of Life

1st Topic - Evolution

Evidence
1. Palaeontology
Fossils – Transitional forms e.g. Archaeopteryx
2. Biogeography
Flightless birds (ratites)
3. Comparative anatomy
Vestigial structures e.g. pentadactyl limb
4. Comparative embryology
Gill slits
5. Biochemistry
Amino-acid & DNA sequencing

Conditions
Physical, Chemical, Competition for resources

Natural selection: Mechanism by which evolution occurs

Divergent evolution	vs	Convergent evolution
-Closely related species in different habitat → different adaptations		- Distantly related species in the same environment → similar adaptations

2nd Topic – Mendel & factors

Experiments
Pea plants; 1 trait at a time

Techniques
Controlled – Self pollination
Accurate – Pollinate by hand
Quantitative – Ratios

Monohybrid Cross (Punnett squares)
Dominant vs Recessive factors
Phenotype vs Genotype
Homozygous vs Heterozygous

Reasons work was neglected
1. Darwin's theory more widely debated
2. Not recognized as an established scientist
3. Mathematical analysis not usually used in research

3rd Topic – Alleles, genes, DNA & chromosomes

Alleles
Different forms of a gene

Gene
Consists of DNA that may encode for a trait

DNA
Double helix molecule with sugar, phosphate group & nitrogenous base

Chromosome
Compact coils of DNA around histones

Boveri
- Sea urchins
- Found factors were in nucleus

Sutton
- Grasshoppers
- Found chromosomes were identical to Mendelian factors

Meiosis
Production of gametes; chromosomal no. halved

Genetic variation
Meiosis
1. Crossing-over
2. Random segregation & independent assortment

Sexual reproduction
3. Fertilization

4th Topic – Deviations from Mendel

Sex linkage
- Genes on sex chromosomes
- Morgan: experimented with fruit flies and showed that fruit fly eye colour gene is sex linked

Codominance
-2 different alleles in heterozygotes expressed together
-e.g. ABO blood type where A is codominant with B

Environment
- Nutrition : Muscle size, Height
- Soil pH : Colour of hydrangea flowers

5th Topic – Processes involving DNA

Mutation
Any change in the nucleotide sequence → new alleles
1. Chromosomal mutation
2. Point mutation
Mutagens – Agents causing mutations *e.g. radiation*

Production of polypeptides & proteins
1. Transcription (DNA → mRNA)
2. Translation (mRNA & tRNA → amino acids)
3. Peptide linkage (amino acids → polypeptides) → proteins

Replication
1. DNA unwinds
2. Parental strands act as templates for synthesizing new complementary strands by base pairing

Significance: Growth, repair, maintenance, maintaining chromosomal number

6th topic – Developing theories of genetics

Watson & Crick; Franklin & Wilkins
Discovered double helical structure of DNA

Beadle & Tatum
'1 gene-1protein' → '1gene-1polypeptide'

Punctuated equilibrium
Quick bursts of change followed by stable periods

Sources of variation
Evidence for Darwin's theory of evolution by natural selection

7th Topic – Genetic technology & engineering

Reproductive techniques
1. Artificial insemination
2. Artificial pollination/Hybridisation
3. Cloning

Transgenic species
e.g. Insulin gene in bacteria
Ethical issues: Tempering nature, Long term health effects unknown, Decrease genetic diversity

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