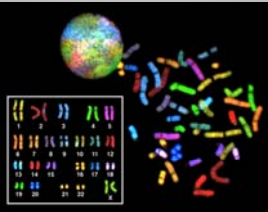


DNA Technologies and Biotechnology
Selected Topics

- Chromosome Structure
- Karyotyping
- Nucleotide detail
- Transcribed and Translated Messages

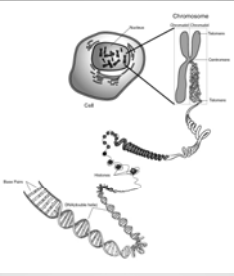
DNA Structure Review

Chromosomes



**Spectral Karyotyping
Identifies Genetic Anomalies**

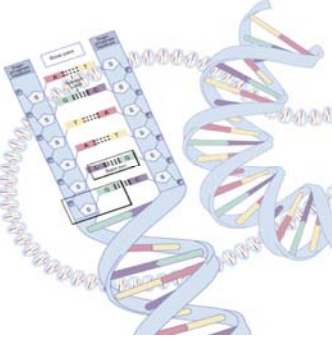
The image shows a human karyotype where chromosomes are color-coded by spectral analysis. A small globe is visible in the upper left corner of the karyotype image.



Packaged into Chromosomes

The diagram illustrates the hierarchical packaging of DNA. It starts with a double helix DNA molecule, which is then wrapped around histone cores to form nucleosomes. These nucleosomes are further condensed into a chromatin fiber, which eventually forms a highly condensed chromosome. Labels include 'Nucleosome', 'Chromosome', and 'DNA'.

Model of DNA



The image shows a 3D model of a DNA double helix. The sugar-phosphate backbone is shown in blue, and the nitrogenous base pairs are shown in various colors (red, yellow, green, purple) connecting the two strands.

Deoxyribonucleic Acid (DNA)

The diagram illustrates the structure of DNA, showing a double helix with base pairs (A-T, C-G) and hydrogen bonds. It also includes chemical structures for Cytosine-Guanine and Thymine-Adenine base pairs, showing the sugar-phosphate backbone and the specific hydrogen bonding patterns between the bases.

Deoxyribonucleic Acid (DNA)

DNA Nucleotide Details

- 5' 3'
- Antiparallel
- Semiconservative
- Codes for Proteins
- Deoxyribose
- ATCG

The diagram shows a single DNA nucleotide with a phosphate group, a deoxyribose sugar, and a nitrogenous base. The 5' and 3' ends are indicated, and the sugar has a hydroxyl group (OH) at the 3' position.

Genes are Composed of Exons and Introns

- Exons Code
- Introns are removed in Eukaryotes.
- No Splicing in Prokaryotes

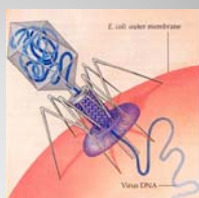
The diagram shows a gene with exons and introns. The gene is represented as a double helix with segments labeled 'Exon' and 'Intron'. A legend indicates that exons code for proteins, while introns are removed in eukaryotes.

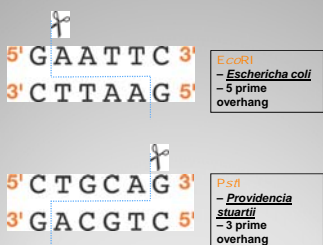
- Where did they come from?
- How do they work?
- What can we use them for?

Restriction Enzymes and DNA Electrophoresis

DNA Restriction Enzymes

- Evolved by bacteria to protect against viral DNA infection
- Endonucleases = cleave within DNA strands
- @ 4,000 known enzymes





Common Restriction Enzymes

Restriction site

Palindrome

```
GTAGAATTCATTACGCA
CATCTTAAGTAAGTGCCT
```

Fragment 1

Fragment 2

Enzyme Site Recognition

Enzyme cuts

- Generates 5 prime overhang

```
5' GAATTC 3'
3' CTTAAG 5'
```

```
5' G 3' 5' AATTC 3'
3' CTTAA 5' 3' G 5'
```

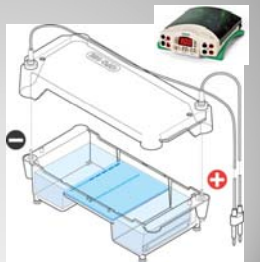
5 vs 3 Prime Overhang

- Cut with enzymes
- Load into a well
- Turn on Electricity
- Run away from -
- Small faster than big

Electrophoresis

Agarose Electrophoresis

- Electrical current carries negatively-charged DNA through gel towards positive (red) electrode
- Small fragments move faster than large ones



Agarose Electrophoresis

- Electrical current carries negatively-charged DNA through gel towards positive (red) electrode
- Small fragments move faster than large ones



Restriction Fragment Length Polymorphism Test.

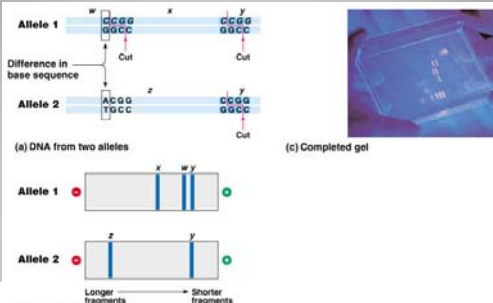
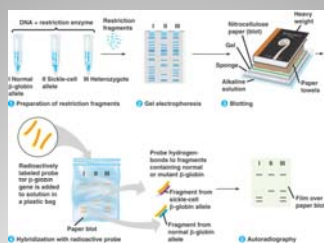


Fig. 20.9 (b) Electrophoresis of restriction fragments
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- Using the PCR technique to generate all possible size pieces from a given template strand.
- [Cycle Sequencing](#)

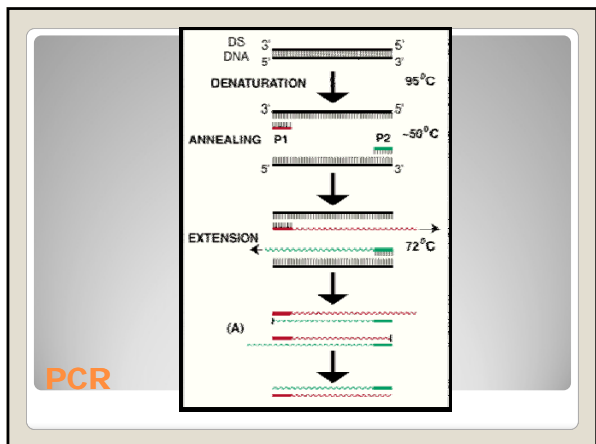
DNA Sequencing



DNA Fingerprinting (Profiling) RFLP Testing

- Polymerase Chain Reaction
 - Controlled DNA Replication
 - Using Specific Primers to Replicate the DNA between the two primers.
 - Use Heat in cycles to unzip strands etc..
 - Heat stable DNA polymerase
 - Thermus aquaticus bacteria is where the "Taq" polymerase was extracted.
- [PCR Projector](#)

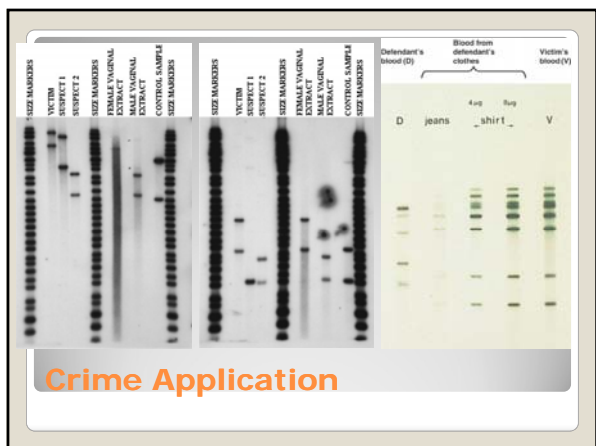
PCR



PCR

- Show Animation of PCR

PCR and AFLP



Crime Application

Gene Therapy

- SCID
- CF

The diagram illustrates the four steps of gene therapy:

1. Insert RNA version of normal allele into retrovirus.
2. Let retrovirus infect bone marrow cells that have been removed from the patient and cultured.
3. Viral DNA carrying the normal allele inserts into chromosome.
4. Inject engineered cells into patient.

Labels in the diagram include: Cloned gene (normal allele, absent from patient's cells), Viral RNA, Retrovirus capsid, Bone marrow cell from patient, and Bone marrow.

Reproductive Cloning

- Can use Recombinant molecules to genetically modify before cloning

The diagram shows the process of reproductive cloning in a sheep:

1. Mammary cell donor and Egg cell donor.
2. Egg cell from ovary and Nucleus removed.
3. Cells fused.
4. Grown in culture.
5. Implanted in uterus of a third sheep.
6. Embryonic development.

Additional labels: Cultured mammary cells are semistarved, arresting the cell cycle and causing dedifferentiation; Nucleus from mammary cell; Early embryo; Surrogate mother; Lamb ("Dolly") genetically identical to mammary cell donor.

- Establish type of cloning
 - Therapeutic vs. Reproductive
 - Cells or Tissues
- Risks vs benefits
- Human Cloning

Issues with Cloning

- Human Genome Project
 - 1986-2000 first draft
 - 2000-?
- What can we learn?
 - 2 benefits?
- Risk/Benefits?

Genome Projects

- What is it?
- Uses?
- Risks and Benefits?

Genetic Screening

- Sanger
- Labels
- Show animations

Sequencing
