

# Genetic Engineering and Biotechnology (4.4)

## Outline PCR and gel electrophoresis (4.4.1 / 4.4.2)

### PCR:

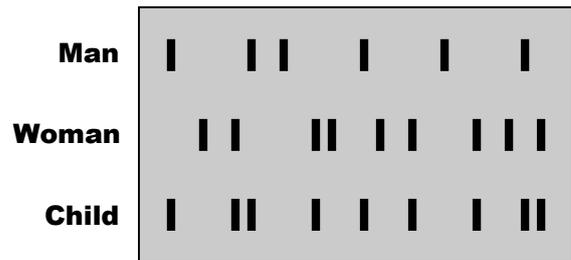
- Copies & amplifies small quantities of DNA
- Process involves 3 repeating steps:
  - DNA heated to separate strands
  - Primers annealed to define copying region
  - Strands copied with a thermophilic polymerase

### Gel Electrophoresis:

- Separates DNA fragments by size
  - DNA fragmented with restriction enzymes
  - Loaded into a gel with a current applied
  - DNA moves towards the anode (+)
  - Small fragments move faster, separate further

## Describe DNA profiling (4.4.3 - 4.4.5)

- DNA profiling uses gel electrophoresis to identify an individual's banding pattern
- Endonucleases target non-coding elements (STRs) that differ in length in individuals
- It can be used to determine paternity and also be used in forensic investigations



**Paternity Test (positive)**

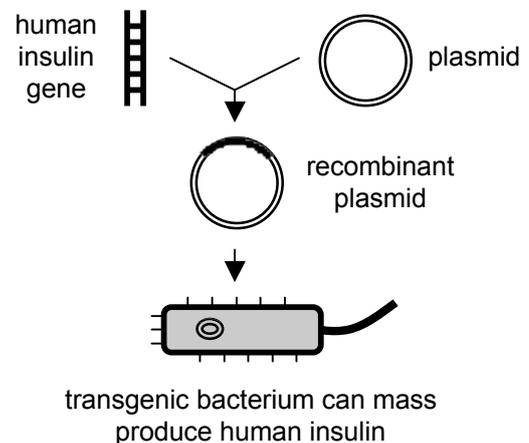
## Outcomes of the Human Genome Project (4.4.6)

1. Mapping (locating genes)
2. Screening (for disease)
3. Treatment (gene therapy)

## Outline the process of gene transfer (4.4.7 / 4.4.8)

- Genes can be transferred between species because the genetic code is **universal**

1. Plasmid removed from bacterial cell
  - Are autonomous units (can self-replicate)
2. Gene of interest removed from organism
  - Gene amplified with polymerase chain reaction
3. Gene of interest spliced into plasmid
  - Gene and plasmid cut with restriction enzyme
  - Spliced together with DNA ligase
4. Recombinant plasmid inserted into host cell
  - The transgenic cells should express the new trait



## Benefits & disadvantages of examples of genetic modification (4.4.9 / 4.4.10)

**Example 1:** Bt corn produces a toxin (*from Bacillus thuringiensis*) that kills corn borers

**Example 2:** Transgenic sheep produce human factor IX (*clotting agent*) in their milk

### Benefits:

- Higher crop yield (lessen food shortages)
- Higher yields = less land used for farming
- Reduction in use of harmful pesticides
- Less expenditure, greater profits

### Disadvantages:

- May be unknown health effects (allergy?)
- Toxin may kill non-pest species
- Cross-pollination to weeds
- Reduced biodiversity