

# TOPIC 3.5: GENETIC MODIFICATION

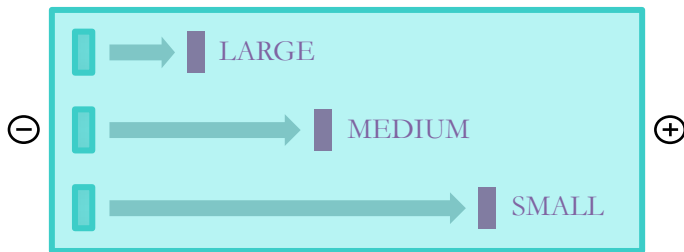
## Gel Electrophoresis

Gel electrophoresis is a technique that separates proteins or fragments of DNA according to size

- Samples placed in a block of gel and current is applied
- Smaller samples move faster through the gel (↓ resistance)

Samples will move towards the positive terminus (anode)

- DNA is negatively charged (due to phosphate group)
- Proteins are treated with an anionic detergent in order to impart a uniform negative charge on all molecules



## Gene Transfer

Gene transfer can occur because the genetic code is *universal*

### Step 1: DNA Extraction

- Gene of interest isolated from organism
- Gene is amplified using PCR (along with a plasmid)

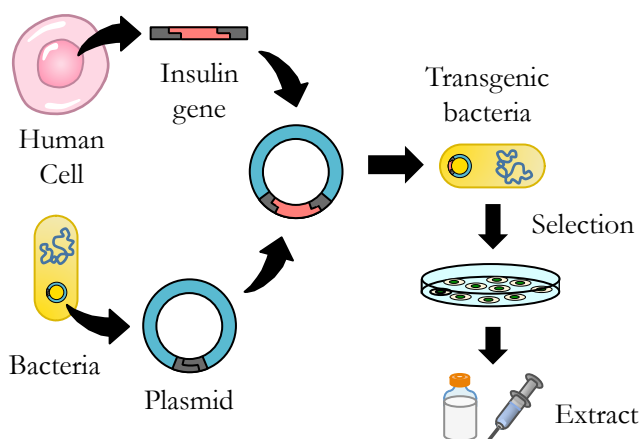
### Step 2: Digestion and Ligation

- Plasmid and gene cut with a specific restriction enzyme
- Gene is spliced into plasmid vector by DNA ligase

### Step 3: Transformation and Expression

- Recombinant plasmid is inserted into a host cell
- Antibiotic selection may be used to select for successful transgenic cells (if plasmid has an antibiotic resistance gene)
- Transgenic cells express new protein (for extraction / use)

### Example: Production of Human Insulin in Bacteria



## DNA Profiling

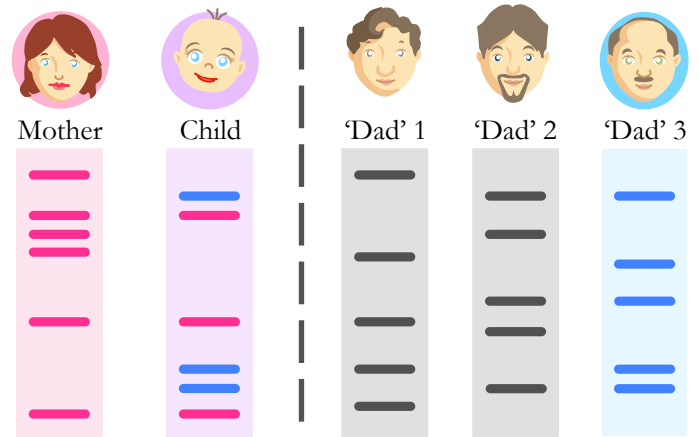
DNA profiling is a technique by which individuals can be identified and compared by their genetic sequences

- Individuals have different lengths of particular DNA segments called short tandem repeats (STR)
- These segments are amplified by PCR and then separated by gel electrophoresis for comparison
- Unique profiles appear when multiple loci are compared

DNA profiling is commonly used for:

- Forensic investigations (matching suspect to the crime scene)
- Paternity tests (offspring STRs are a combination of parents)

### Sample Paternity Test



## GMO Debate

### Benefits of GM Crops:

- Could be used to improve nutritional standards
- Can grow in a wide range of environments (↑ yields)
- Could reduce farming costs and associated deforestation
- Can be used to reduce spoilage (longer shelf life)

### Risks of GM Crops:

- Could trigger unexpected health issues (e.g. allergies)
- Patent protections could restrict access (equity issues)
- Possible cross-pollination with weeds (hard to contain)
- Could compete with native plants (reduce biodiversity)

### Example of GM Crop:

- Bt corn is a transgenic crop that produces an insecticide (*B. thuringiensis* toxin kills European corn borer insect)
- Bt corn may be impacting survival of monarch butterflies
- In lab conditions, butterfly mortality is higher when fed plants dusted with Bt pollen, however there is insufficient field evidence to support this (diet not naturally restricted)