



# **ATOMIC ENERGY CENTRAL SCHOOL 4 MUMBAI**

**UNIT-IX BIOTECHNOLOGY  
CH – 12 : BIOTECHNOLOGY AND ITS APPLICATION  
MODULE : 2/3**

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# TOPICS TO BE COVERED

## Biotechnological Applications in the field of Medicine

Genetically  
Engineered Insulin

Gene Therapy

Molecular Diagnosis

# BIOTECHNOLOGICAL APPLICATIONS IN THE FIELD OF MEDICINE

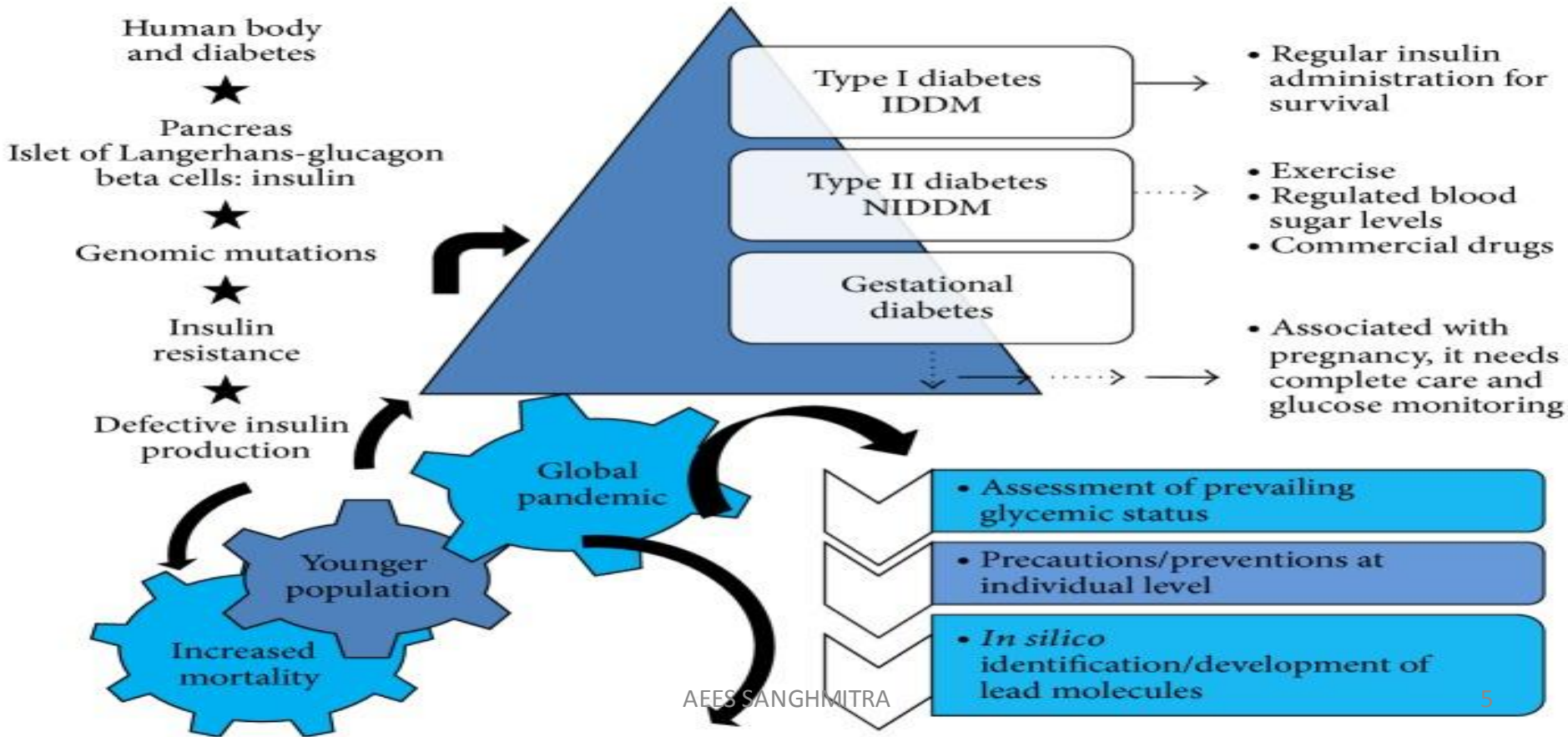
- ❖ The rDNA technology processes have made great impact in the area healthcare by mass production of safe and more effective therapeutic drugs.
- ❖ There are 30 recombinant therapeutics all over world approved for human use.
- ❖ Out of these 12 are marketed in India.

# Recombinant Therapeutic Drugs Approved for Marketing in India

<b>Molecules</b>	<b>Therapeutic applications</b>
Hepatitis B vaccine (r- HBsAg based)	Immunization against Hepatitis B virus
Erythropoietin	Treatment of anemia
Interferon alpha 2B	Treatment of leukemia, Hepatitis B and Hepatitis C
Epidermal Growth factor (EGF)	Organ morphogenesis and mitogenesis
Streptokinase	Dissolution of clot in acute myocardial infarction
Human insulin	Treatment of diabetes
GM-CSF; G-CSF	Treatment of chemotherapy induced neutropenia; treatment of neutropenia
Interferon alpha 2A	Chronic myeloid leukemia
Human growth hormone	Treatment of dwarfism in children
Nimotuzumab	Treatment of breast cancer
Rituximab	Treating non-Hodgkin's lymphoma & arthritis.
Tissue Plasminogen Activator	Dissolution of clot in acute myocardial infarction
Blood factor VIII	Treatment of hemophilia type A
Follicle stimulating hormone	Treatment of reproductive disorders
Teriparatide (Forteo)	Parathyroid hormone for treating osteoporosis
Drerecogin alpha (Xigris)	Burns and severe sepsis
Platelet Derived Growth Factor (PDGF)	Receptor antagonist in certain types of cancer
Interleukin 2; interleukin 11	Treatment of renal cell carcinoma; treatment of thrombocytopenia
Blood factor VII (Eptacogalpa)	To control bleeding in hemophilia patients



# DIABETES



In the early 1920s **Frederick Banting** and **Charles Best** discovered insulin under the directorship of **John Macleod** at the University of Toronto. With the help of **James Collip** insulin was purified, making it available for the successful treatment of diabetes. Banting and **Macleod** earned a Nobel Prize for their work in 1923.



Frederick G. Banting,  
1891-1941

J.J.R. MacLeod,  
1876-1935

Charles Best,  
1899-1978

J.B. Collip,  
1892-1965

## Discovery of Insulin



Charles Best (left) and Frederick Banting, with a dog used in their experiments to isolate insulin

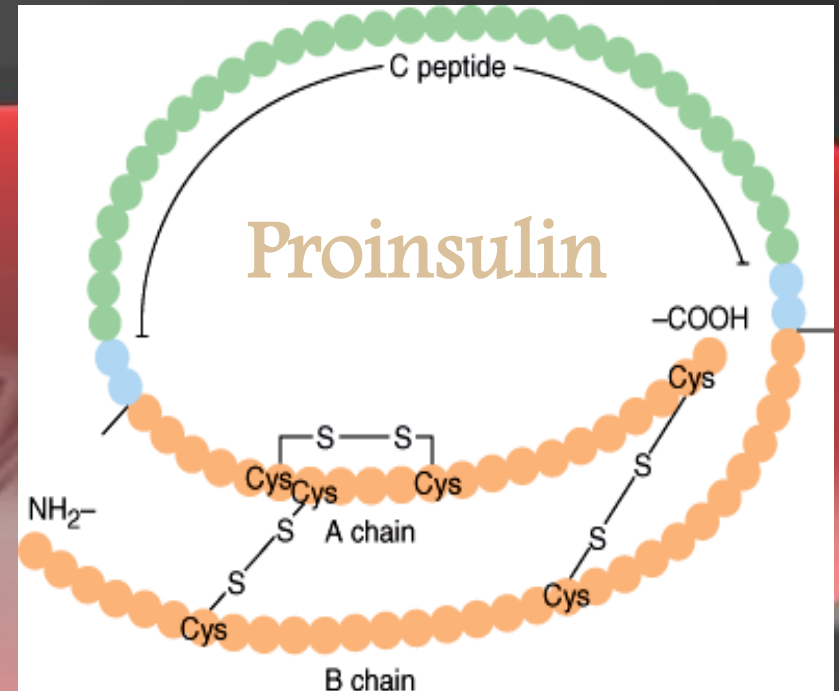
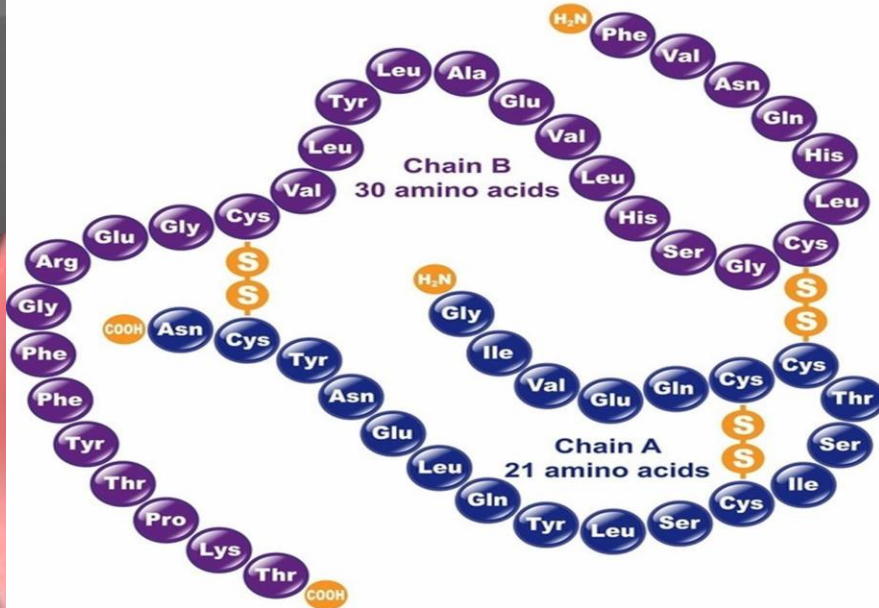
- Sir Frederick Banting was the co-discoverer of insulin and shared Canada's first Nobel Prize
- In the winter of 1921-22, the discovery of insulin was made by a team of researchers that included Banting
- Banting was hailed as the principal discoverer of insulin because his idea had launched the research



Frederick Banting  
1891-1941

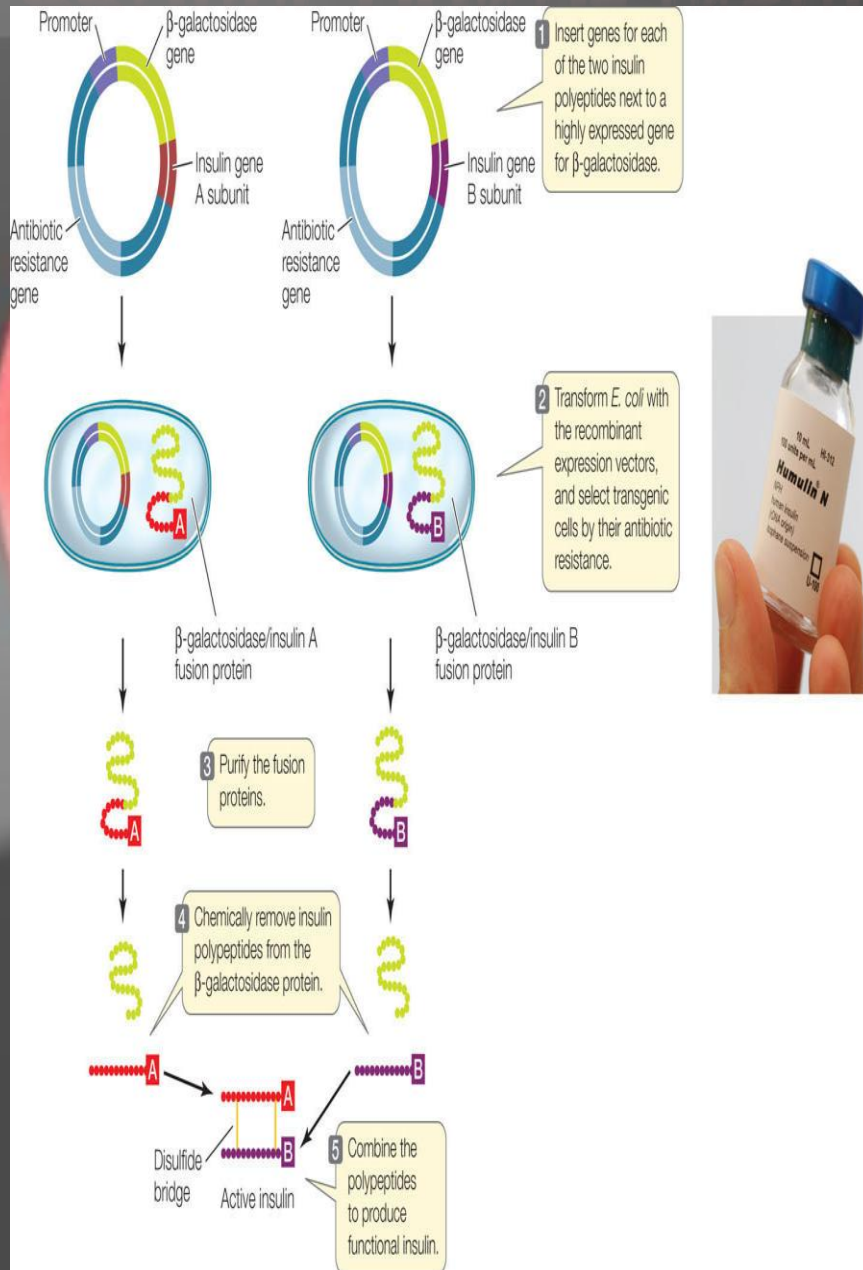


# Human Insulin



- Human Insulin is made up of 51 amino acids arranged in two polypeptide chains.
- A has 21 amino acids and B has 30 amino acids.
- The two polypeptide chains are interconnected by two disulphide bridges.
- A disulphide linkage also occurs in A chain.
- The hormone develops from a storage product proinsulin has 3 chains- A, B and C.
- C chain has 33 amino acids which is removed prior to insulin formation.

# PRODUCTION OF INSULIN BY RDNA TECHNOLOGY



- In 1983, Eli Lilly an American company, first prepared two DNA sequences corresponding to A and B chains of human insulin and introduced them in plasmids of *E. coli* to produce insulin chains.
  - Chains A and B were produced separately, extracted and combined by creating disulphide bonds to form human insulin (humulin).
- Steps involved are:
- Isolation of Donor or DNA segment
  - Formation of rDNA
  - Production of multiple copies of rDNA
  - Introduction of rDNA in recipient organisms
  - Screening of the transformed cells
  - Dr Saran Narang, a scientist of Indian origin, working in Ottawa, Canada was involved in cloning of insulin gene.



# GENE THERAPY

It is a technique of genetic engineering to replace a faulty gene by a normal healthy functional gene.

## TYPES OF GENE THERAPY:

- Germline Gene Therapy
- Somatic cell Gene Therapy

The diseases for which the Gene Therapy will be used:

- SCID
- Duchenne Muscular Dystrophy
- Cystic Fibrosis

The first clinical gene therapy was given in 1990 to a 4 year old girl with adenosine deaminase (ADA) deficiency. The enzyme is very important for the function of immune system.

# ADENOSINE DEAMINASE DEFICIENCY

- In some children this ADA can be cured by bone marrow transplantation.
- In others it can be treated by enzyme replacement therapy, in which functional ADA is given to the patient by injection.
- But in both approaches patients are not cured completely, as these patients do not have functional T-lymphocytes.
- T-lymphocytes are extracted from the bone marrow of the patient and are cultured outside the body.
- Functional ADA cDNA ( a retroviral vector) is then introduced into these lymphocytes, which are reinjected into the bone marrow of the patient.
- The patient requires periodic infusions of such genetically engineered lymphocytes as these cells do not remain alive always. But if injected at early embryonic stages it may be a permanent cure.



# MOLECULAR DETECTION

- ❖ rDNA, PCR, ELISA are some of the techniques where early diagnosis of an infection is possible.
- ❖ Very low concentrations of bacteria or virus can be detected by amplification of their nucleic acid by PCR. This is used in the suspected cases of AIDS and cancer.
- ❖ ELISA is based on the principle of antigen and antibody interaction.



# ACKNOWLEDGEMENT

The following text books and the sites were referred to complete this PPT:

1. Text book of NCERT Class – XII

2. Trueman's Elementary Biology Part – 2

3. Google images



*Thank You*

