

The Use of Recombinant DNA to Produce Human Insulin

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Why synthesize human insulin?

- ▶ Patients' immune systems do not produce antibodies against human insulin as they do with bovine or porcine insulin
 - ▶ Projected decline in the production of animal-derived insulin
 - ▶ Need for a more reliable and sustainable method of obtaining the product
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Why is insulin needed?

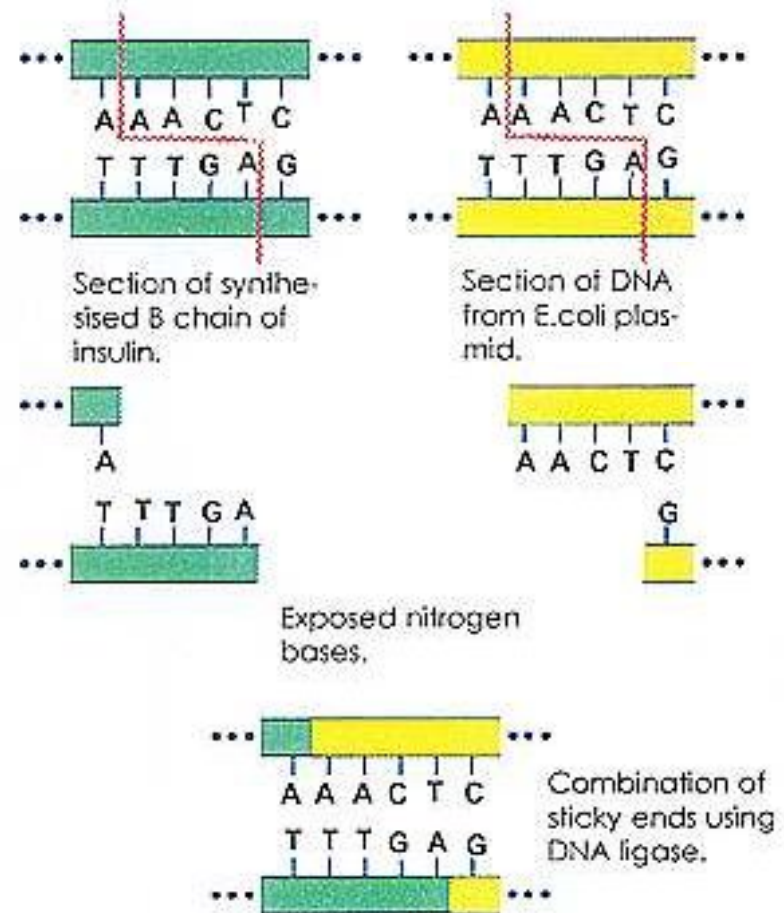
- ▶ Protein hormone produced by beta cells of islets of Langerhans in the pancreas
- ▶ Regulates blood sugar by allowing uptake of glucose from bloodstream into body cells
- ▶ Patients with diabetes have insufficient or impaired production of insulin

Structure of Insulin

- ▶ Two polypeptide chains; one with 21 amino acids and the second with 30 amino acids
- ▶ Chains are linked via a disulfide bond
- ▶ Gene encoding the insulin protein is found on chromosome 11

Recombinant DNA Technique

- ▶ Restriction enzymes used to cut out insulin gene and to cut a bacterial (*E. coli*) plasmid at the same “sticky ends”



Recombinant DNA Technique

- ▶ Mutant strains of *E. coli* used to avoid bacteria attacking “foreign” genes
- ▶ Insert insulin gene next to *E. coli* B-galactosidase gene which controls transcription
- ▶ Bacterial cells replicate and make copies of insulin gene

Recombinant DNA Technique

- ▶ Insulin protein is purified (B-galactosidase removed)
- ▶ Chains are mixed and disulfide bridges form
- ▶ Yeast cells provide a sterile growth medium
- ▶ Final product is Humulin – chemically identical to human insulin

Possible Complications of Using Human Insulin

- ▶ hypoglycemia (low blood sugar) tends to be more common than with animal insulin