4. Type I diabetes: how molecular and cell biology research facilitate treatments

What is type I diabetes?

Every year, about 90 000 people worldwide, mostly children and young people, are diagnosed with type 1 diabetes – a disease in which the body does not produce the hormone insulin. Type 1 diabetes patients develop an autoimmune response against insulin-producing beta-cells in the pancreas, i.e. their immune system attacks and destroys these cells, and the absence of insulin leads to elevated blood glucose levels. *You can learn more about insulin, its release, actions and regulation in "Insulin signalling" section on the "Regulation of metabolism by cell signalling" resource*.

Symptoms of the disease include increased hunger and thirst, frequent urination and weight loss. If untreated, the disease could lead to kidney failure, cardiovascular disease and eye damage. Research is under way into how this disease might be both cured and prevented, but currently the only treatment is insulin therapy, involving life-long everyday injections of insulin.

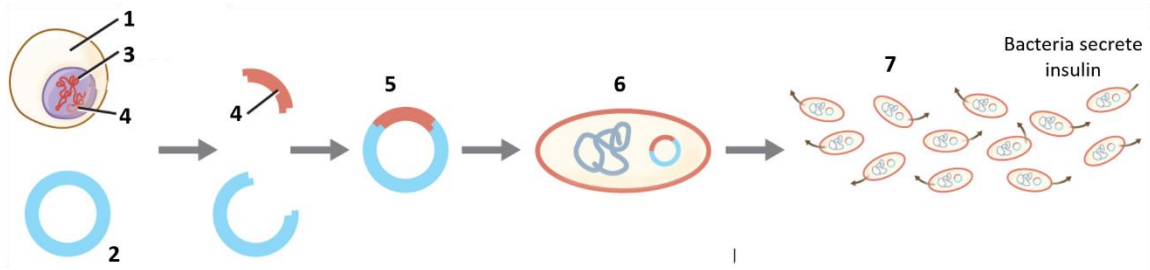
References

Katsarou, A. *et al*. Type 1 diabetes mellitus. *Nature Reviews Disease Primers* **3**, 17016 (2017).
"Diabetes Fact sheet N°312". World Health Organization (WHO). November 2016.

How genetic engineering revolutionised insulin production

So where to get this insulin from? In the first half of 20th century, insulin from cows and pigs was used. However, with advancements of biotechnology and genetic engineering, the following method was developed to produce human insulin on a large-scale, without involving animals. This method involves taking the sequence of the human insulin gene and inserting it into bacteria, allowing the bacteria to produce insulin which we can then collect.

Complete the table by writing the correct number from the diagram next to each label.



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http://cnx.org/contents/e42bd376-624b-4c0f-972f-e0c57998e765@4.2

Number	Label
	Genetically modified bacterium
	Human DNA
	Plasmid, which has insulin gene inserted
	Human cell
	Plasmid*
	The progeny of genetically modified bacteria
	Insulin gene

*Plasmid is a small circular DNA molecule sometimes present in addition to the chromosomal DNA in a cell

Other treatment options: stem cells

One of the promising alternative treatments for type 1 diabetes that is currently being investigated through clinical research is stem cell therapy. How do you think this might work?

Stem cells are cells that have an ability to differentiate into (i.e. become) many cell types. Stem cells can be grown in the lab.