pancreatic islets
and glucose regulation

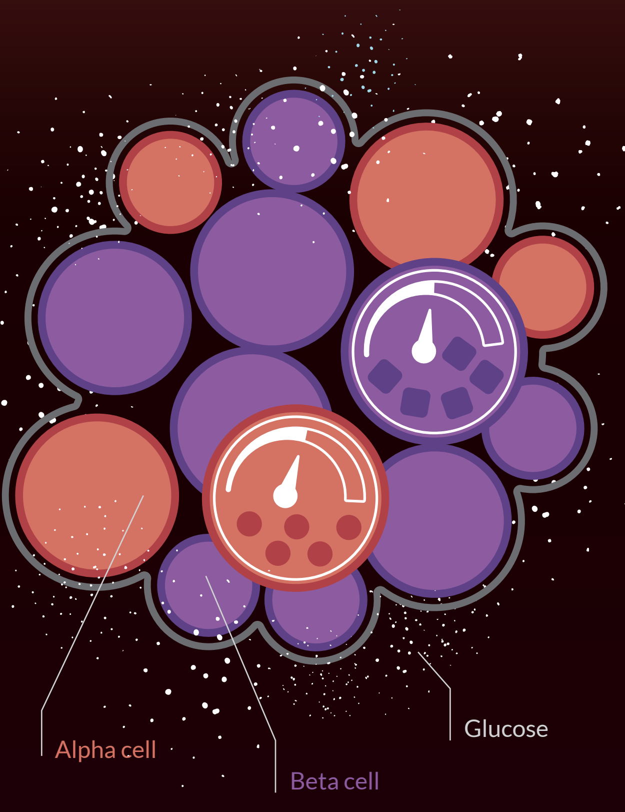
Our cells require a tight control of glucose supply to perform the functions needed to sustain life. Pancreatic islets play a key role in blood glucose regulation.

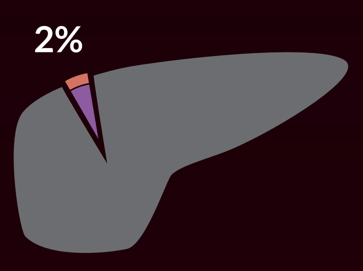
Islets of Langerhans behave as complex micro-organs

Islets are clusters of cells located in the pancreas. They are made up of different cell types involved in blood sugar regulation. The most abundant are alpha and beta cells.

Beta cells produce insulin hormone in response to high levels of blood glucose (blood sugar).

Alpha cells produce glucagon hormone in response to low levels of blood glucose.





Islets of Langerhans represent a very small portion of the pancreas. Although islets form only 2% of the tissue, their role is crucial in preventing glucose levels from getting dangerously too high or too low.

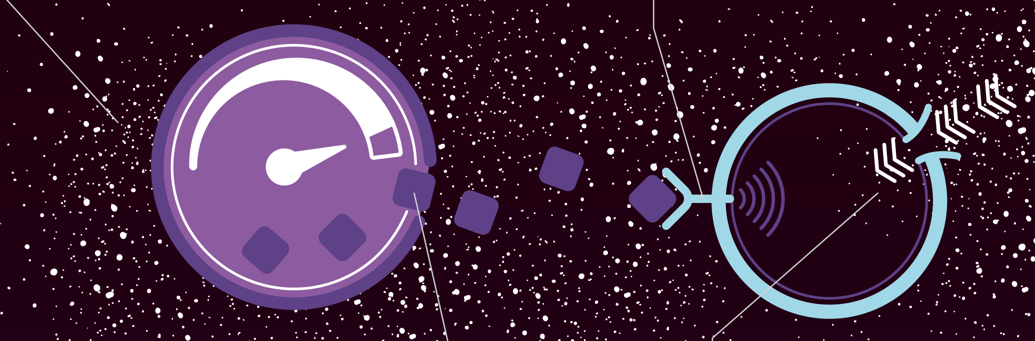
The remaining 98% of the pancreas is responsible for producing digestive juices.

Beta cells respond to high blood glucose

Beta cells act as glucose sensors, monitoring blood glucose levels. When they start to rise, insulin is released and signals cells in need of energy to take glucose in from the bloodstream.

Glucose derives from the food we eat and, after a meal, it moves through the bloodstream to fuel our body.

Insulin binds to specific receptors on other cells of the body. This interaction causes glucose channels to open.



An increase in blood sugar triggers beta cells to start producing insulin.

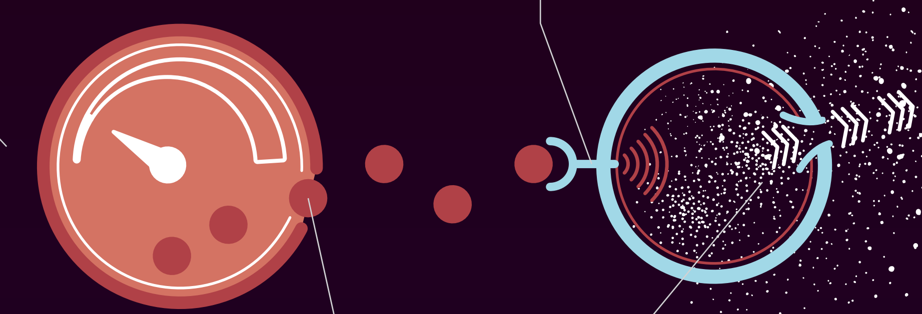
The absorbed glucose can be used right away as an energy source or stored for later mainly in the muscles and in the liver. As a result, blood glucose levels decrease.

Alpha cells respond to low blood glucose

Alpha cells are sensitive to a fall in blood glucose levels. Glucagon signals target cells, mostly in the liver and muscles, to break down their stored glucose allowing its diffusion into the bloodstream.

In fasting conditions, blood sugar levels drop and alpha cells release glucagon.

The interaction between glucagon and its receptor results in glucose release from the cells.

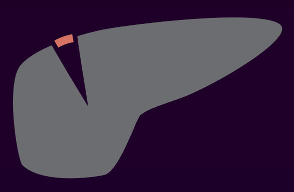


Glucagon works to counterbalance the effect of insulin.

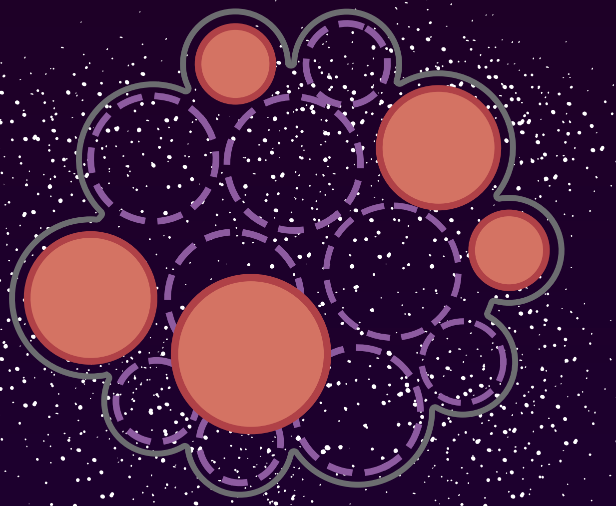
Blood glucose levels increase ensuring an adequate supply of energy to other cells.

Beta cell loss in type 1 diabetes

In type 1 diabetes, the healthy balance of blood glucose levels is compromised due to an impaired insulin production.



Type 1 diabetes is an autoimmune disease: for unknown reasons, a faulty immune system recognizes islets as foreign and mistakenly destroys beta cells. In absence of insulin, glucose cannot get into the cells where it is needed. As a result, blood sugar levels increase abnormally.



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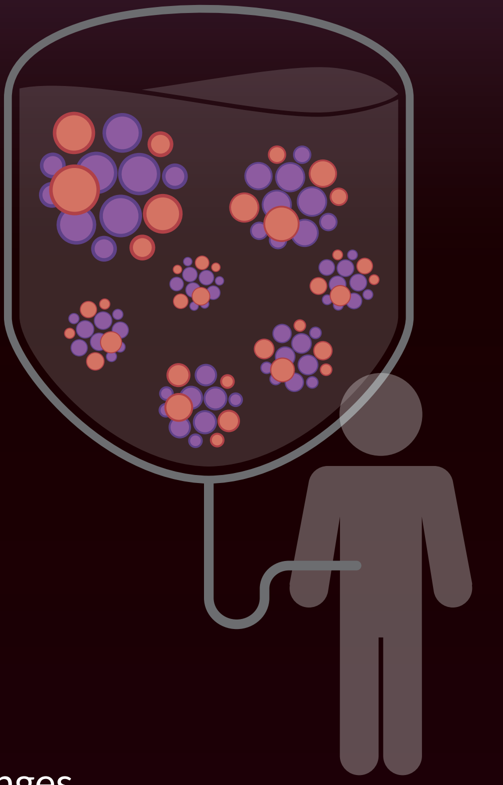
cell transplantation
and type 1 diabetes

Islet transplantation is an advanced strategy to replace the pancreatic cells that are damaged or missing in patients with type 1 diabetes.



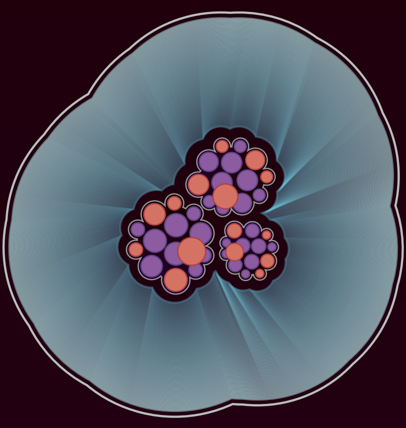
Islet transplantation restores pancreatic functions

Transplantation of islets is a safe and non-invasive procedure performed only in selected patients with type 1 diabetes. Eligibility criteria are a severe pancreatic failure with a highly unstable glucose control.

In type 1 diabetes beta cells are destroyed by the immune system and fail to produce insulin. Islet transplantation consists in cell infusion to restore a physiological production of the hormone, thus improving quality of life in patients.

Current challenges

- At least two donors are needed to provide a suitable number of insulin producing cells.
- The immune system recognizes the donor cells as foreign and reacts, rejecting the transplant.
- Immunosuppressive drugs are needed to avoid immune response against the transplanted islets.
- Insulin independence is only temporarily restored because beta cell number and function are lost.



Islet encapsulation overcomes some of the challenges of transplantation

Encapsulation entails coating the cells with a permeable and biocompatible material that protects the islets from the attack of the immune system. A successful encapsulation for diabetes therapy depends on several aspects.

- Capsule thickness should not hinder the access of oxygen and glucose or the release of insulin.
- The material needs to guarantee an adequate cell integration with the surrounding tissue.
- The capsule should provide a physiologically ideal environment for islet function and survival.
- The material of the capsule must avoid both inflammatory reaction and immune response.

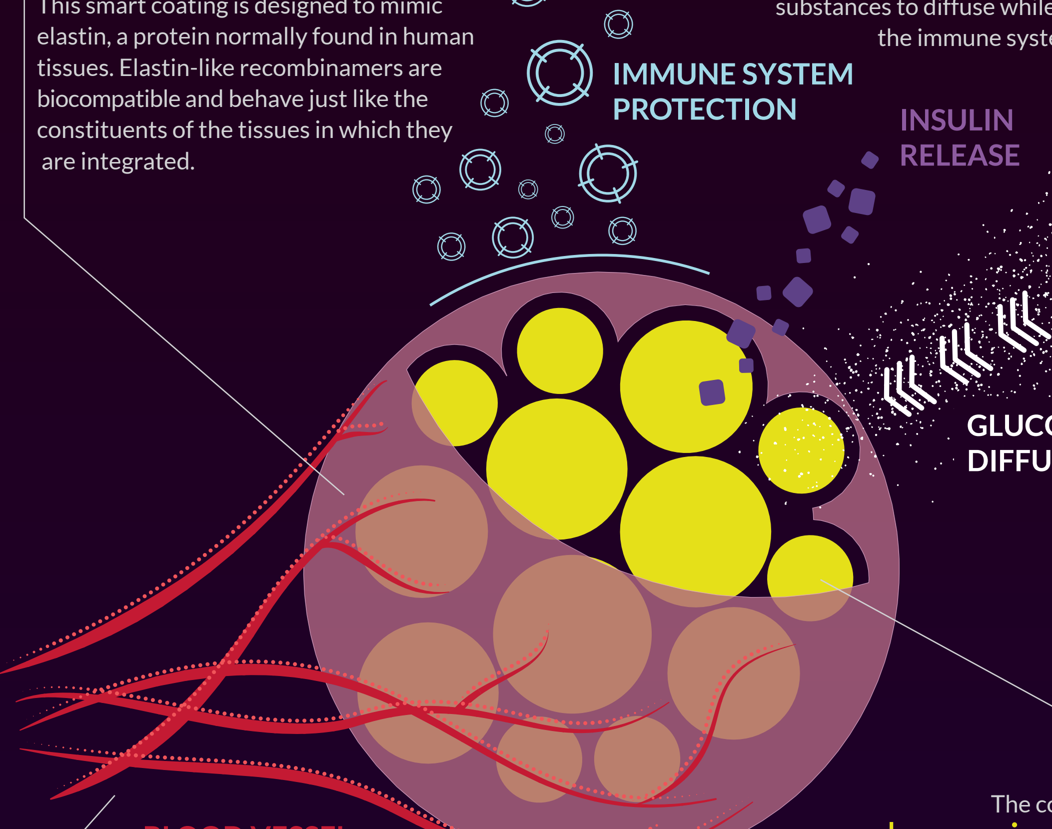
Elastislet's encapsulation strategy

The European Union is supporting cutting-edge research to overcome diabetes. Thanks to EU funding, Elastislet researchers are devising a strategy to combine biomaterial design and stem cell therapy for advancing encapsulation technologies.

Elastin-like recombinamers

form Elastislet's bioengineered capsule. This smart coating is designed to mimic elastin, a protein normally found in human tissues. Elastin-like recombinamers are biocompatible and behave just like the constituents of the tissues in which they are integrated.

Elastislet's thin and porous capsule assures permselectivity, allowing substances to diffuse while keeping the immune system away.



The capsule boosts vascularization thus enhancing cell oxygenation and the supply of nutrients.

The core holds **human induced pluripotent stem cells** (hiPSCs) derived from adult tissue and transformed into insulin-producing cells. hiPSCs will represent an "unlimited" source of implantable cells.

Insulin-producing hiPSCs coated with Elastin-like recombinamers is a promising technology to replace the missing cells in patients with type 1 diabetes.

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