

Energy Metabolism

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Pancreas Gland

Exocrine and Endocrine Gland

The pancreas is unique in that it's both an endocrine and exocrine gland. In other words, the pancreas has the dual function of secreting hormones into blood (endocrine) and secreting enzymes through ducts (exocrine).

Pancreatic hormones are released by the pancreas as a direct response to the glucose levels of the body's inner environment. (It does NOT react to hormones released by the hypothalamus or pituitary glands.)

Exocrine gland

- provides enzymes for digestion and for systemic catabolism
- provides bicarbonate to alkalize the small intestines for enzymatic activity and digestion
 - (alkaline pH in intestines is required for carbohydrate and fat digestion and to protect intestinal mucosa)

Endocrine gland

- Manages blood sugar by secreting insulin in response to high blood glucose levels and glucagon where glucose levels fall

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Hormones of the Pancreas

The production of pancreatic hormones, including insulin, somatostatin, gastrin, and glucagon, play an important role in maintaining sugar and salt balance in our bodies.

Primary hormones secreted by the pancreas include:

- Gastrin:** This hormone aids digestion by stimulating certain cells in the stomach to produce acid.

- Glucagon:** Glucagon has a major role in maintaining normal concentrations of glucose in blood, and is often described as having the opposite effect of insulin. It stimulates your cells to release glucose, and this raises your blood glucose levels. Glucagon is a linear peptide of 29 amino acids.

- Insulin:** This hormone regulates blood glucose by allowing many of your body's cells to absorb and use glucose. In turn, this drops blood glucose levels.

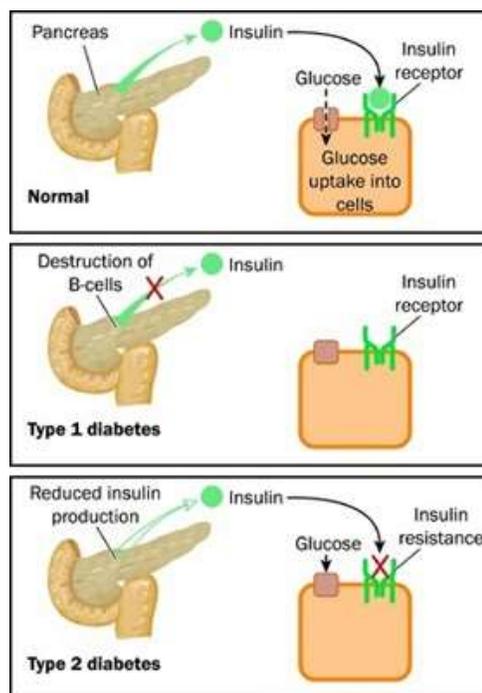
- Somatostatin:** When levels of other pancreatic hormones, such as insulin and glucagon, get too high, somatostatin is secreted to maintain a balance of glucose and/or salt in the blood.

- Vasoactive intestinal peptide (VIP):** This hormone helps control water secretion and absorption from the intestines by stimulating the intestinal cells to release water and salts into the intestines.

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- Type 1 diabetes:** Loss of the ability of beta cells to produce insulin. Insulin deficiency causes a range of complications, so people with type 1 diabetes have to take insulin to help their body use glucose appropriately.

Much of the damage found in diabetes and in insulin dysregulation is to the microvasculature. The kidneys, retina, brain, and toes are the most common areas affected. The influence of insulin promotes capillary smooth muscles to increase feeding, i.e., insulin increases the intake of glucose, amino acids, and fats into the smooth muscle walls leading to hypertrophy and damage of the file vasculature and capillaries. This makes the capillary lumen smaller, reducing circulation in the capillaries associated with diabetes.



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Support for Type 1 - Insulin dependent Diabetic

Product	Dosing Range	Description
GlucoBalance	6 caps qd	Multivitamin/mineral designed for diabetic and dysinsulinism
Optimal EFAs Or Mixed EFAs	6 caps qd	Balanced blend of Omega-3,-6,and-9 from fish, flax seed, and borage oils. Mixed EFAs contain sesame seed oil indicated by pain/inflammation.
Bio-Cyanidins	3-6 tablets qd	Antioxidant and bioflavanoid formulation of bine bark and grape seed extract useful for microvasculature health. Improves the fine capillaries of skin and tissues.

Consider additional support:

Cytozyme-PAN	2-4 tablets with meals	Neonatal pancrease. For repair and rebuilding of pancrease, diabetics, prediabetics, pancreas stress, enzyme deficiency.
Bio-6-Plus	2-4 tablets with meals	Pancreas extract containing digestive enzymes are often deficient in diabetics. Promotes digestion and enzyme activity.

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Type 2 diabetes: Type 2 diabetes is much more prevalent than type 1. People with type 2 diabetes may be able to produce insulin, but it is not effective at the target cells while blood sugar remains elevated. They might also be unable to produce enough insulin to handle the glucose in their body. Lifestyle choices, such as diet and exercise, play a major role in managing and preventing type 2 diabetes.

Deficiencies in chromium, vanadium, thiamin, or zinc may render insulin less effective.

Physiologically, it is very important for the body to maintain a narrow range of blood sugar. Insulin and the kidney threshold manage glucose on the up side, while glucagon, glucocorticoids, and gluconeogenesis manage it on the low side.

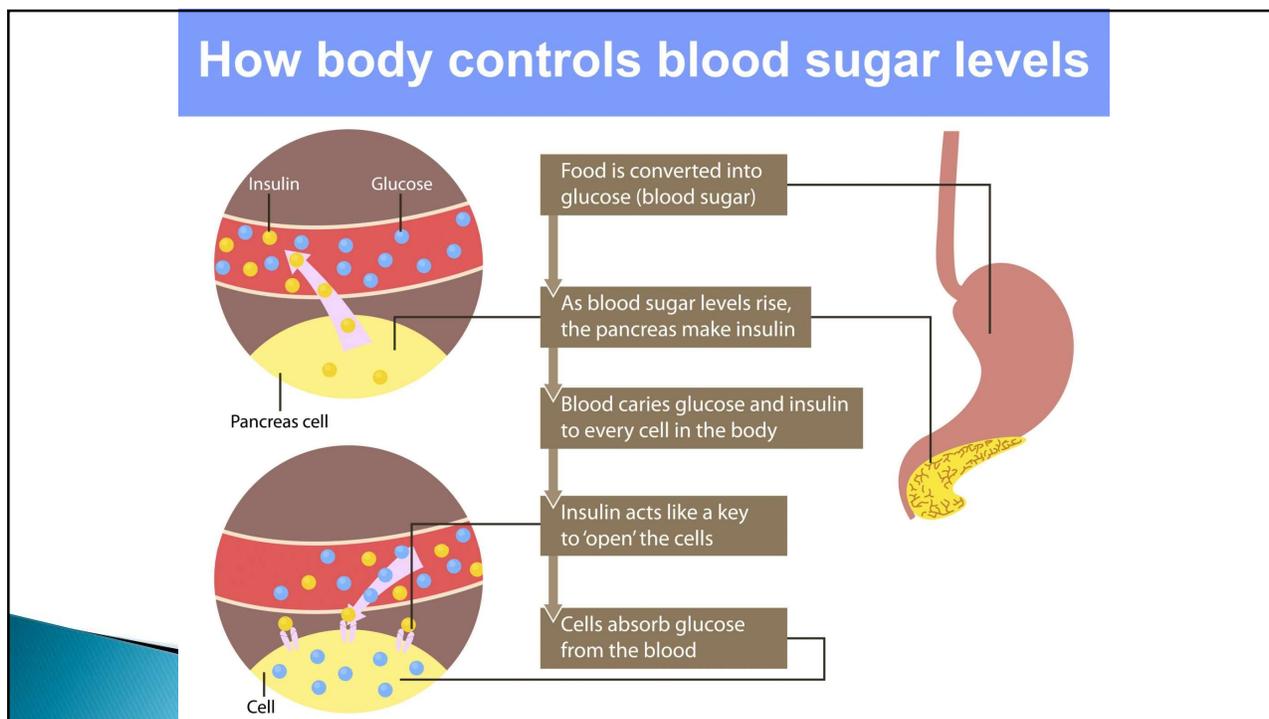
High blood sugar

- breeding ground for microorganisms and cancer
- disrupts pH, enzyme function, fat metabolism, electrolyte balance

Low blood sugar

- foggy brain, slow metabolism, slow physical and mental activity

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“Type 1 and type 2 diabetes are characterized by chronic inflammation; both diseases involve pancreatic islet inflammation, while systemic low-grade inflammation is a feature of obesity and type 2 diabetes. Long-term activation of the innate immune system impairs insulin secretion and action, and inflammation also contributes to macrovascular and microvascular complications of diabetes. Strong preclinical evidence and proof-of-principle clinical trials demonstrate that targeting inflammatory pathways can prevent cardiovascular disease and other complications in patients with diabetes.”

Donath, M.Y., Dinarello, C.A. & Mandrup-Poulsen, T. Targeting innate immune mediators in type 1 and type 2 diabetes. *Nat Rev Immunol* 19, 734–746 (2019).

Inflammatory Pathway in Diabetes

Insulin release
Increased glucose level
NLRP3 activation
β-cell
IL-1β
Macrophage proliferation or recruitment and further release of IL-1β
Apoptotic β-cell
IL-1β
IL-1Ra
Treatment with IL-1Ra breaks inflammatory cycle
IL-1β decreases insulin secretion and induces β-cell apoptosis

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