Cellular hexose transport

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Introduction

Reactome is open-source, open access, manually curated and peer-reviewed pathway database. Pathway annotations are authored by expert biologists, in collaboration with Reactome editorial staff and cross-referenced to many bioinformatics databases. A system of evidence tracking ensures that all assertions are backed up by the primary literature. Reactome is used by clinicians, geneticists, genomics researchers, and molecular biologists to interpret the results of high-throughput experimental studies, by bioinformaticians seeking to develop novel algorithms for mining knowledge from genomic studies, and by systems biologists building predictive models of normal and disease variant pathways.

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Literature references


Reactome database release: 79

This document contains 1 pathway and 17 reactions (see Table of Contents)
Two gene families are responsible for glucose transport in humans. SLC2 (encoding GLUTs) and SLC5 (encoding SGLTs) families mediate glucose absorption in the small intestine, glucose reabsorption in the kidney, glucose uptake by the brain across the blood-brain barrier and glucose release by all cells in the body. Glucose is taken up from interstitial fluid by a passive, facilitative transport driven by the diffusion gradient of glucose (and other sugars) across the plasma membrane. This process is mediated by a family of Na+-independent, facilitative glucose transporters (GLUTs) encoded by the SLC2A gene family (Zhao & Keating 2007; Wood & Trayhurn 2003). There are 14 members belonging to this family (GLUT1-12, 14 and HMIT (H+/myo-inositol symporter)). The GLUT family can be subdivided into three subclasses (I-III) based on sequence similarity and characteristic sequence motifs (Joost & Thorens 2001).

Hexoses, notably fructose, glucose, and galactose, generated in the lumen of the small intestine by breakdown of dietary carbohydrate are taken up by enterocytes lining the microvilli of the small intestine and released from them into the blood. Uptake into enterocytes is mediated by two transporters localized on the luminal surfaces of the cells, SGLT1 (glucose and galactose, together with sodium ions) and GLUT5 (fructose). GLUT2, localized on the basolateral surfaces of enterocytes, mediates the release of these hexoses into the blood (Wright et al. 2004). GLUT2 may also play a role in hexose uptake from the gut lumen into enterocytes when the luminal content of monosaccharides is very high (Kellet & Brot-Laroche 2005) and GLUT5 mediates fructose uptake from the blood into cells of the body, notably hepatocytes.

Cells take up glucose by facilitated diffusion, via glucose transporters (GLUTs) associated with the plasma membrane, a reversible reaction. Four tissue-specific GLUT isoforms are known. Glucose in the cytosol is phosphorylated by tissue-specific kinases to yield glucose 6-phosphate, which cannot cross the plasma membrane because of its negative charge. In the liver, this reaction is catalyzed by glucokinase which has a low affinity for glucose (Km about 10 mM) but is not inhibited by glucose 6-phosphate. In
other tissues, this reaction is catalyzed by isoforms of hexokinase. Hexokinases are feedback-inhibited by glucose 6-phosphate and have a high affinity for glucose (Km about 0.1 mM). Liver cells can thus accumulate large amounts of glucose 6-phosphate but only when blood glucose concentrations are high, while most other tissues can take up glucose even when blood glucose concentrations are low but cannot accumulate much intracellular glucose 6-phosphate. These differences are consistent with the view that the liver functions to buffer blood glucose concentrations, while most other tissues take up glucose to meet immediate metabolic needs.

Glucose 6-phosphatase, expressed in liver and kidney, allows glucose 6-phosphate generated by gluconeogenesis (both tissues) and glycogen breakdown (liver) to leave the cell. The absence of glucose 6-phosphatase from other tissues makes glucose uptake by these tissues essentially irreversible, consistent with the view that cells in these tissues take up glucose for local metabolic use.

Class II facilitative transporters consist of GLUT5, 7, 9 and 11 (Zhao & Keating 2007, Wood & Trayhurn 2003).

**Literature references**


**Editions**

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GLUT1 (SLC2A1) tetramer transports Glc from extracellular region to cytosol

**Location:** Cellular hexose transport

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