



Physiology vs. Metabolism

The same, part of, different?

History

- During the modifications of the development portion of the graph, we split out processes that occurred at a cellular level from those that occurred at a higher level.
 - Many cellular processes are universally conserved
 - Eventually all other processes would consist of building blocks of cellular processes

Physiological processes

- We decided since the graph was already arranged in this way, we would break physiology into organismal physiology and cellular physiology
 - Struggled with whether cell growth and or maintenance was equivalent to cell physiology
 - Struggled with how to fit metabolism into the physiology part of the graph
 - Is metabolism biochemical physiology?

Physiological process continued

- Decided to put metabolism under physiological process.

GO:0008105 ; biological process

-GO:0007582 ; physiological process

---GO:0008152 ; metabolism

-GO:0009987 ; cellular process

--GO:0050875 ; cellular physiological process

-----GO:0008151 ; cell growth and/or maintenance

Metabolic things are wrong

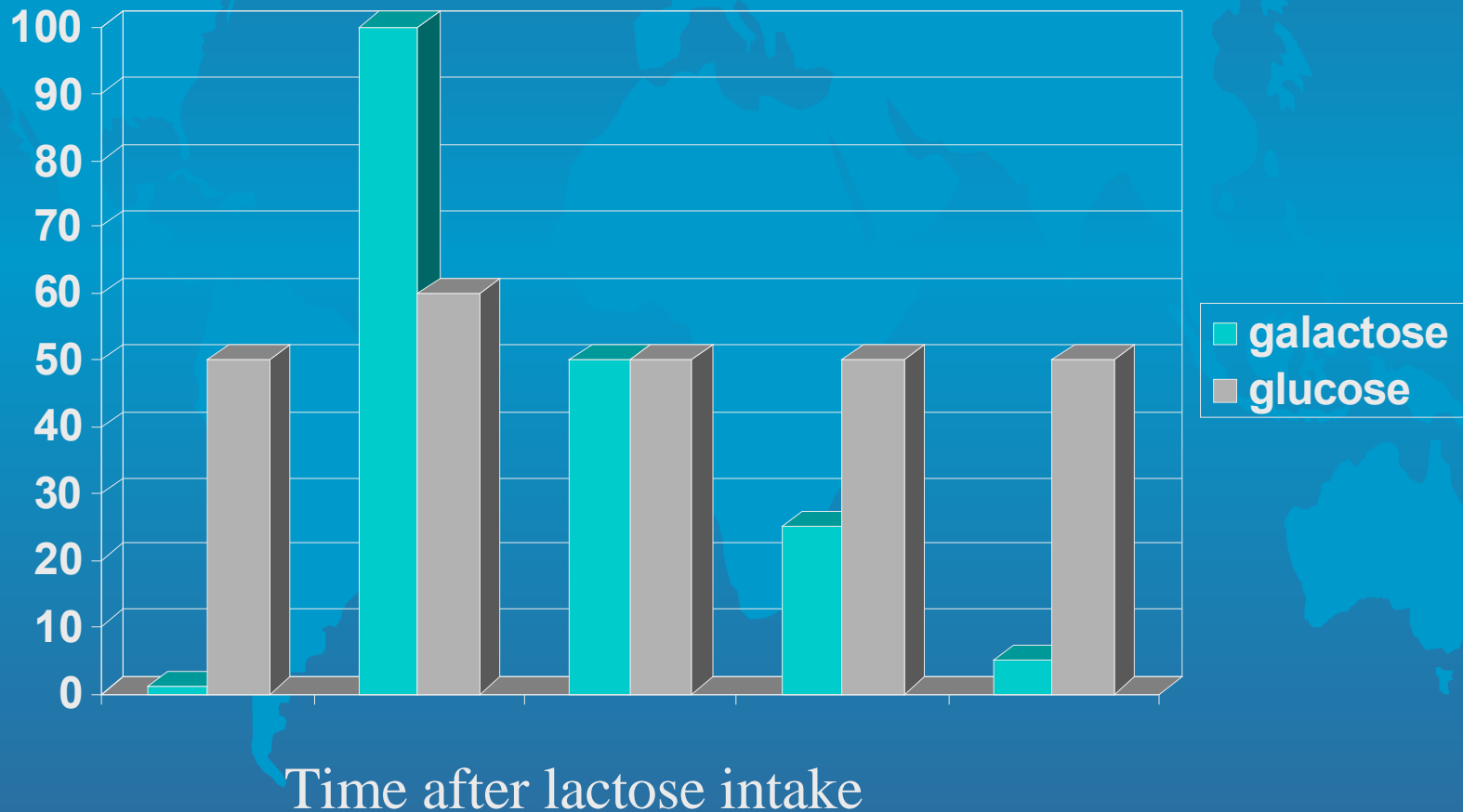


- DNA repair
- Transcription
- RNA metabolism
- Protein folding
- Protein targeting
- Protein modification
- Protein biosynthesis

What do we do with metabolism?

- Split it out to the top level of the graph
- Put it under cellular process
- Keep it under physiological process but have some of its children (DNA metabolism) be cellular
 - The problem here is where does it begin and end. Some argue that getting the building blocks to make a macromolecule are part of its metabolism. So it includes things like transport of starting materials.

We can' simply make it cellular:glucose homeostasis



A world map in a light blue color is centered on a dark blue background. The map shows the outlines of the continents.

Glucose homeostasis is systemic

Pancreatic beta cells

Hypothalamus

Pancreatic beta cell

- Serves as a glucostat for high glucose levels
 - Glucose transporters bring glucose in
 - Glukokinase and hexokinase make G6P
 - When the rate of production of G6P gets high enough the cell depolarises
 - Calcium channels open
 - The cell secretes insulin by exocytosis

Hypothalamus

- Serves as glucostat for low glucose levels
 - Actual sensor is unknown
 - Activates autonomic nervous system
 - Adrenal medulla->adrenaline and noradrenaline
 - Pancreatic alpha cells->glucagon
 - Pituitary gland->ACTH
 - Adrenal cortex->glucocorticoids

The insulin/glucagon ratio

- Glucagon is an antagonist of insulin
 - It stimulates pathways that put glucose into the blood
 - Take it out of storage (glycogen)
 - Make new glucose from amino acids
- Insulin is an antagonist of glucagon
 - Stimulates pathways that put glucose into storage



It is the **Insulin/Glucagon ratio**
that is the **key factor**

lower ratio by reducing insulin or
increasing glucagon

Bottom line is this is happening on a
much higher level than a single cell

The brain uses glucose as its only energy source

- Glucose must get through the blood-brain barrier
 - Blood vessel endothelial cell transporters put glucose into the cerebrospinal fluid
 - Brain cell plasma membrane transporters take glucose into the brain cells
 - There is also diffusion

So back to the problem with the GO

- Is glucose homeostasis a physiological process?
 - It relies on many different cells and systems to be maintained.
- But wouldn't all of these steps also be thought of a glucose metabolism?
 - What about the initial digestion of lactose into galactose and glucose?

Conclusion

- We define metabolism to be restricted to processes where there is a transformation of the chemical substance.
- This means that simple transport is not a part of metabolism.

Do we need Organismal metabolism?

- Yes. We still need it for things like protein, and carbohydrate catabolism in higher organisms.
- We also need it for things like C4 photosynthesis.
 - This process is split among three different cells
 - Metabolites are transported between the cells
 - In this case, the transport IS part of the metabolic process because of its necessity.