

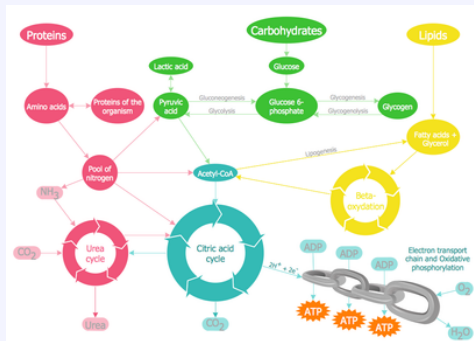
#13: Summary of Metabolic Pathways

BIOCHEM2280

Fed State

- **Carbohydrates ingested = increased blood glucose**
- Pancreas releases insulin
- Tissues take glucose via transport → G6P
 - Some stored in liver + muscle as glycogen
 - Some enter pentose phosphate pathway → NADPH + R5P
- OxPhos makes ATP
- Energy readily available
 - Glycogen storage, triacylglycerol storage favoured
 - Active protein synthesis + biosynthetic pathways (PPP)

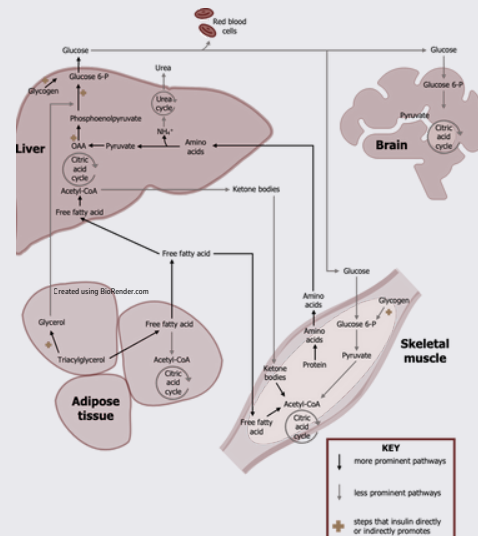
Note: refer to class material for the full diagram of all metabolic pathways



Sourced from: <https://www.conceptdraw.com/examples/catabolic-pathways-flowchart>

Unfed State: Liver

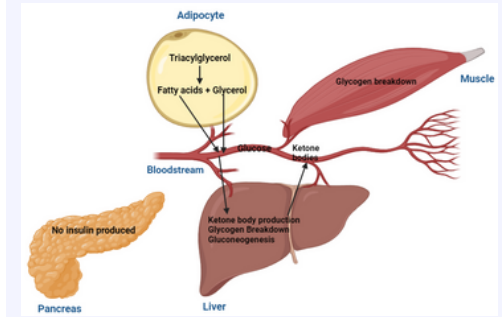
- **Blood glucose decrease, glucagon increase**
- Release glycogen → G6P (16-24 hrs)
- Gluconeogenesis degrades proteins → amino acids
- Liver gets own energy from fatty acids (adipocytes), released from the triacylglycerol
 - Beta oxidation breaks down acetyl-CoA → fuel ATP synthesis
 - Nitrogen depleted
 - Acetyl-CoA → ketone bodies into blood (72 hrs)
- Brain uses glucose from gluconeogenesis (glycerol as starting material)
 - No strength to clear lungs, infections, lack essential amino acids
 - Unable to maintain ion gradients
- Healthy person has fat for 2-3 months of fasting until starvation (will then consume proteins)



Sourced from: https://med.libretexts.org/Bookshelves/Basic_Science/Cell_Biology_Genetics_and_Biochemistry_for_Pre-Clinical_Students/03%3A_Fed_and_Fasted_State/03.01%3A_Fed_and_Fasted_State

Type I Diabetes

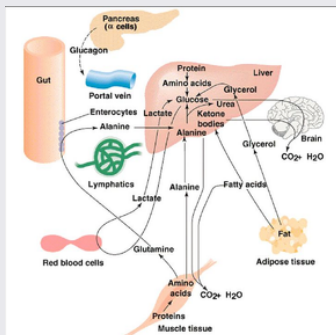
- Childhood autoimmune destruction of pancreatic cells that produce insulin
- Body is fasting
- Fatty acids released from triacylglycerol live
 - Ketone body production, glycogen breakdown, gluconeogenesis favored
- Increased blood acidity
- Increased blood glucose = glycosylation of protein
 - Nerve and eye damage
- Glucose draws more water = increased urine production = increased thirst
- **Treatment:** Periodic insulin injections



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Unfed State: Most Tissues

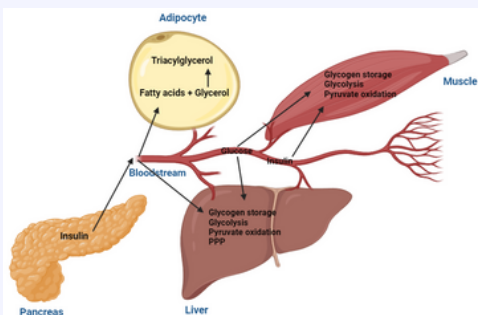
- **Metabolism slows down to save energy: Glucose → G6P**
- Muscle cells release glycogen → G6P
- Muscles degrade proteins → amino acids for gluconeogenesis
 - Nitrogen is eventually depleted
- Most tissues take up ketone bodies from liver
 - **NOT brain cells**
- Decrease blood glucose = increased glucagon = inhibit glycolysis, stimulate glycogen breakdown



Sourced from: Wiley-Liss, Inc, 1997

Healthy Response to High Blood Glucose

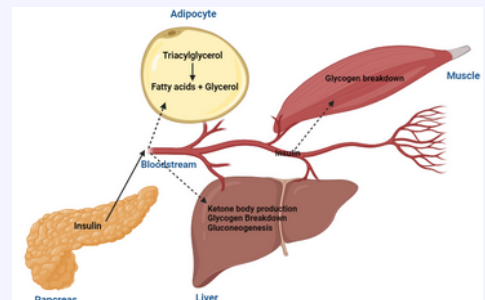
- Increased blood glucose = pancreas secretes insulin to blood stream
- Insulin promotes glucose intake and glycogen storage
- Inhibit fatty acid release
- Stimulate **fatty acid synthesis** from acetyl-CoA and storage as triacylglycerols in the liver
- Glucose oxidation produces ATP (Pentose phosphate pathway)



Created using BioRender.com

Type II Diabetes

- Overweight, sedentary individuals
- Pancreatic cells **reduced in function**
- Insulin resistance, small amount secreted
- **Treatment:** Weight loss, increased fiber, reducing mono and disaccharides in diet, drugs treatment, insulin injections for some



Created using BioRender.com

Source of Fuels

1. Immediately after meal → mainly carbohydrates, some fatty acids, some amino acids (still less than fatty acids)
2. After 24h fast → mainly fatty acids, some carbohydrates and amino acids (equal amounts approx.)
3. After prolonged fasting (ketosis) → about 95% fatty acids, some amino acids, **NO GLUCOSE**

Note: all cells in body can use ketone bodies as fuel.

Calories

- Energy content of food
- 1 Calorie (**Capital C**; dietary calories/food calories/kilogram calories/large calories) = 1000 calories (gram calories/small calories)
- 1 calorie = amount of energy needed to raise the temperature of one gram of water by one degree Celsius at standard pressure
- 1 g of **fat** provides 9 Calories
- 1 g of **carbohydrates/proteins** provides 4 calories
 - *Numbers assume that biomolecules are absorbed by the body and can be broken down in cells
- Dietary fibre provides little energy to cells, because it is not degraded and absorbed into the body

LETTER TO THE STUDENT

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Created by students for other students, this resource aims to provide a comprehensive view of material taught within this course. Our goal is to help students develop, solidify, and refine their understanding of course content. Our resource is also open access meaning there are no financial or legal barriers to students who wish to access and use our resource.

To maximize the benefits of this resource, we recommend that you read carefully through the topics, focusing on *bolded terminology, compound structures, and diagrams*. Although this resource ideally will cover all testable content as of the 2024-2025 academic year, we cannot guarantee this and strongly encourage you to cross-reference with class material and notes.

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We appreciate you using our resource! Best of luck on your exams :)

-The WebStraw team

 Note to Instructors: If this resource has been created for your course and you would like to collaborate with us, please email us at team@webstraw.org

biochem 2280.

BROUGHT TO YOU
BY WEBSTRAW

a handmade guide

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Questions? Ask us at team@webstraw.org