Macronutrient Metabolism Overview

Focused on energy use (not digestion),
for non-athletes

- Macronutrients = energy-providing compounds: **protein, fat, carbs**
- Micronutrients = vitamins/minerals in smaller amounts essential for functions, but not energy
- '***Essential***' = in Nutrition, means must come from the diet
- Most nutrient absorption occurs in the small intestine
- Macros are chemical categories, not foods
  (for example, rice is rich in carbs, not a carb)

CENTRE LOW CARB

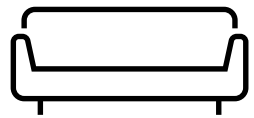
Whole Foods

- **Carb** (virtually all): sugar, honey, fruit-juice concentrate, maple syrup
- **Protein/Carb**: fruits & veg. (low protein), grains & legumes (higher protein)
- **Protein/Carb/Fat**: nuts, seeds, milk, avocado (mixed macros, mostly fat)
- **Protein/Fat**: meat, fish, eggs, cream, cheese, plain yogurt
- **Fat** (virtually all): oils, butter, lard

Notes:

- In nature, there are no protein-only whole foods.
- Some foods — rice, potatoes, corn starch, wheat flour (even fortified) — are functionally carb-only.
- Mayonnaise is functionally fat-only.

Where Does Energy Go (Without Exercise)?

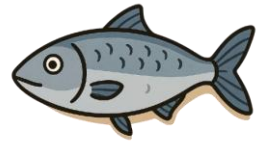


- Basal Metabolic Rate (**BMR**): 60% - 70%
  (includes heart, breathing, 20% brain)
- Digestion: 10%
- Non-exercise activity: 15% - 30%

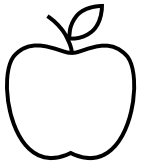
Exercise builds healthy cells and mitochondria
- but has very limited impact on weight loss

Don’t lose weight to get healthy - get healthy, and weight recalibrates.

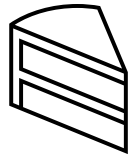
Protein Metabolism



- Protein used for growth, repair, enzymes, hormones
- Broken into **amino acids**, absorbed and distributed
- Excess amino acids → converted to energy in liver → nitrogen waste → kidneys
- No storage for amino acids; excess may stress kidneys (if kidney issues)
- Optimal protein intake depends on many factors (age, gender, activity level)
- Optimal intake: 10% - 35% of calories, or ~ 0.8g/kg body weight
- Muscle breakdown is the body's Plan C for energy
- Plant-based protein is not the same as animal-based protein

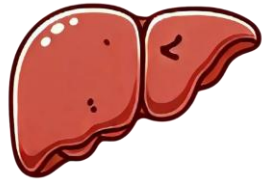


Carb Metabolism



- Mostly plant-sourced (except lactose)
- Digested into mostly glucose, absorbed into bloodstream
- Three fates:
  - Immediate energy
  - **Glycogen** storage (short-term reserve)
  - Fat storage (as TGs, via **Lipogenesis**)
- Fiber = indigestible plant material, passes through

Glucose & Gluconeogenesis (GNG)



- Glucose is required for certain cells (e.g., red blood cells)
- When carbs are low, body makes glucose via **GNG** from non-carb sources
- GNG is triggered by carb scarcity, stress, injury, infection
- Even pure carnivores (like lions) rely on GNG
- Result: *Humans need glucose, but not dietary carbs*

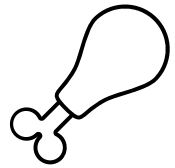
↑ Insulin & Glucagon ↓

- **Insulin**: lowers blood sugar, promotes glucose storage
- **Glucagon**: raises blood sugar, triggers glycogen and fat release
- Together, they maintain energy balance

Stored Fat as Energy

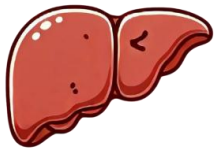
- Excess carbs & fat → both stored as **TGs** (fat)
- **Lipolysis**: TGs broken into free fatty acids (**FFAs**) + glycerol
- FFAs → energy in mitochondria
- Glycerol → glucose via GNG
- *Body constantly cycles between lipogenesis and lipolysis* ⇆

Fat Metabolism



- Highly bioavailable; absorbed as triglycerides (**TGs**)
- Transported via chylomicrons in blood
- Two fates:
  - Immediate energy
  - Storage as TGs (via Lipogenesis, same as carbs)
- Fat also serves structural roles (cell membranes, hormones). For this reason, dietary fat (like protein) is *essential*.

Ketones & Fat Adaptation



So where do **ketones** fit into all of this? ***So far, they don't.***

Ketones = alternative fuel for brain, muscles, heart

When carbs are very low, GNG and **ketogenesis** are triggered.
The liver makes:

- Glucose for glucose-dependent tissues
- Ketones for everything else
- Ketones = survival fuel during scarcity (e.g., hibernation)

Fat-adaptation = metabolic re-tooling (not just a diet shift)

- Changes in hormones, enzymes, mitochondria
- Takes days or weeks to achieve
- Now, most people never engage this system

Hunger = Physiology + Psychology

Physiological drivers:

- Stomach fullness (stretch receptors)
- Energy availability in the blood
- Hormones: ghrelin (hunger), leptin (satiety)

Psychological drivers:

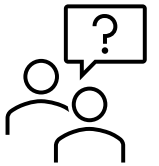
- Environmental cues (smell, sight of food)
- Emotions (stress, boredom, habit)

Macronutrients and satiety:

- Protein → strongest satiety
- Fat → moderate satiety (esp. combined with protein)
- Carbohydrates → hunger rebound is stronger after carb-driven glucose/insulin dips.

Metabolic Flexibility in Modern Diets (No carb scarcity)

If glucose is essential, why not just eat the carbs?
Well, that's what we're doing.



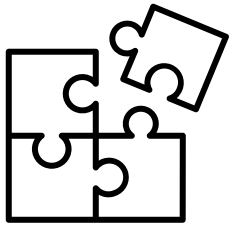
- Global average: ~ 60% carbs, 25% fat, 15% protein
- Most people rarely enter fat-adapted states anymore , and the results are in the global statistics of Non-Communicable Diseases (**NCDs**) and obesity.

Autophagy, the body's cellular recycling process, is suppressed by frequent eating (even healthy foods). The body prioritizes digestion and storage over repair processes like autophagy.

Glycation is sugar binding to proteins and fats in the blood; its role in NCDs (particularly heart disease) will be covered in a future session.

Evolutionary Context

Human evolution is a puzzle with most of the pieces missing
- but some things are clear:



- All over the planet, we've adapted to diverse food environments
- Shifting metabolic priorities allowed us to trade gut size for brain size
- But we retained the machinery to digest some plant-based foods
- With the Agricultural Revolution of ~ 10,000 years ago, we traded nutritional diversity for food security

It is hoped that this presentation provides a basis for ongoing learning.