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The Shrinking of a Fat Cell

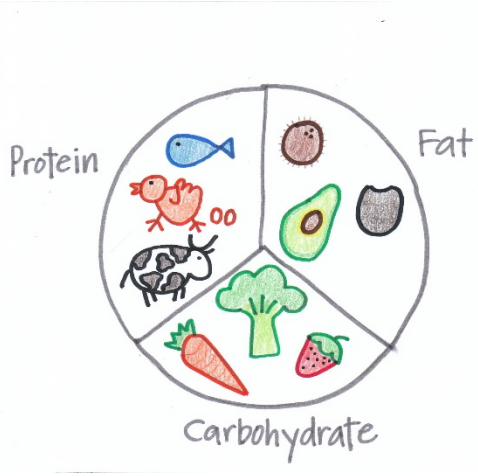
Melissa Layne, MEd.

How do we lose weight?

- Eat less calories than we expend.
- Fat cells shrink.
- Fat cells aka adipocytes that release adipokins and adiponectins.
- Fat cells are actually endocrine glands.
- Fat cells are made up of fatty acids that need to
- Find the way to an active muscle
- But they aren’t soluble in water and
- Blood is mainly water (plasma)
- So what happens?

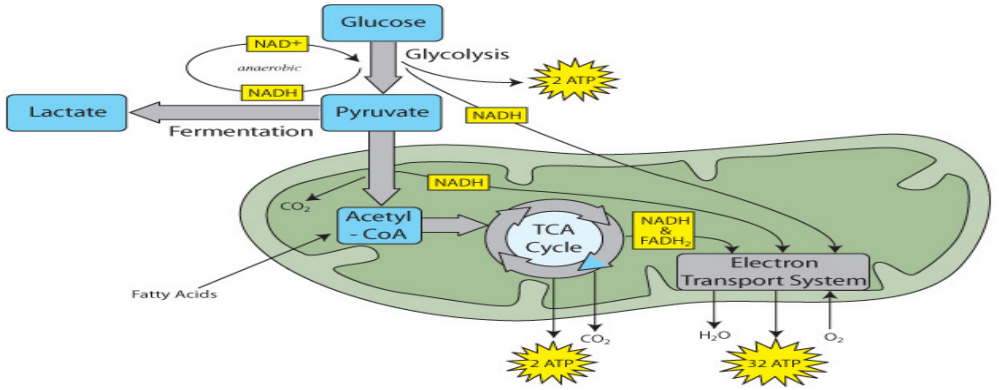
Just a Review

- Three macronutrients begin as substrates (water is needed but not a substrate)
  - CHO – carbs, 4 calories per gram
  - Fat – 9 calories per gram, made of carbon, hydrogen and oxygen
  - Protein – 4 calories per gram, made of carbon, hydrogen, oxygen and nitrogen
    - Body's least preferred fuel source as long as carbs and fat are present
- First Law of Thermodynamics
  - Energy neither is created nor destroyed, it simply changes forms
  - The form we need to make a muscle contract is ATP.



Basics of Metabolism

- If well-fed, each macronutrient can enter certain energy pathways:
  - Carbohydrates can enter into glycolysis either aerobically or anaerobically
    - Carbs are the only macronutrient that can be burnt anaerobically
  - Fats can enter into lipolysis which is part of the oxidative energy pathway
    - The oxidative pathway also includes aerobic glycolysis of carbohydrates
  - Proteins are broken into amino acids and certain amino acids undergo gluconeogenesis which allows them to act as a carbohydrate after deamination
    - gluco- sugar
    - neo- new
    - genesis- making



Basics of Weight Loss

- First Law of Thermodynamics
  - Energy is neither created nor destroyed, it simply changes forms.
    - We intake calories in the forms of macronutrients made of C, H, O.
    - We expend calories to make ATP when a muscle contracts.
    - Those calories are given off as CO2 when we exhale and as H2O when we sweat as a byproduct of the Kreb cycle in aerobic metabolism
      - We breathe at a faster rate when the exercise intensity increases.
      - We sweat more than the insensible perspiration when the exercise intensity increases.
      - Acetyl CoA enters the Kreb cycle quicker as intensity increases as long as we stay aerobic.

Transporting Fat from Cells to Muscles

- Fat is not soluble in water.
- Blood is over 50% water in the form of plasma.
- FFA are mobilized and transported via albumin proteins.
- The proteins help maintain oncotic pressure and hold plasma in the vessels if not carrying fat or steroid hormones.
- Once transport is complete, the albumin allows the FFA to cross the plasmalemma for lipolysis in the mitochondria.

Is a Calorie Always Just a Calorie?

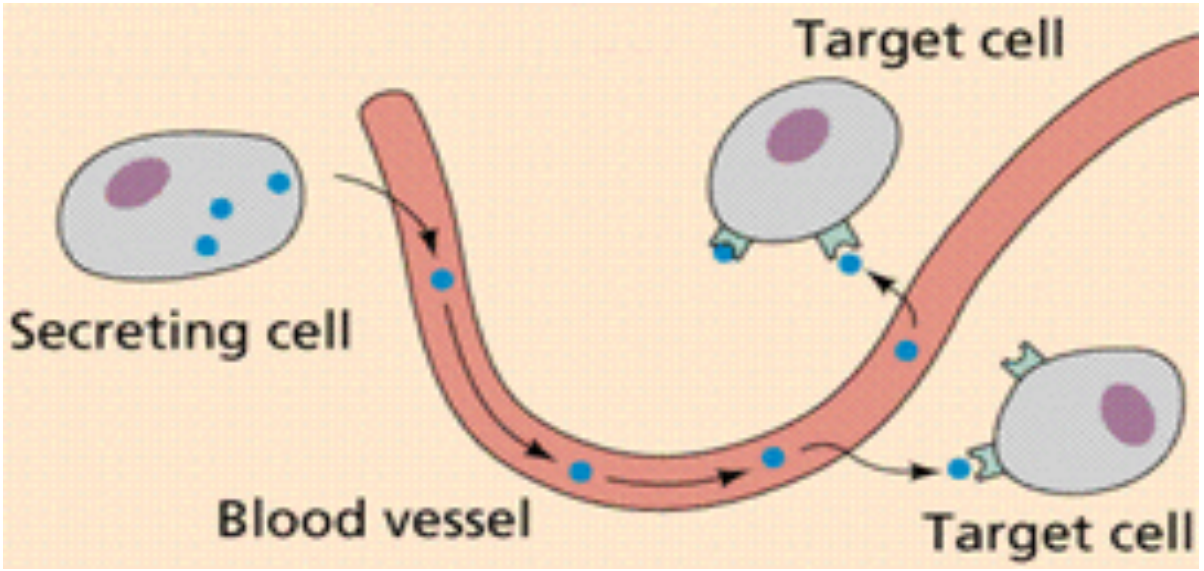
- Is this a trick question?
- Is a calorie just a calorie in a fasting state?
- Is a calorie from a brownie the same as from broccoli?
- Is a calorie in a man metabolized the same as in a woman?
- Is a calorie in a teenager metabolized the same as in a centurion?
- Alcohol does what?

What Determines the Amount of Fat Burned?

- The predominant macronutrient in the bloodstream
- Caloric state – signaling AMPkinase – true fasting-fed status
- The amount of mitochondria in the muscle fibers
- The intensity of exercise
- Hormones present

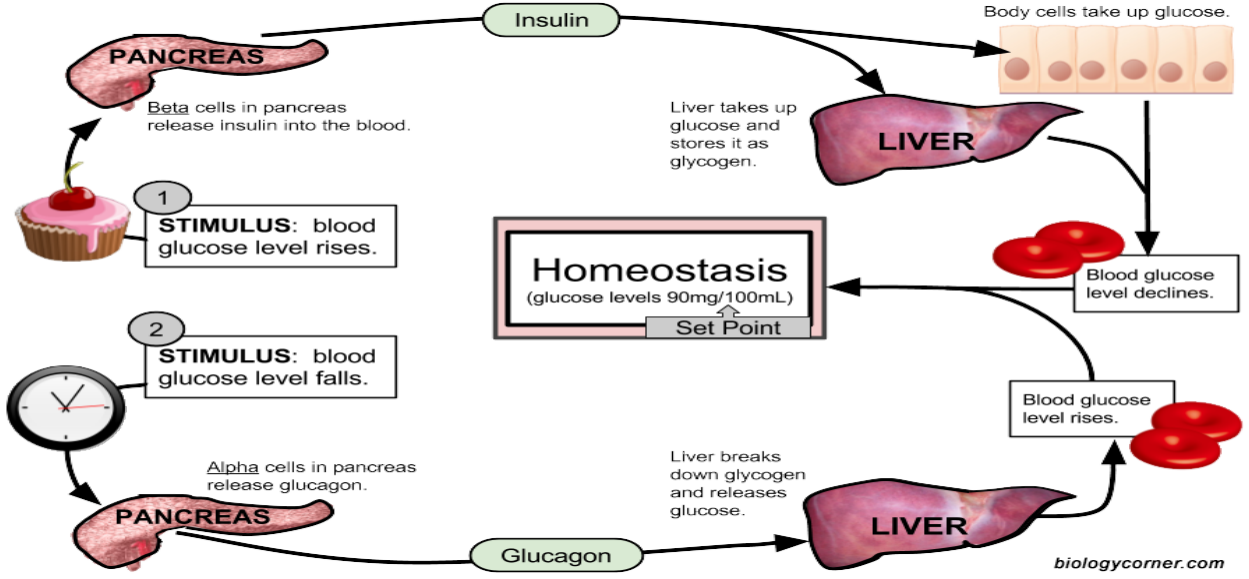
What Hormones Affects Weight Gain/Loss?

- Insulin
- Glucagon
- Testosterone
- Estrogen
- Epinephrine
- Norepinephrine
- Cortisol
- Growth Hormone



Insulin and Glucagon

- Released by the pancreas
- Insulin – when glucose is high
  - Allows glucose and other substrates to be shuttled into the cell for storage
- Glucagon – when glucose is low
  - Allows the liver to release stored glycogen to the blood stream as glucose

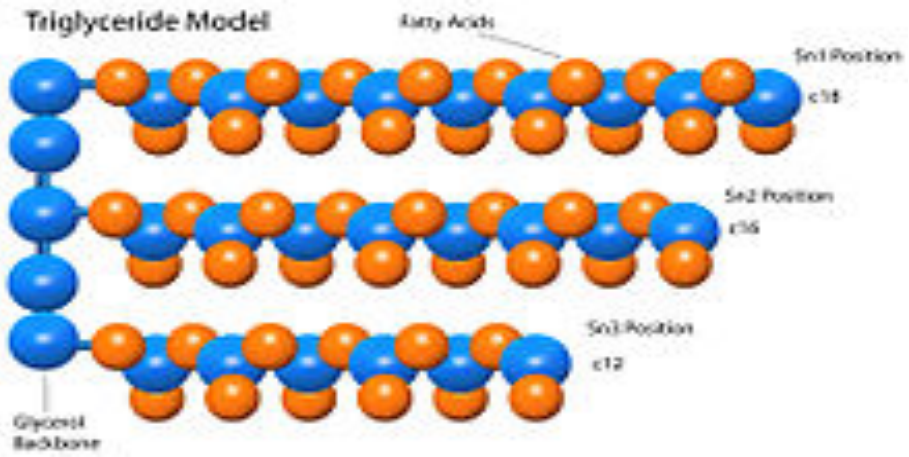


Testosterone and Growth Hormone

- Made while you sleep
- Testosterone – during REM sleep, from certain foods and during workouts
- Growth hormone – during non-REM sleep, when insulin levels are low
- Both increase the rate of hypertrophy of a Type II muscle fiber
  - The increase in size of a type II fiber, increases the amount of albumin binding sites
  - An increase in sites, increases the amount of albumin that can deliver fatty acids to the cell for energy

Estrogen

- A reproductive steroid hormone that can cross the lipid bilayer
- Increases the cleavage of the glycerol molecule from the triglyceride
- This enables the fatty acids to become free and available for metabolism

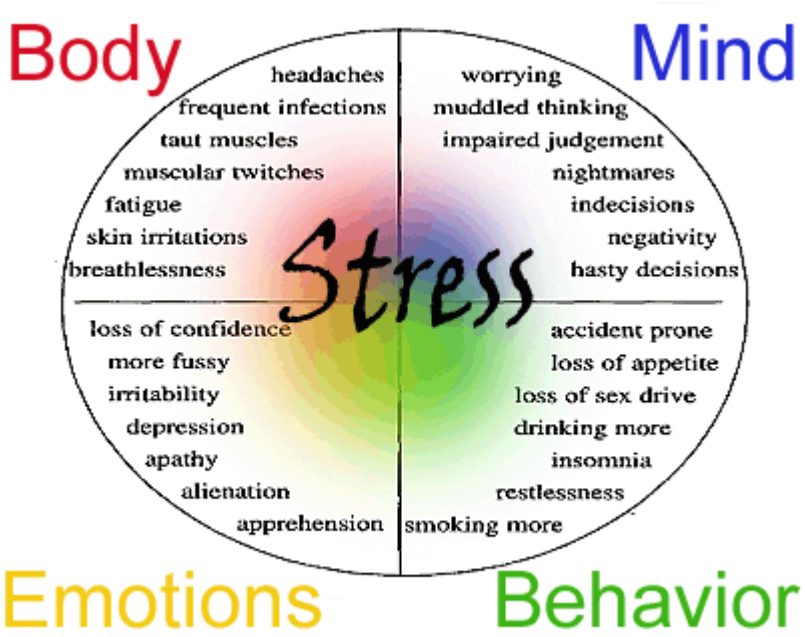


Epinephrine and Norepinephrine

- Catecholines made in the adrenals in response to stress from the mind or the body
- Epinephrine increases when rate of work hits 75% of VO2 max
- Norepinephrine increase when rate of work hits 50% of VO2 max
- Epinephrine increase under chronic levels of cortisol
- “fight or flight” hormone
- Must utilize glucose as a fuel source

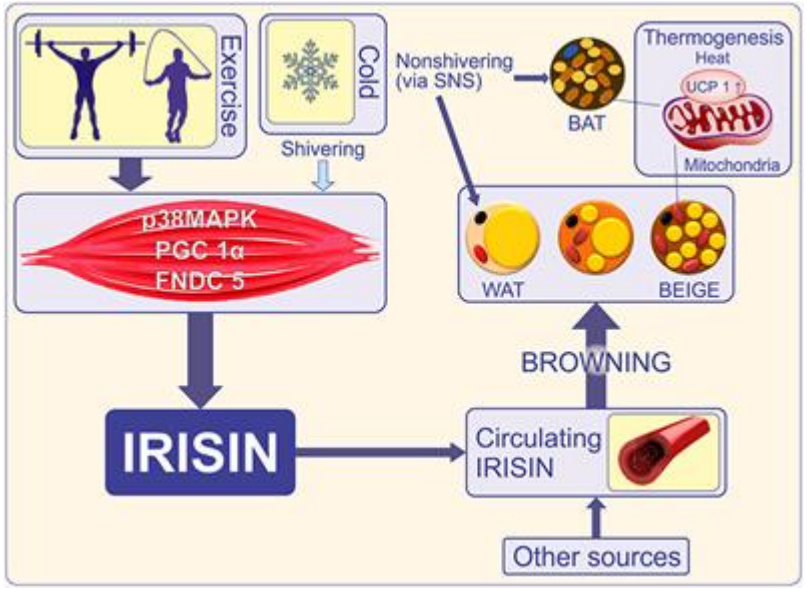
Cortisol

- Acute levels are positive in the body
- Chronic levels are not
- Stimulate levels of epinephrine to rise
- Acute levels are catabolic
- Chronic levels are anabolic



Irisin

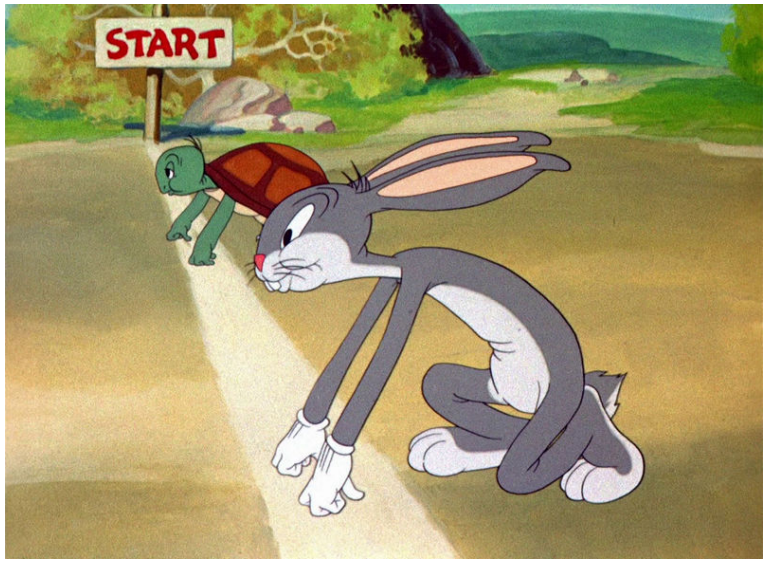
- Released during moderate to high intensity exercise
- Produced in muscle tissue
- “browns” white fat
- Epinephrine is though to also be responsible for “beiging” white fat



Rest and Recovery

- Proper sleep results in
  - Greater growth hormone
  - Increased testosterone
  - Decreased cortisol

Takeaway



- Slow and steady wins the race.
  - Aim for 1-2 pounds per week
  - Remember the principle of diminishing returns
- Supplements are not needed unless disease causes an omission of a food group.
- Alcohol derails the goal.
- Hormones play a role in metabolism.
- Remember the principle of individuality.
- Any diet that you go on, you have to go off! Create a meal plan you can live with for life – a long life.