Why worry about Ingestive behaviors?

- Can be the symptoms of many psychological disorders
  - Mind and body need to be in "balance"
  - Psychological dysfunctions may cause biological dysfunction: drinking (alcohol), eating, (anorexia, bulimia), sexual, sleep
  - Ex. Depression

- Can be source of psychological disorders
  - Metabolic encephalopathy (ex. Glucose and vitamin deficiencies): dementia, seizures
    - Biological disorder
  - Alcohol -> liver degeneration -> lack of estrogen breakdown -> feminization
  - Pickwickian syndrome: type of obesity accompanied by irritability, aggressiveness, jealousy, suspiciousness
    - Treatable
    - Also biological

Homeostasis and deregulation 11.1

- Body: needs proper nutrition (stored in fat, muscle)
- Mind/brain: needs proper neurological environment (hormones, ions)
- These two things lead to
  - Homeostasis: Process used to regulate the mind/brain-body balance (to correct and compensate for variations)

- Process of regulations
  - System variable (actual)
  - Detector
  - Set point (desired)
  - Mechanism to change the B+ variable
    - Negative feedback

Ingestive behavior: eating or drinking

- A physiological regulatory mechanism maintains the constancy of some internal characteristics of the organism in the face of external variability.
  - Ex. Keeping body temperature constant despite changes in the temperature externally
A regulatory mechanism contains four essential features: the system variable (characteristic to be regulated), a set point (the optimal value of the system variable), a detector that monitors the value of the system variable, and a correlational mechanism that resources the system variable to the set point.

Drinking (water/liquids) 11.2
- **System variable**: amount of fluids/water in the body

  - Slow (~20 mins) (Body fluids-stomach on diagram)
  - Fast (~ seconds) (from correctional mech. Through satiety mechanism)
- **Drinking trigger**: "low fluid detections"
- **Drinking termination**: "satiety mechanism" (fast signals in anticipation of the slow signals)
  - Partly established through experience
- **Schizophrenia, antipsychotic drugs -> overhydration**

The 4 fluid "compartments" 11.3
- **Intercellular**: 2/3 of body water
- **Extracellular**
  - Interstitial: between cells
  - Intravascular: in blood vessels
  - Cerebro-spinal fluid (CSF)
- **Vascular balance**
  - Blood plasma volume is regulating independently
    - Important for a good functioning of heart and kidneys
  - Loss of blood volume: **Hypovolemia**
    - Dehydrations, blood loss, severe burns
  - Too much blood volume: urination
    - Edema (feet+ ankles)
  - Exception: pregnant women
- About 50% more blood stored by vasodilation
  - Increased cardiac output and heart rate

**Intracellular vs. interstitial balance 11.4**

- **Tonicity** = concentration of solutes (ions)
  - Cell membranes are permeable to water, not solutes
    - Hypertonic: solution A is hyper (more) tonic to solution B: water is drawn out of solution B
    - Isotonic (same amount)
    - Hypotonic: Solution C is hypo (less) tonic to solution B; water is drawn into solution B

- 2 types of thirsts
  - Osmometric thirst: when interstitial tonicity increases (ex. After salt meal)
    - Mechanical detection of changes in tonicity
      - Osmoreceptors
        - Located in the hypothalamus, near the third ventricle (AV3V)

- Osmoreceptors in AV3V
  - 11.6 (left side water enters, right side water leaves)

- Cell volume increases -> membranes potential decreases -> firing rate decreases
  - Water enters cell (volume increases)
- Cell volume decreases -> membrane potential increases -> firing rate increases
- Water leaves cell (volume decreases)
  - Experiment: injection of hypertonic saline in humans
    - Just after drinking: anterior Cingulate cortex and AV3V are active
      - Few minutes after drinking only AV3V remains active
        - Findings of experiment
          - anterior Cingulate is part of the satiety system (~ seconds)
          - AV3V contains the osmoreceptors (~ minutes)
        - Circuit: av3v -> Median Preoptic Nucleus -> drinking
  - Second kind of thirst
    - Volumetric thirst: when blood plasma volume decreases
    - Loss of blood loss -> loss of water + loss of sodium
    - Renin/angiotensin system:
      - Blood flow detectors in the kidneys
        - Angiotesin blood -> subfornical Organ (SFO) -> Median preoptic nucleus
          - These result in drinking

Neural substrate of drinking
Median preoptic nucleus: site of integration of thirst information
  Drinking initiation circuit

Ingestive behaviors: eating
- Facts about weight
  - 60% Americans 20 years old or older are overweight
    - 30% are obese
  - Mexican and African American have 10% more incidence for overweight/obesity
  - American Indian with most obesity are in Arizona
  - Cities with most obesity
    - Houston, TX
  - Cities with less obesity
    - San Diego, Boston and Tucson
  - Reason?
Energy set point theory

- Hypothesis: hunger is a low energy detection signal
- Eating starts when the signal decrease below a give set point
- Energy fuels (3 sources)
  - Glucose <-> carbohydrates (calories)
  - Fatty acids <-> fat
  - Amino acids <-> proteins
- 2 fuel storage systems
  - 1% short term: carbs (glycogen) liver and muscles
  - 85% long term: triglyceride in fat cells
  - 14% long term: amino acids
- Short term: the energy rush
  - Glucose is the only source of energy of the CNS/PNS (neurons and glia)
  - Detected in PET scan
  - After glycogen storage is full, extra glucose is used to form triglycerides
  - Glucagon is secreted early morning when glucose is low
  - Glucagon also stimulates the release of energy from long-term storage
- Long-term: dieting/prolonged fasting
  - Triglycerides (fat tissue)
  - Triglyceride: breakdown under neural control (sympathetic system) and hormonal control (glucagon and adrenaline)
  - Glucose: the brain has priority
    - PNS-CNS cells: passive absorption of glucose
    - Other cells: need insulin receptors and active glucose transport
- Long term storage: the benefits of exercising
  - Muscle proteins -> amino acids -> fuel for body and not brain
- Absorptive and fasting phases: summary

- Top half absorption
Ingestive behaviors: control

- Staring a meal
- Cultural signals: eating can be a social behavior
- Eating can be triggered by learned external signals (Pavlovian conditioning with sight of food)
- Eating can be triggered by hormonal (ghrelin) signals from the stomach and duodenum (part of small intestine)
  - Injections of Ghrelin will trigger thoughts of food/eating

- Note for figure: ghrelin secretion is inhibited by digestive activity

- Starting a meal: metabolic signals
  - Surgery studies-> stomach not necessary to feel hungry
  - Glucoprivation and Hypoglycemia
    - Glucose doesn’t enter the cells
  - Lipoprivation: fatty acids are not converted to fuels
  - Evidence:
    - Glucoprivic hunger:
      - Injection of 2-DG (blocks glucose entry into cells)
      - Hunger lesions of vagus nerve-> hunger disappears
    - Lipoprivic hunger
      - Injections of drugs that blocks fatty acid metabolism
      - Hunger
      - Lesions of vagus nerve-> hunger disappears
  - Conclusion: liver and vagus nerve motion glucose and fat levels and send signals to the brain to single hunger (-> start meal)
Starting a meal: Satiety

- **Gastric factors: nutrient receptors in the stomach**
  - Stretch receptors in the stomach
- **Intestinal factors**
  - Detection of fat in duodenum-CCK → Stomach (decrease outflow)

Long term satiety: fatty storage factors 11.16 and 11.17

- Leptin secreted by fat cells increase fat metabolism
- OB mouse: leptin deficient
- Injection leptin → smaller meals
  - Leptin is a (fat related) satiety signal