Review of hormone signals:

**Gastrin** † HCl and pepsinogen, churns stomach, relaxes IC valve (head, gastric phases)

**Secretin** ‡ gastric juices and emptying, stimulates neutralization from pancreas

**CCK** ‡ gastric juices and emptying, stimulates digestive enzymes from pancreas.

This slide is to help you organize these hormones – I won’t use it in lecture

Your wonderful liver

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- Makes bile salts
- Stores glycogen, fats, vitamins
- Makes plasma proteins
- Processes compounds from digestion – many different conversions
- Releases LDLs, bilirubin

Hepatic portal system

- Brings blood to liver to detoxify and convert absorbed compounds
- **Question**: “1st pass” effect of drugs. Methods other than oral drugs avoid this: intravenous, intramuscular, inhalant, others..

Liver cells receive both arterial and portal blood, flows toward vein. Cells perform metabolic conversions, make components of **bile (bile salts)**, breakdown old RBCs with **bilirubin** as waste product
How is alcohol metabolized?

The liver has enzymes that metabolize alcohol at a rate determined by the number of enzymes, liver size, and enzyme isotype.

Acetaldehyde is toxic, forms free radicals, and is associated with liver, kidney damage, and cancer. Relative levels of ADH, ALDH influence a person’s alcohol metabolism.

Fatty liver disease

Associated with obesity, diabetes, high fructose and alcoholism.

Lipids collect in liver because of high input and/or inhibited output of lipids.

How does cirrhosis develop?

Inflammation recruits fibroblasts – fibrous scarring. How does hepatitis C affect liver?

Liver regeneration

Even if more than half of liver is damaged, it can regenerate completely to fit under diaphragm.

Hepatic stem cells? ‘Stellate’ cells? Recruited stem cells? Hepatocytes themselves?
How bile helps digestion

Bile enters along duct from gall bladder to duodenum

Detergent action of bile emulsifies fats to droplets, then micelles. Lipase can act on micelles.
Absorption of nutrients
- $Na^+$ is pumped into interstitial fluid (NaK pump)
- Disaccharides, amino acids are cotransported

<table>
<thead>
<tr>
<th>Cotransport</th>
<th>Fats repackaged, go into lymph</th>
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<tbody>
<tr>
<td>Carbohydrates</td>
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<td>Proteins</td>
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Gastrin signal relaxes ileocecal valve
This valve prevents contamination of the small intestine by bacteria from colon

What causes lactose tolerance?
Lactose intolerance (standard in most cultures)
- Body cannot make lactase to digest lactose
- Lactose in intestine attracts water, bacterial colonies grow and consume lactose
- Not an allergy
Large intestine

- Chyme mixes w/ bacteria (gut flora)
- Water, some vitamins are resorbed from chyme to yield solid feces

Gut flora

- You have billions of microbes – hundreds of species. Some are *symbiotic* (i.e. we depend on their presence)
- They provide vit. K, biotin, help digestion & immunity, inhibit harmful bacteria
- Your flora changes w/ diet, age. Flora can influence disease, allergies, and more. Many unknowns!

How does the digestive system react to different types of food?

**Fats** - detected by duodenum, slows emptying. If your poop floats, probably too many sat. fats.

**Proteins** - stomach senses them, regulates emptying

**Carbs** - Pass more quickly through GI, esp. simple carbs. Makes insulin spike, causing hunger afterwards

**Fiber** - thick bands of cellulose – provides few nutrients, helps motility. Fruits, veggies, whole grains

- Fiber added to processed food via wood pulp

I will be assuming you know basic categories of endocrine hormones introduced in chapter 4: hydrophilic (peptides, amines) vs. lipophilic (steroids, thyroid hormone)

You should also remember what ‘target tissue’ means
Hormones are transported by the blood, but only elicit responses in target cells.
**Vasopressin** - water reabsorption in collecting duct

Osmoreceptors in hypothalamus trigger release of vasopressin

**Oxytocin** - cause uterine contractions, milk expulsion

Oxytocin levels increase during arousal, orgasm.

Women: also during birth and when nursing

Feelings of empathy, nurturing, and trust increase with oxytocin applications.

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**Anterior pituitary**

**Hypothalamus**

Portal system

**Anterior pituitary**

- Prolactin
- TSH

**Posterior pituitary**

- Oxytocin
- ADH

**Hypothalamus**

- Tropic hormones
- Hypophysiotropic hormones

Endocrine cells of anterior pituitary

Systemic venous blood out

KEY

= Hypophysiotropic hormones
= Anterior pituitary hormone
Growth hormone
Promotes cell division, protein synthesis, calcium retention. Also prepares body for fasting periods (saves glucose)

Helps the postnatal growth spurt

What growth hormone does
GH signals an increase in the # of cells and size of cells in bone, muscle, and mobilizes fat.
GH stimulates protein synthesis

Controls on GH

Gigantism
Dwarfism
Agromegaly
**Athletes and hGH**

hGH can help enhance lipolysis as well as muscle growth – lean muscle mass.

Cartilage and connective tissue growth helps recovery from injury.

However some studies show muscles retain more water, ↑ lactate (fatigue), joint pain.

**Thyroid gland**

Thyroid gland consists of follicle cells that surround center filled with proteins that hold thyroid hormones

- **T4 (Thyroxine)**
- **T3**

Basal metabolic rate, stimulates GH and promotes sympathetic effects

**Hypothyroidism**

Puffiness, thick skin, lethargic

Primary hypothyroidism: thyroid can’t produce enough of hormones pituitary calls for

Secondary hypothyroidism: thyroid isn’t being stimulated by pituitary to produce hormones

**TSH**

Also maintains thyroid
Heat intolerance, anxious, weight loss

Hyperthyroidism

Cortex - aldosterone, cortisol, sex hormones
Medulla - epinephrine, norepinephrine

Grave’s disease - an autoimmune disease

Several hormones from adrenal gland are released during ‘stress’