



BI 121 Lecture 6

- I. *Announcements*** Data + flash drive/e-mail for today's lab!
If you want to be sure to have your notebook to study for Exam I on Tuesday Oct 23rd, best to turn in prior to lecture next Tuesday Oct 16th. Review Session Sunday Oct 21st, 6-7 pm. Q? Sample Exam Q? Be sure to see *Active Learning Questions!*
- II. *Nutrition Connections*** Why whole grains? Carbohydrates? Fasting, Intermittent dieting, Best diets? Practical weight loss?
- III. *Gastrointestinal Physiology*** DC Module 3 pp 17-23, LS ch 15+
 - A. Steps of digestion Dr. Evonuk + LS pp 437- 9; DC p 23
 - B. Hydrolysis + monomer to polymer: central linking themes!
 - C. What's missing? LS fig 15-1 p 438
 - D. GI-Donut analogy Dr. Brilla @ WWU
 - E. Common control mechanisms
 - F. Gut layers & secretions LS p 438, 440-1
 - G. Organ-by-organ review LS tab 15-1 pp 440-1 + DC fig 3-1
 - H. Accessory organs of digestion
 - I. Ulcers? Causes?

DietController Software for Personal Nutrition Analyses!



***No purchase necessary!
On computers in lab!***

Sample Exam I Questions

Sample 1. What is *human physiology*? (+2) How does it differ from *human anatomy*? (+2)

Sample 2. What happens to *blood pressure* when you stand up? (+2) To compensate, how do *heart rate* and *blood vessel diameter* change? (+2)

Sample 3. *Cells* are progressively organized into

- organs, systems, tissues, then the whole body
- tissues, organs, systems, then the whole body
- systems, tissues, organs, then the whole body
- None of the above are correct.

Why Eat Whole Grains?



Based on existing evidence, eating whole grains is definitely good for our health.

Shengmin Sang, Professor of Food Science & Human Health North Carolina A&T

Fiber ↑ fullness, motility, beneficial bacteria, wt control
↓ cholesterol, insulin response, inflammation, diabetes and CVD risk...



B-vitamins thiamin, niacin, riboflavin ↑ energy metabolism

Folate ↑ red blood cells, ↓ neural tube defects

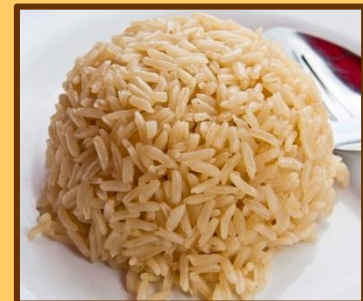
Iron ↑ O₂ carrying, ↓ iron-deficiency anemia in women

Magnesium ↑ bone building & muscle energy release

Selenium an anti-oxidant, protects body cells & ensures a healthy immune system...



<https://www.choosemyplate.gov/grains-nutrients-health>



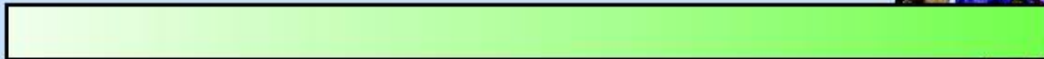
Dietary Composition & Physical Endurance

eg, Atkins!

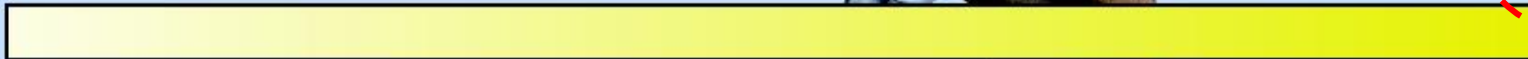
High-fat diet



Normal mixed diet



High-carbohydrate diet



~ 1/3 endurance!

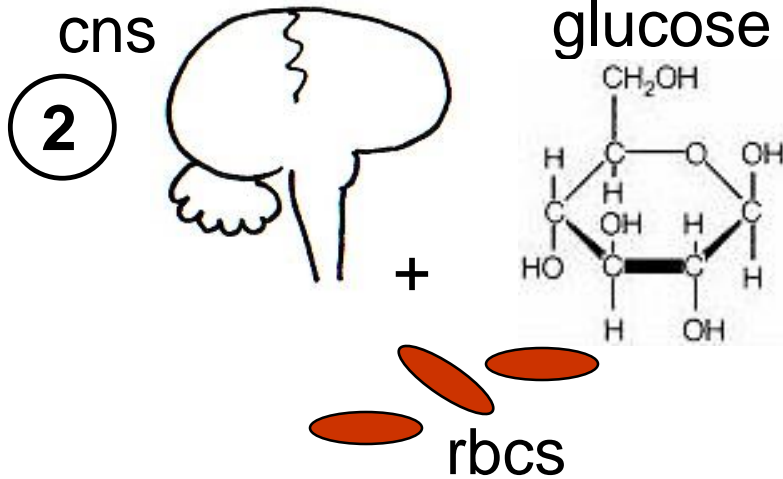
Maximum endurance time:

57 min

114 min

167 min





Negative Effects of Low Carbohydrate

1



- ① ↑ fatigue/exhaustion central & peripheral!
- ② ↓ glucose – brain+spinal cord, rbcs thrive upon.
- ③ ↓ variety which reduces intake of phytochemicals, vitamins, minerals & fiber.
- ④ ↑ risk of respiratory infections.

4



+ gall stones,
↓ thermoregulation...

We're better at storing fat vs carbohydrate!

Dietary Fat



3 % Kcal

Body Fat



23 % Kcal

**Dietary
Carbohydrate**



**To Help Lower Body Wt & %Fat
EXERCISE!! + *Minimize* These!!**

FAT 9 Kcal/g

ETOH 7 Kcal/g

CARB 4 Kcal/g

PRO 4 Kcal/g

**DIETFITS (2018)
+ Pounds Lost
Trial (2009)
indicate that
reducing overall
calories is more
important than
macronutrient
composition of
the diet!**

**NB: Minimize not Eliminate!
Moderation not Abstinence!!**

<https://www.ncbi.nlm.nih.gov/pubmed/29466592>

<https://www.ncbi.nlm.nih.gov/pubmed/19246357>

***I'm not sure I believe you!
Why can't I just starve to
lose weight?***



TOTAL FAST =
No Energy Nutrients
**(No Carbohydrates, Fats
or Proteins)**

ONLY

- 1. Water**
- 2. Vitamins**
- 3. Minerals**

60-day Fast???

Lost 60 lb!! Wow!!

Yet

26 lb Water

20 lb Lean Body Mass

14 lb Fat

Fat < $\frac{1}{4}$ total wt loss!

> $\frac{3}{4}$

***You can lose weight by
starving – but it's mostly
water & muscle! Also, there
can be complications!***



Potential Complications of Total Fasting

**Nausea, diarrhea, persistent vomiting,
postural hypotension, nutritional
deficiencies, menstrual irregularities,
and...sudden death.**

Positive Aspect??

**General loss of appetite within
first 2 days, maintained
throughout fasting period.**

The Filthy Food Act, p. 2

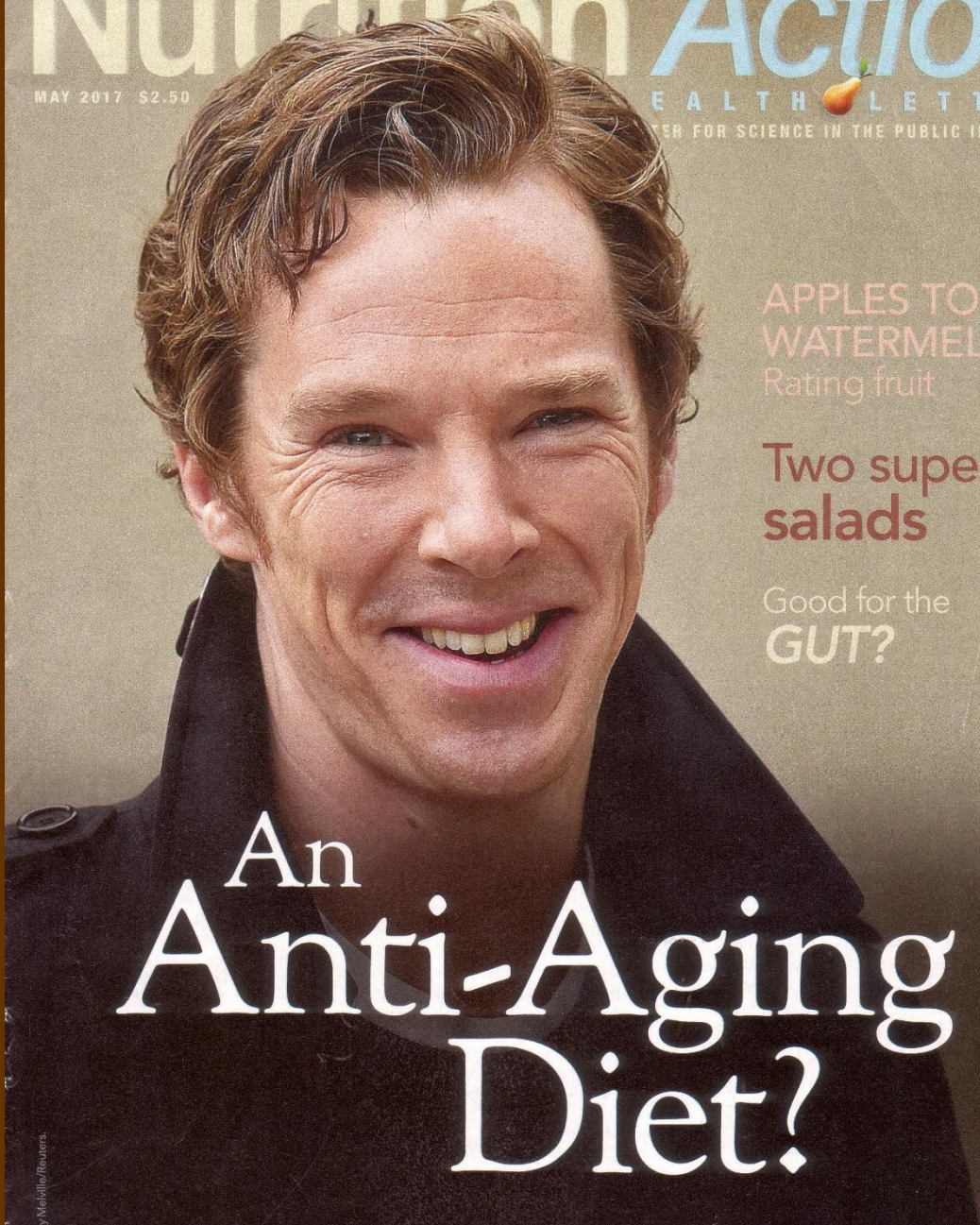
Vitamin D, calcium, & cancer, p. 8

Almond creamers, back cover

Nutrition Action

MAY 2017 \$2.50

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APPLES TO
WATERMELON
Rating fruit

Two super
salads

Good for the
GUT?

An Anti-Aging Diet?

© 2017, Toby Melville/Reuters



CALERIE STUDY

Comprehensive Assessment of Long-term
Effects of Reducing Intake of Energy



- 2-yr kcal restriction, assess biomarkers longer, healthier life
- 218 people, 21 – 51 yr, ½ ~ overweight, ½ normal wt
- Usual diet or cut kcal by 25% (achieved ~ 12% so < ½ goal)
- If cut calories, lost 10% body wt ~ 17 lb & kept off for 2 yr
- Cardiometabolic Δ s: ↓ Cholesterol, ↓ Inflammatory markers,
↑ control blood sugar control w/o
adverse sexual or immune function Δ s

Some bone loss, but attributed to weight loss.



National Institute
on Aging



Das SK, Roberts SB, Bhapkar MV & coworkers.
Am J Clin Nutr 2017 Apr, 105(4):913-927.

<https://www.ncbi.nlm.nih.gov/pubmed/28228420>

5:2 Intermittent “Fasting”

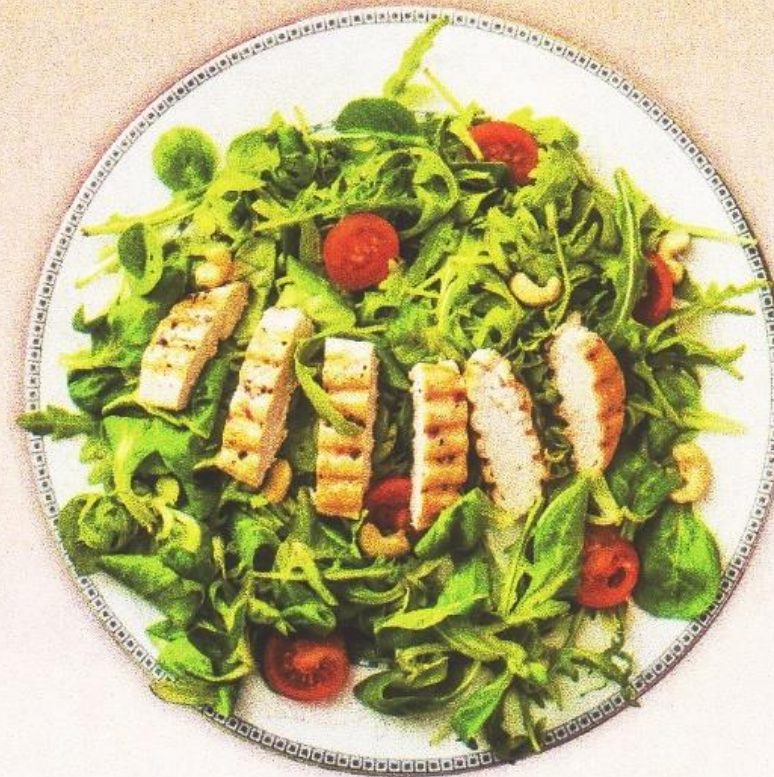
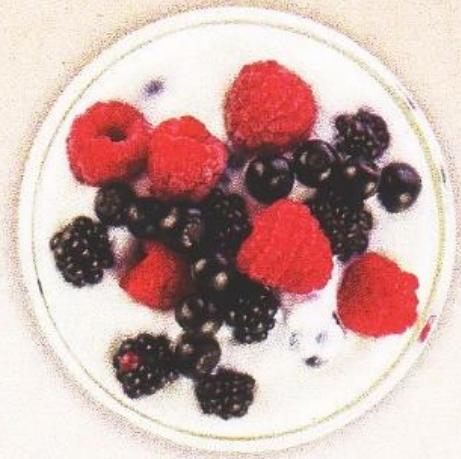
2 Days a Week

500-CALORIE DAY



Breakfast

*Plain low-fat yogurt
with berries*
200 calories



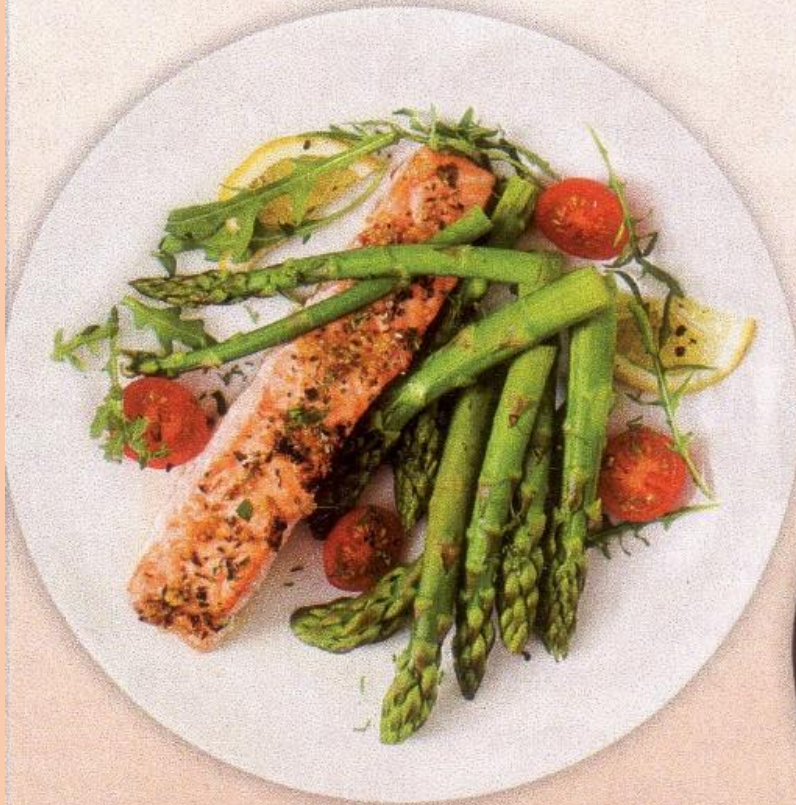
Dinner

*Mixed greens
with grilled chicken*
300 calories

NAHL 2017 May

5:2 Intermittent “Fasting”

600-CALORIE DAY



Dinner

*Baked salmon with
asparagus and
tomatoes*

350 calories

Breakfast

*Oatmeal with
peaches, berries,
and milk*

250 calories



Human Intermittent Fasting Studies

- ~100 overweight or obese women
- ½ cut 25% kcal every day
- ½ ate normally 5 d, but only 650 kcal/d for 2 d/wk
- After 3 – 6 mo, each group lost ~ same amount of wt but women on 5:2 diet had better insulin function!
- Likely easier for most humans to restrict for only 2 d/wk!

The Nightingale Centre
Wythenshawe Hospital
Southmoor Rd
Manchester
M23 9LT



UHSM
Your Hospital

Harvie M, Wright C, Pegington M and coworkers. *Br J Nutr* 2013 Oct,110(8): 1534-47. <https://www.ncbi.nlm.nih.gov/pubmed/23591120>

Harvie M, Peginton M, Mattson M and coworkers. *Int J Obes* (London), 2011 May, 35(5):714-27. <https://www.ncbi.nlm.nih.gov/pubmed/20921964>

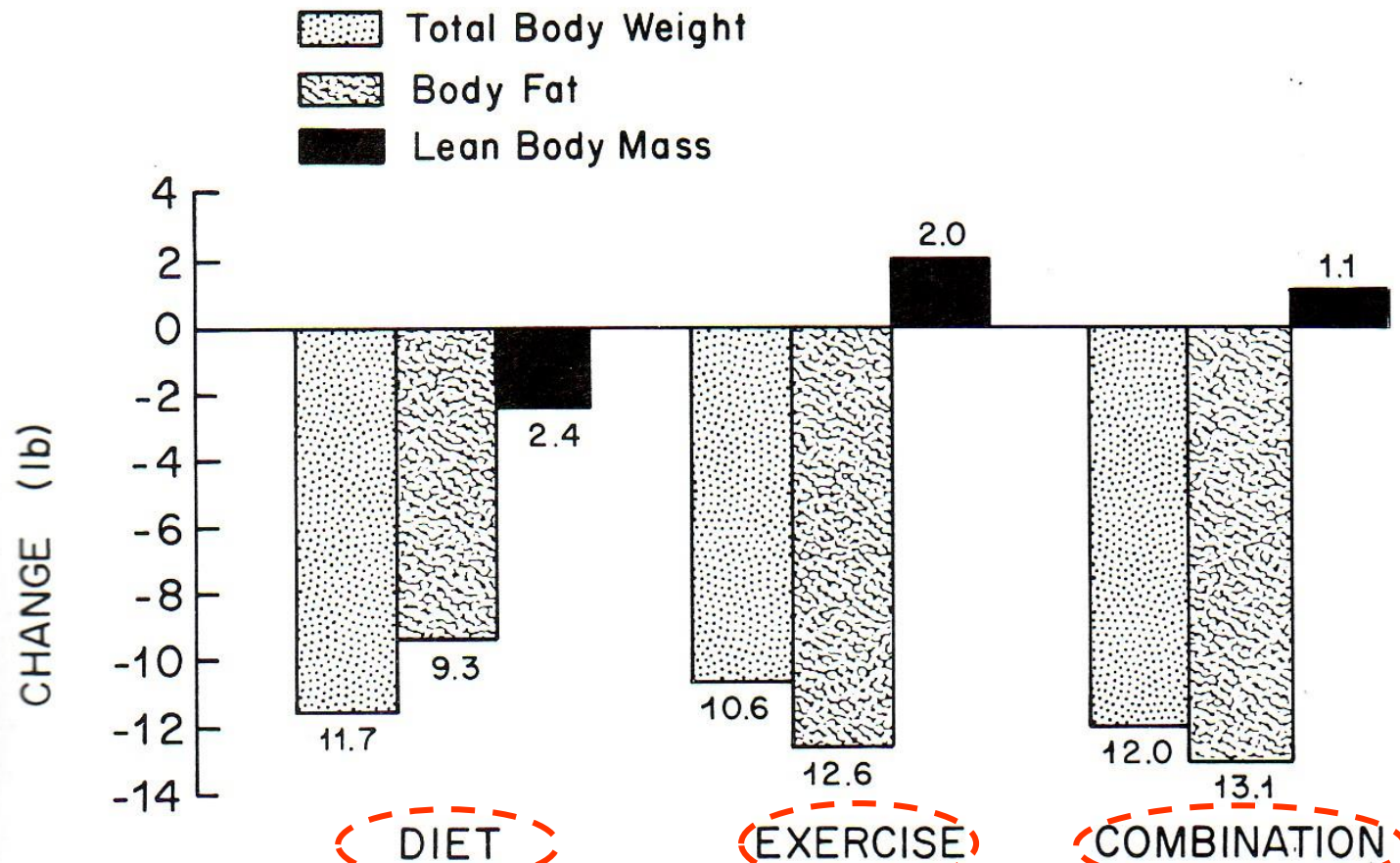


Figure 4-9. Changes in body weight, body fat, and lean body weight for diet, exercise, and combination groups. (From Zuti W. B., and Golding, L. A.: Comparing diet and exercise as weight reduction tools. *Phys. Sportsmed.* 4:49-53, 1976.)

NB: Each group 500 kcal deficit/day, 16 weeks



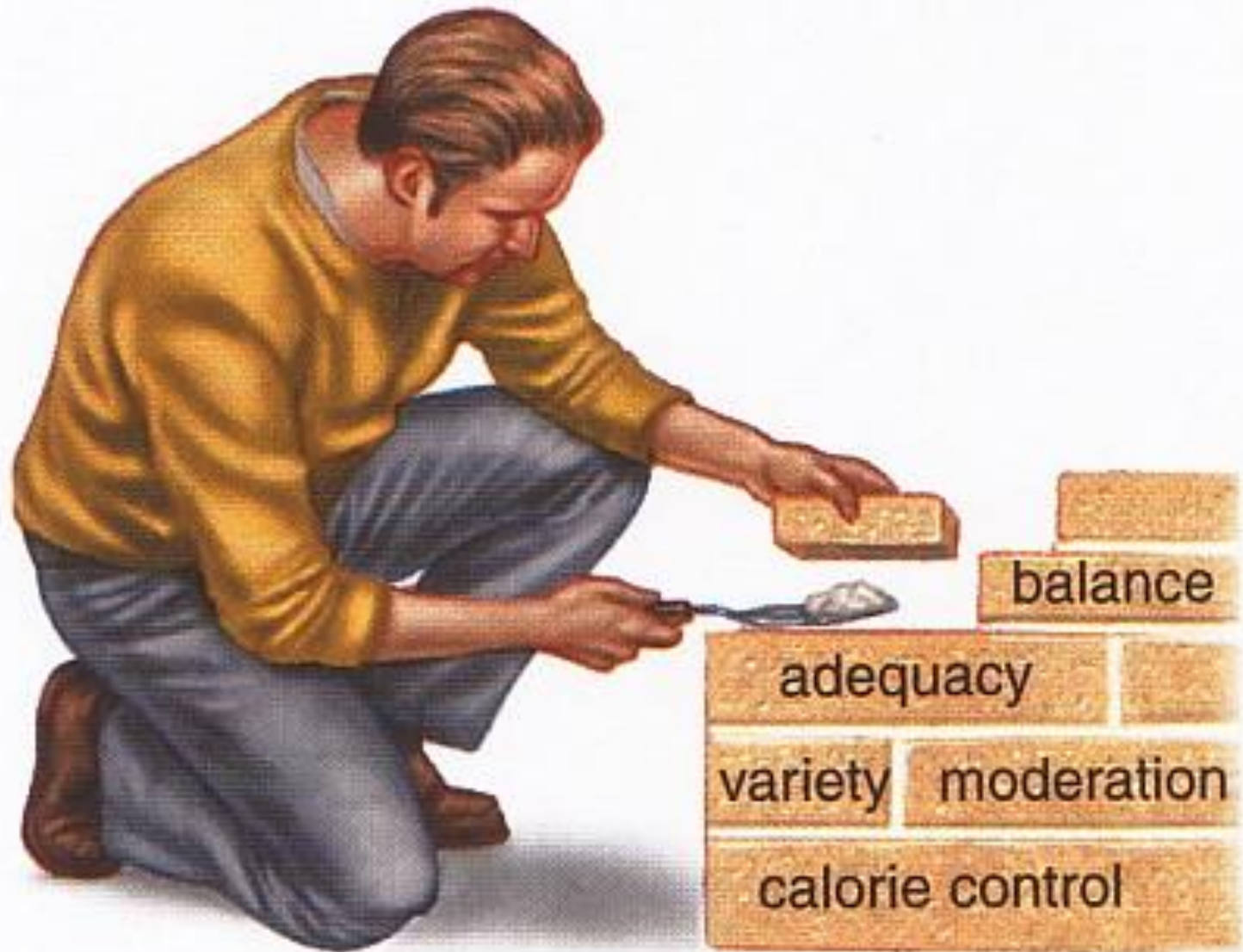
Exercise is better than dieting in lowering body fat & preserving muscles!



Emphasize ABCs + Variety & Moderation!



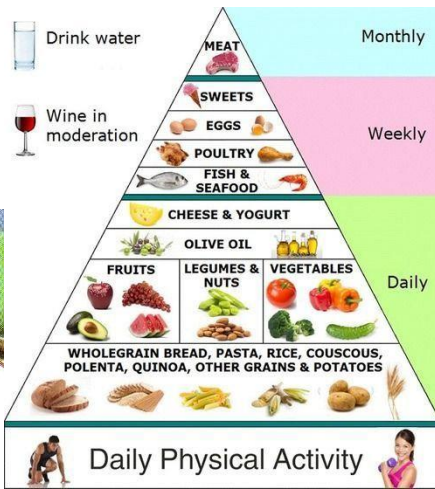
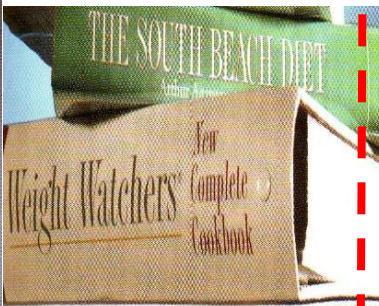
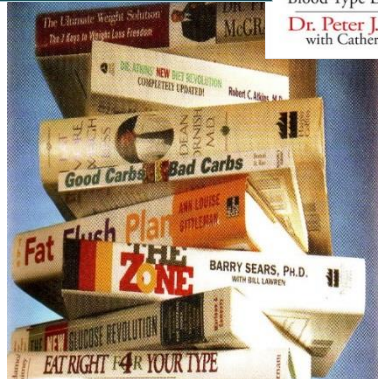
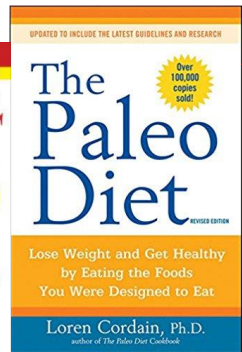
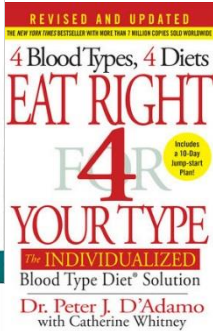
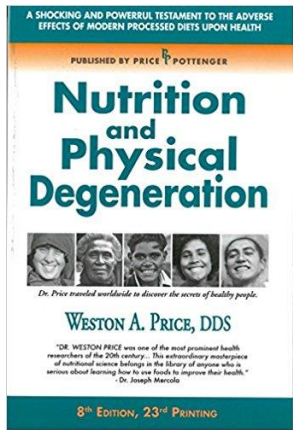
*All of these factors help to build
a nutritious diet.*



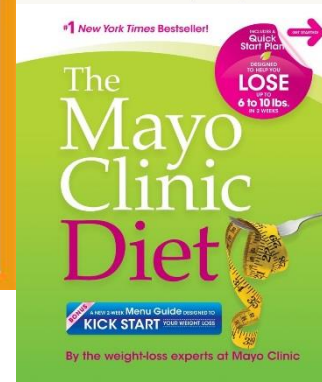
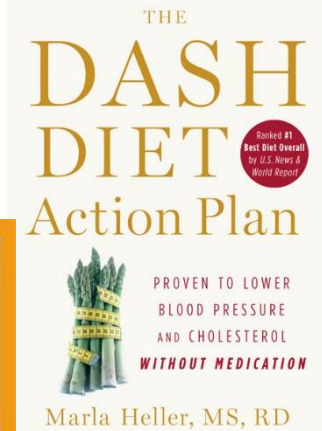
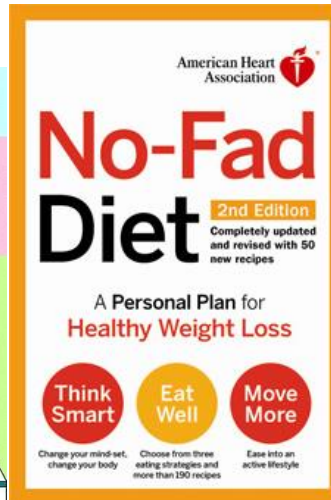
Kleiner's & Monaco's Top 10 Hit List for Nutrition Quackery

1. Treatment based on unproven theory calling for non-toxic, painless therapy.
2. Author's/purveyor's credentials aren't recognized in scientific community.
3. No reports in scientific, peer-reviewed literature but rather mass media used for marketing.
4. Purveyors claim medical establishment is against them & play on public's paranoia about phantom greed of medical establishment.
5. Treatments, potions, drugs manufactured according to secret formula.
6. Excessive claims promising miraculous cures, disease prevention or life extension.
7. Emotional images rather than facts used to support claims.
8. Treatments require special nutritional support including health food products, vitamins and/or minerals.
9. Clients are cautioned about discussing program to avoid negative.
10. Programs based on drugs or treatments not labeled for such use.

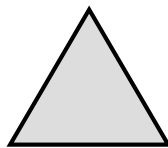
Which Diets are Best?



Mediterranean Diet



**Not Plant-based
Lower Carbohydrate**



**Plant-based
Lower Fat**



**Not Peer-Reviewed =
Trade Book
→ Opinion**



**Peer-Reviewed =
Text Books
→ Research**

Nutrition *Action*

JULY/AUGUST 2018 \$2.50

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How Did We Get Here?



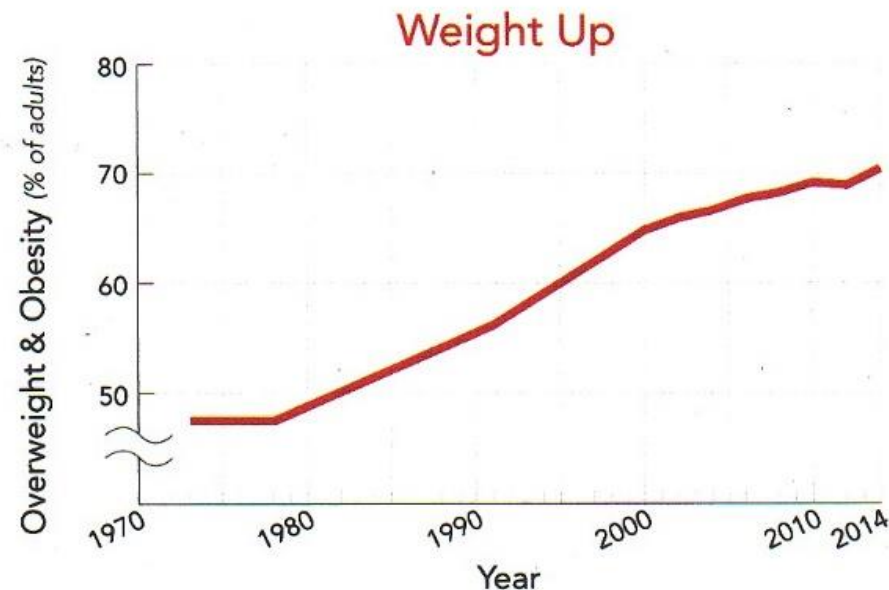
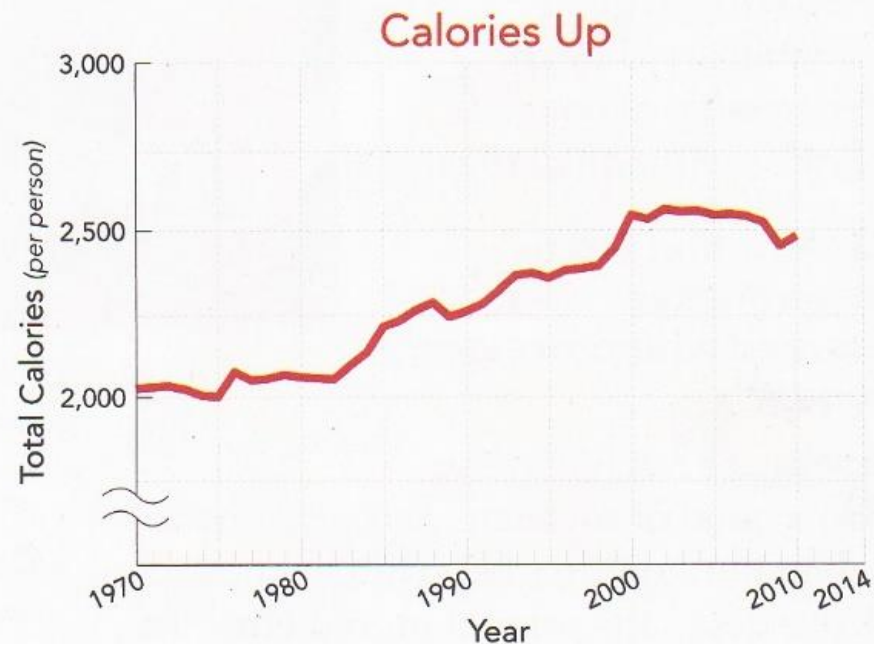
Explaining the obesity epidemic

HOW TO
EAT LESS

2018
**Xtreme Eating
Awards**

**Trans Fat
R.I.P.**

Calories in the food supply have risen consistently since the onset of the obesity epidemic!



SOURCE: Liebman B & Hall H. How did we get here? Explaining the obesity epidemic. *Nutrition Action Health Letter*, 2018 Jul-Aug, 3-8.

Cheap, but
calorie & fat
dense!

\$5 **HOT-N-READY LUNCH COMBO** **1640 kcal!**



\$1 Any Size Soft Drink All items only

\$2 Small McCafé Smoothies, Frappés & Shakes

290 kcal!

530 kcal!



Watch out for
drinking your
calories!

5 times per wk? \equiv 106,600 calories/yr \equiv \pm 30.5 lb fat/yr



\equiv



Starbucks
Cinnamon
Dolce Latte,
whipped cream
Venti (20 oz.)

410 calories

Jogging | **50 min.**

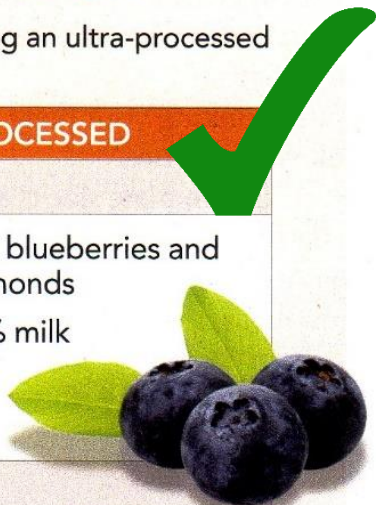


**Better
choices!**

What's an Ultra-Processed Diet?

Here are two sample menus from Kevin Hall's study pitting an ultra-processed diet against an unprocessed diet.

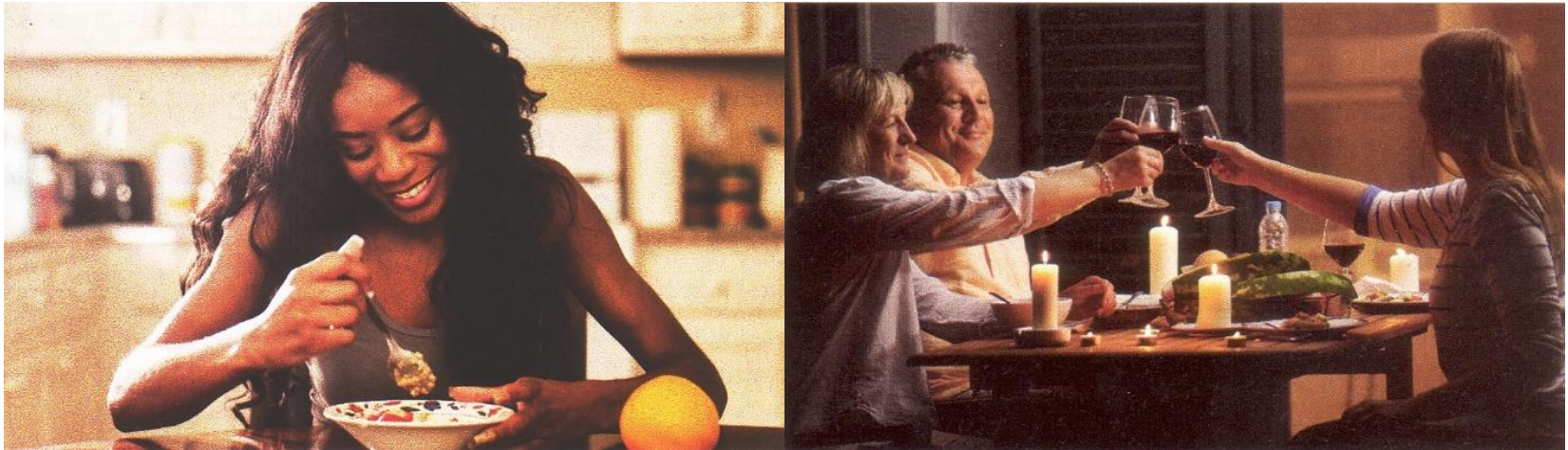
ULTRA-PROCESSED	UNPROCESSED
Breakfast	
Pancakes with margarine and syrup Turkey sausage Tater tots Apple juice	Oatmeal with blueberries and almonds 2% milk
Lunch	
Turkey sandwich with American cheese and mayo on white bread Baked potato chips Diet ginger ale	Entrée salad with grilled chicken breast, farro, apples, grapes, and lemon vinaigrette
Dinner	
Cheeseburger French fries and ketchup Diet ginger ale	Beef tender roast Couscous with lemon and garlic Green beans Side salad with honey vinaigrette
Snack	
Sweetened greek yogurt Canned peaches in heavy syrup	Carrots Black bean hummus



For more information: *BMJ Open* 2016. doi:10.1136/bmjopen-2015-009892.

SOURCE: Liebman B & Hall H. How did we get here? Explaining the obesity epidemic. *Nutrition Action Health Letter*, 2018 Jul-Aug, 3-8.

Eat Breakfast, Eat Early, Downsize, Go Low!



Eating early & less late (< ~ 6:30 pm) may help insulin work efficiently!

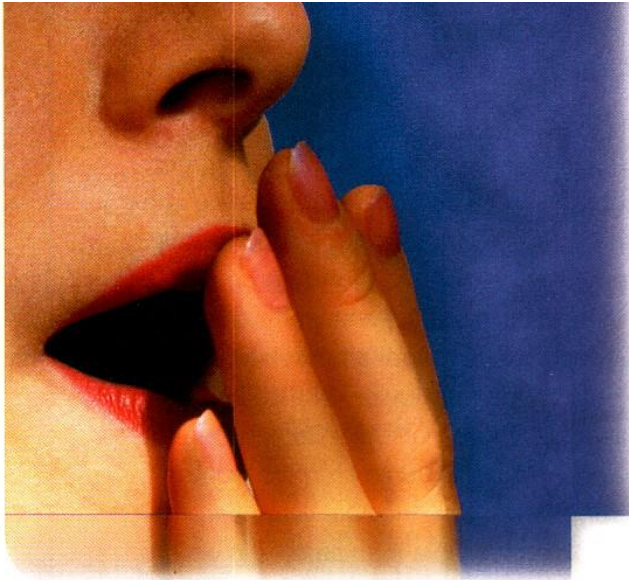


Smaller amount vs plate size!



**Fruits & vegetables for
low-calorie density!**

SOURCE: Dow C. How to eat less. What works. What doesn't.
Nutrition Action Health Letter, 2018 Jul-Aug, 6-8.



Sleep More, Eat Less

Wondering why you're so hungry? Maybe it's because you're not getting enough sleep.

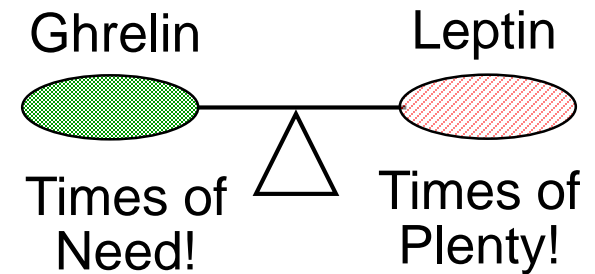
Researchers allowed 12 healthy young lean men to sleep for either four or eight hours in a laboratory. After one night of

four hours of sleep, the men ate 22 percent more calories the next day than they did after eight hours. They also reported being more hungry before breakfast and dinner.

In a separate study, scientists found that a single night with only four hours of sleep led to insulin resistance in nine healthy lean men and women in their 40s. After the night of restricted sleep, the participants were less able to move blood sugar into their cells, which suggests that their bodies were at least temporarily resistant to insulin. Insulin resistance can lead to heart disease, diabetes, and possibly breast cancer.

What to do: Get enough sleep. Most adults need 7 to 8 hours a night. (School-aged children need at least 9 hours.) Other studies that limit adults' sleep find higher levels of ghrelin (which makes people hungry) and lower levels of leptin (which makes people feel full) in their blood. Changes in ghrelin, leptin, and insulin resistance may explain why studies find a higher risk of obesity, heart disease, diabetes, and high blood pressure in people who get too little sleep.

**promotes
Leptin
release!**



<http://www.vivo.colostate.edu/hbooks/pathphys/endocrine/gi/ghrelin.html>

Successful Dieting – National Weight Control Registry

- 5000 people, ≥ 30 lb weight loss, ≥ 5 yr
- High-carbohydrate (55-60%), low-fat (24%) diet with the rest (~ 16 -21%) from protein
- Wholesome vs. high-sugar carbohydrates including fruits, vegetables, high-fiber foods

- Conscious of calories knowing that total calories count, no matter what diet type

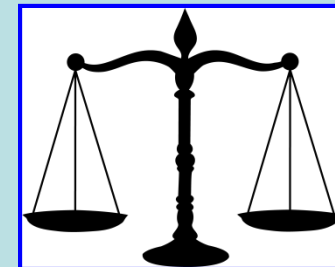
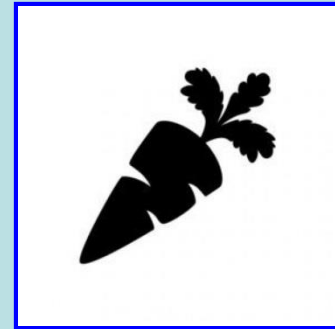
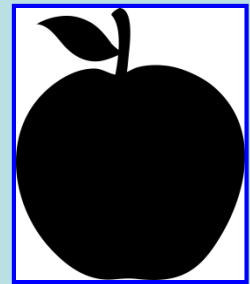
- Eight of 10 ate breakfast daily which may help better manage calories during the day

- Self-monitor, weigh themselves ≥ 1 x/wk & many still keep food dairies

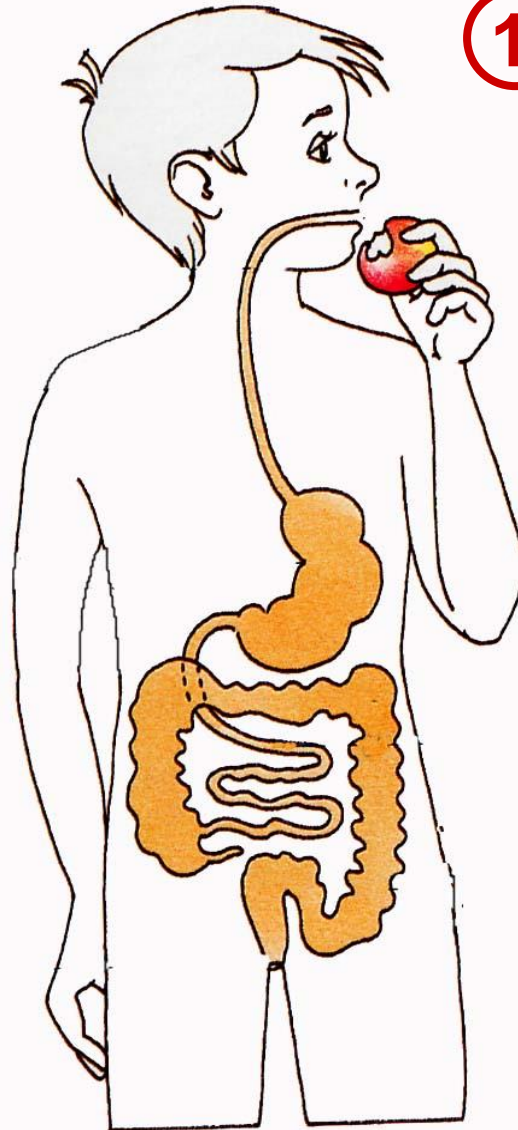
- Much planned physical activity, 60-90 min/d, 1⁰ walking + looked for other ways to be active

<http://www.nwcr.ws/Research/published%20research.htm>

UC Berkeley Wellness Engagement Calendar, September 2013



Digestion Steps



① Ingestion

② Mechanical Digestion

③ Chemical Digestion

④ Peristalsis

⑤ Absorption

⑥ Storage

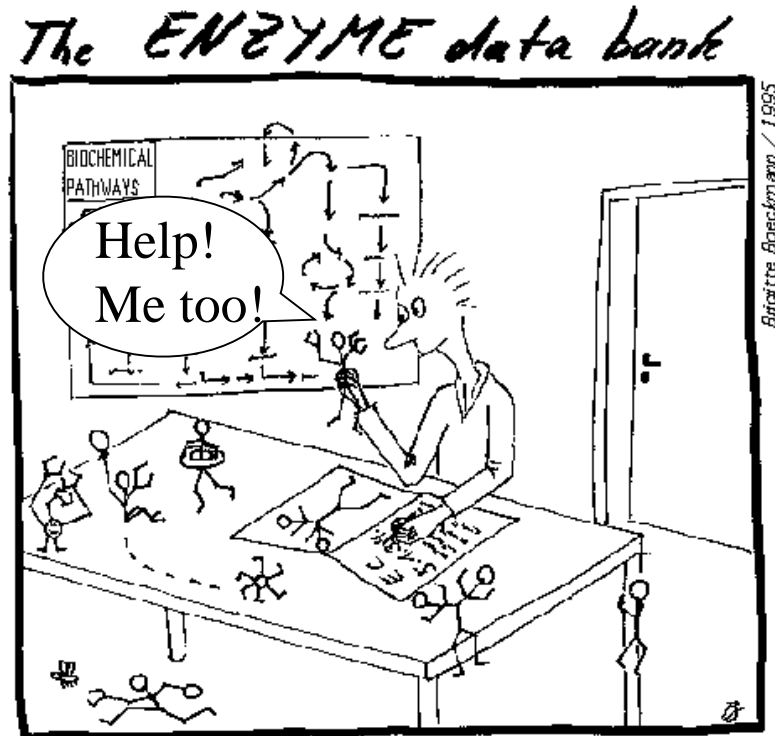
⑦ Defecation

Hydrolysis of Energy Nutrients

Hi gang!!
You need me
for digestion!!



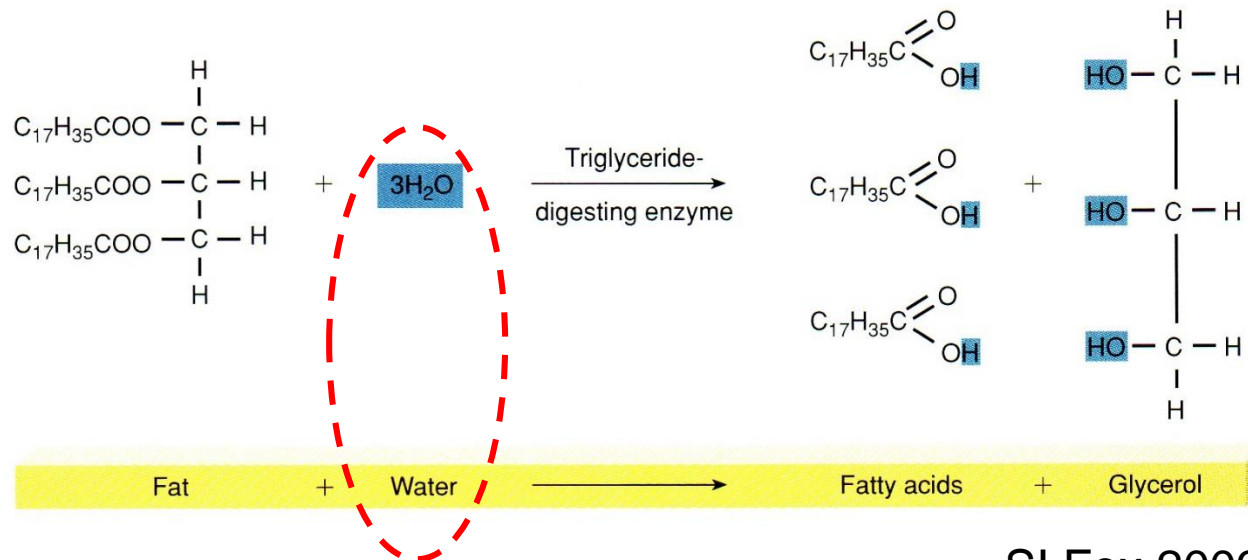
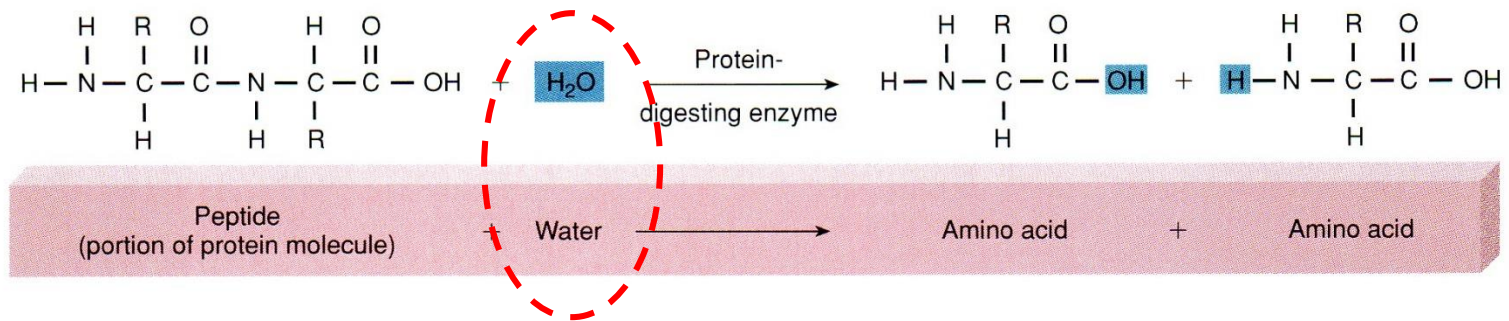
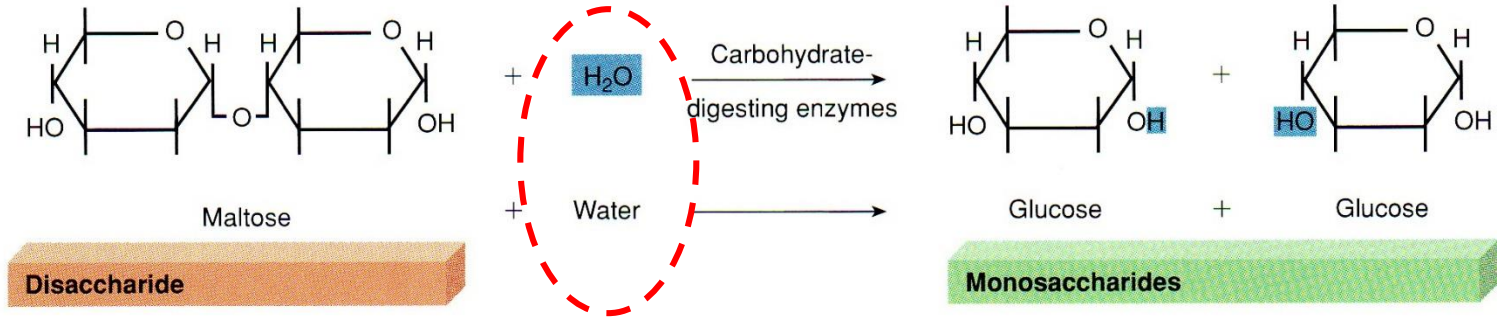
+



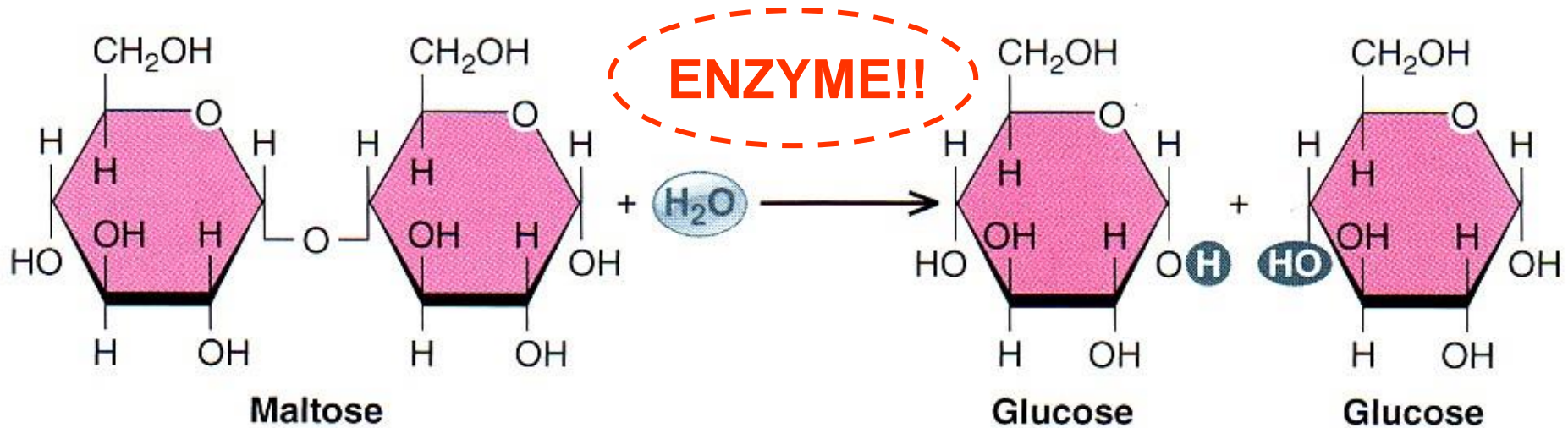
H₂O

+

Enzyme



What's missing?

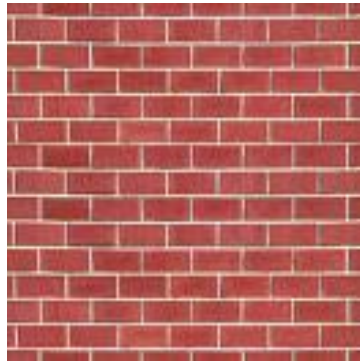


● **FIGURE 15-1** An example of hydrolysis. In this example, the disaccharide maltose (the intermediate breakdown product of polysaccharides) is broken down into two glucose molecules by the addition of H_2O at the bond site.

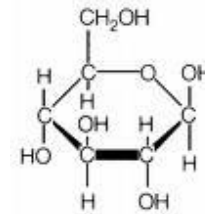
Polymer to Monomer (Many to One)



...Central-linking theme!!

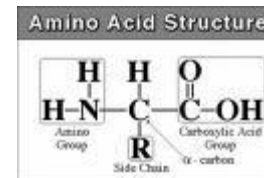


Carbohydrate

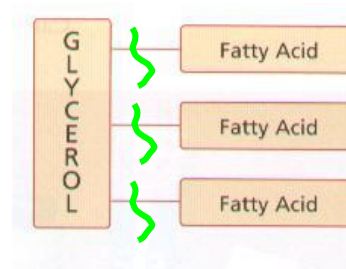
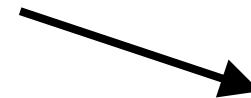


Glucose

Protein
+
Fat



Amino Acids



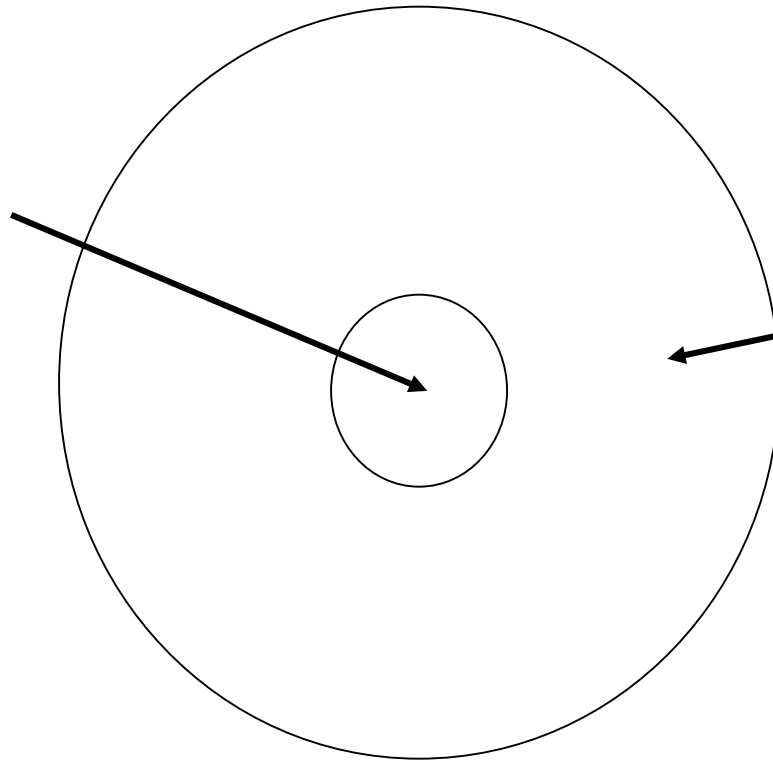
Fatty Acids
+
Glycerol



GI-Doughnut Analogy



GI Lumen



Body



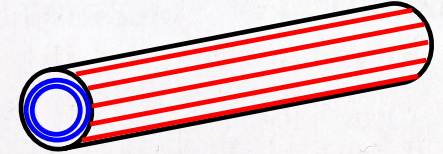
Me?



Common Control Mechanisms

- 1. Local (autoregulation)**
- 2. Nervous (rapidly-acting)**
- 3. Hormonal (slower-acting/
reinforcing)**

Longitudinal → Shortens L



Circular → ↓d or Width

Body wall

Serosa

Submucosa

Duct of large accessory digestive gland (i.e., liver or pancreas) emptying into digestive-tract lumen

Outer longitudinal muscle

Inner circular muscle

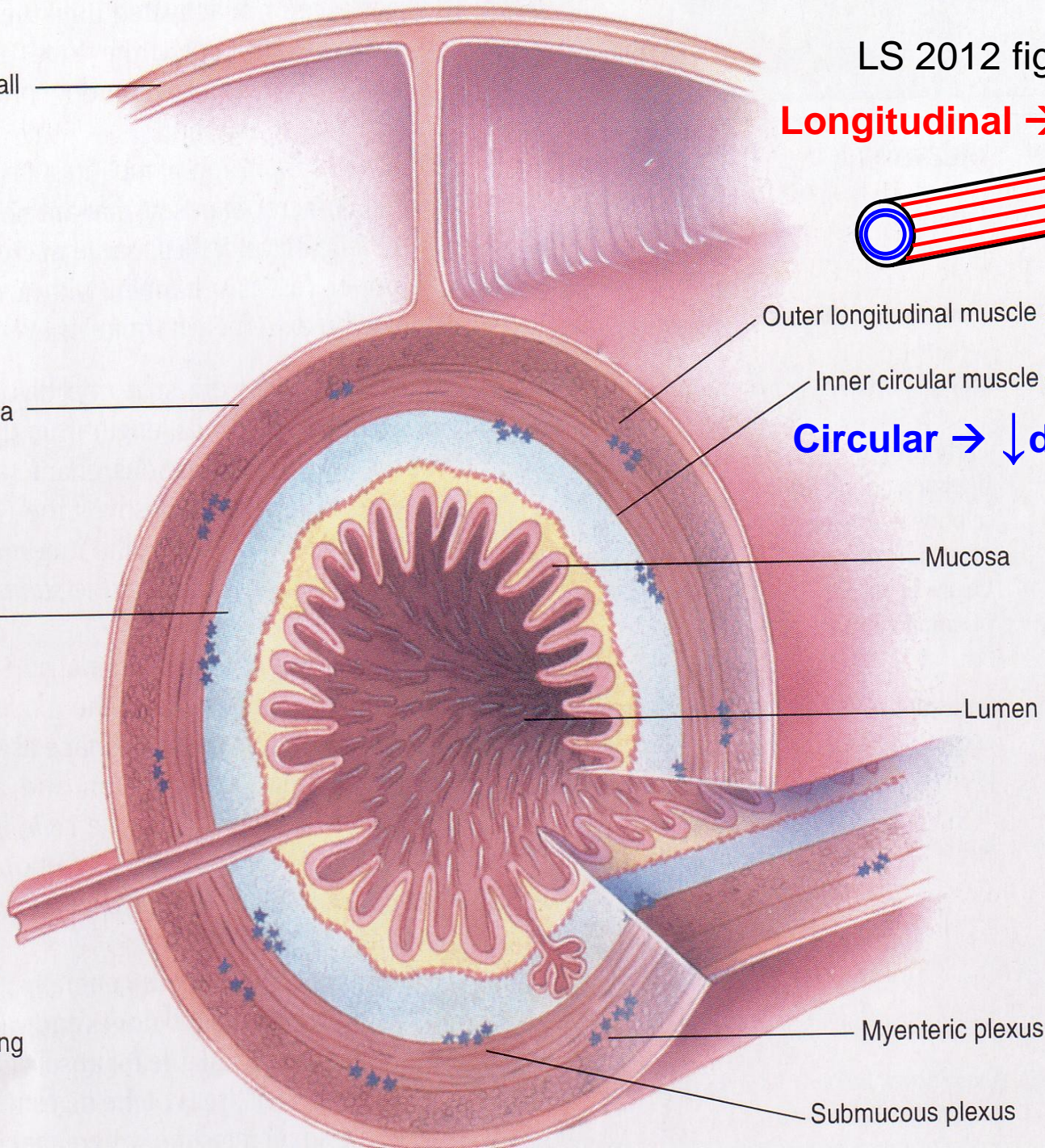
Muscularis externa

Mucosa

Lumen

Myenteric plexus

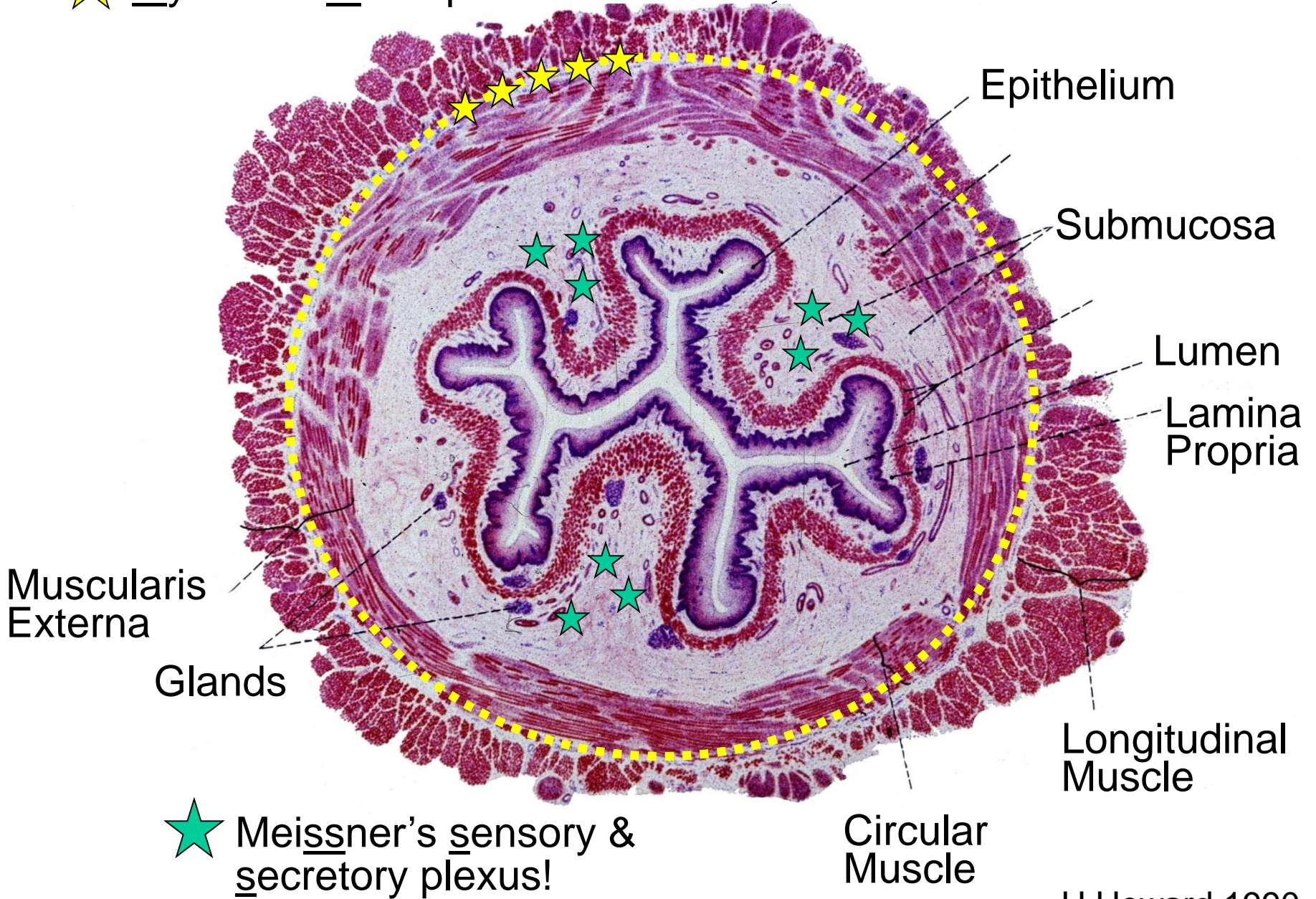
Submucous plexus



★ Myenteric motor plexus!

Serosa

cf: G&H fig 62-2



Epithelium

Submucosa

Lumen

Lamina Propria

Muscularis Externa

Glands

Longitudinal Muscle

Circular Muscle

★ Meissner's sensery & secretory plexus!

H Howard 1990

Gut Secretions

Secretion

Release Site

1. Mucus

into GI Lumen

2. Enzymes

into GI Lumen

3. H₂O, acids, bases+

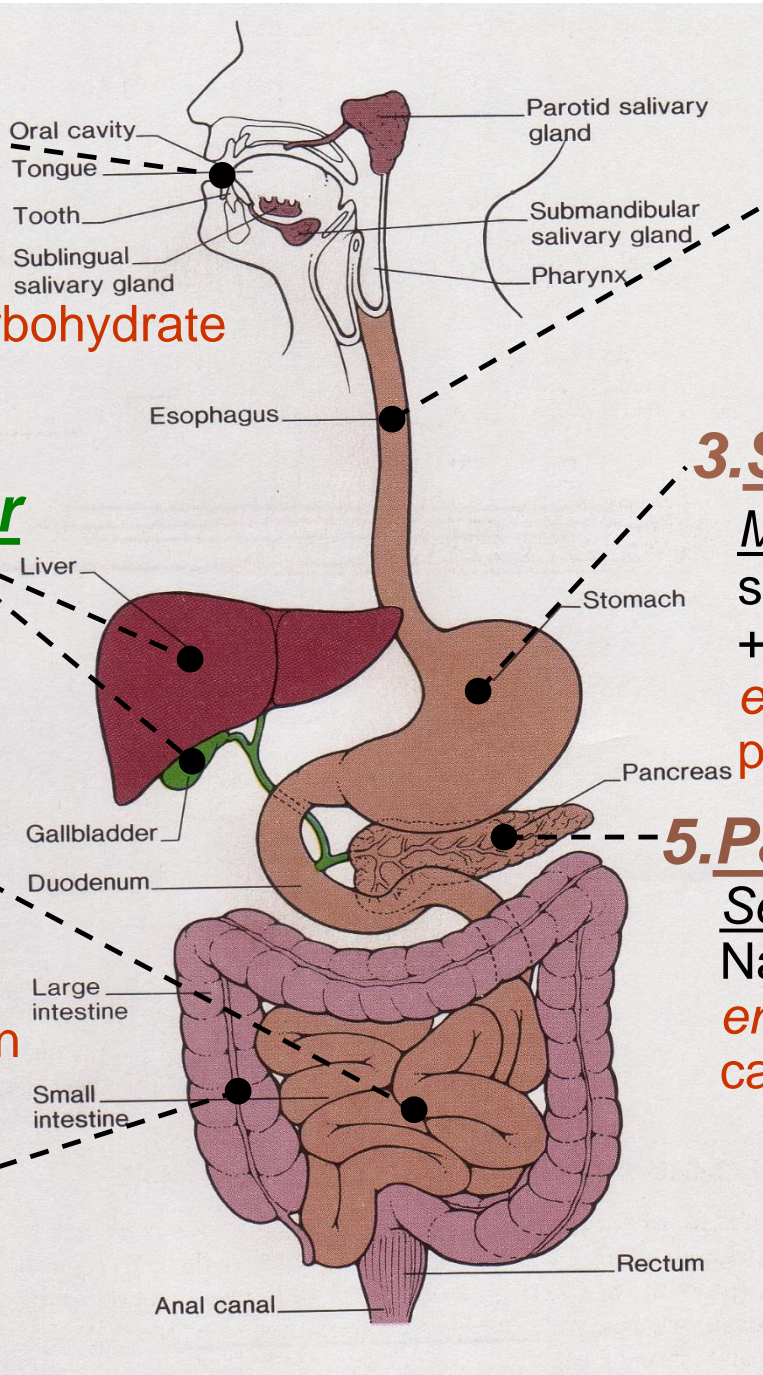
into GI Lumen

4. Hormones

into Blood

1. Mouth

Ingestion entry way
salivary gland secretion
mucus + enzymes
enzymatic digestion: carbohydrate
mastication = chewing
deglutition = swallowing



2. Esophagus

Rapid transit
peristalsis
secretion mucus

3. Stomach

Mixing peristalsis
secretion mucus + HCl
+ enzymes
enzymatic digestion:
protein + butter fat!

5. Pancreas

Secretion mucus +
NaHCO₃ + enzymes
enzymatic digestion:
carbohydrate, fat, protein

4. Liver-Gall Bladder

Emulsification =
detergent action of bile
+ secretion

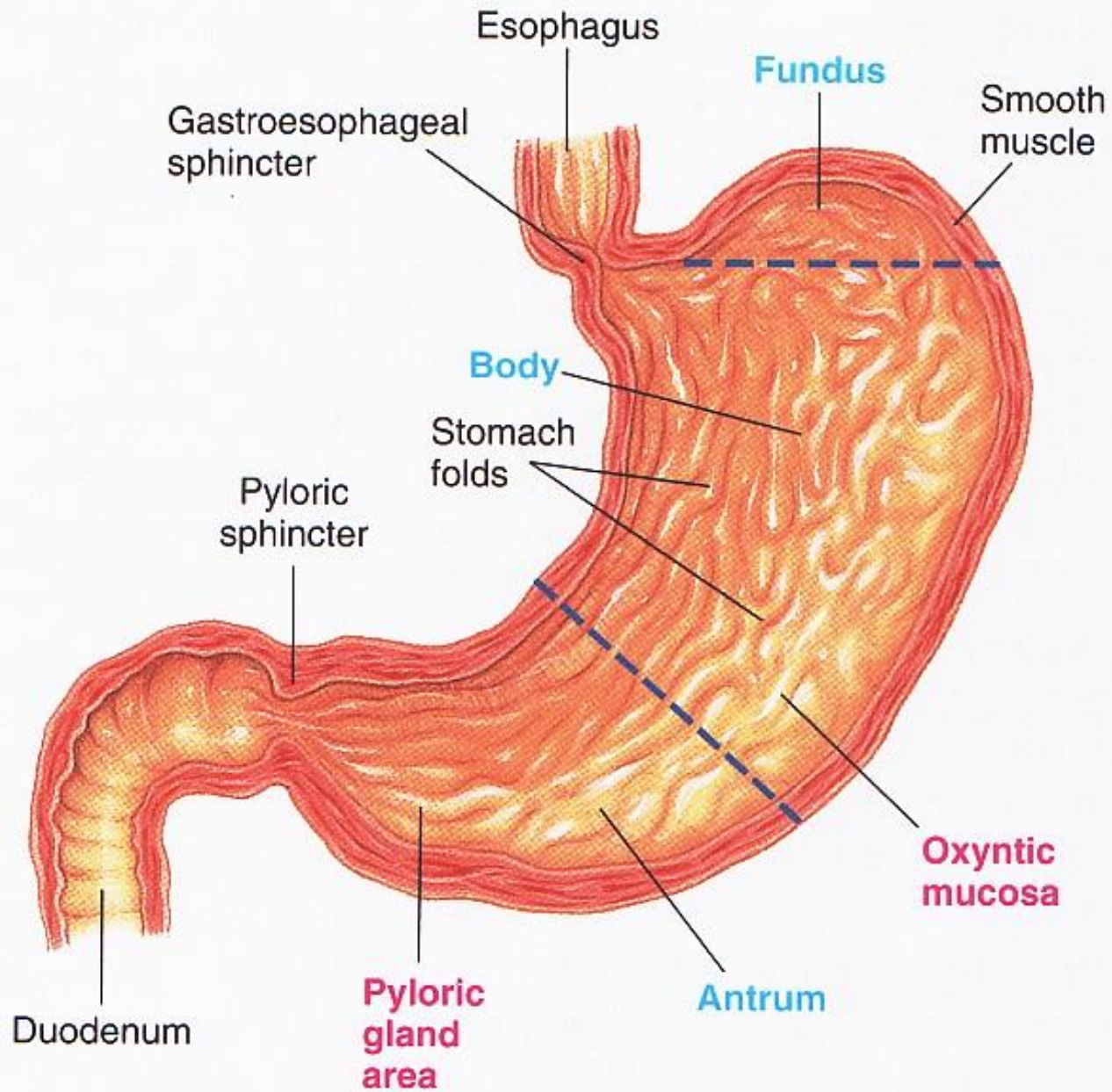
6. Small Intestine

Absorption
Secretion mucus
+ enzymes
enzymatic digestion:
carbohydrate, fat, protein
Peristalsis

7. Large Intestine

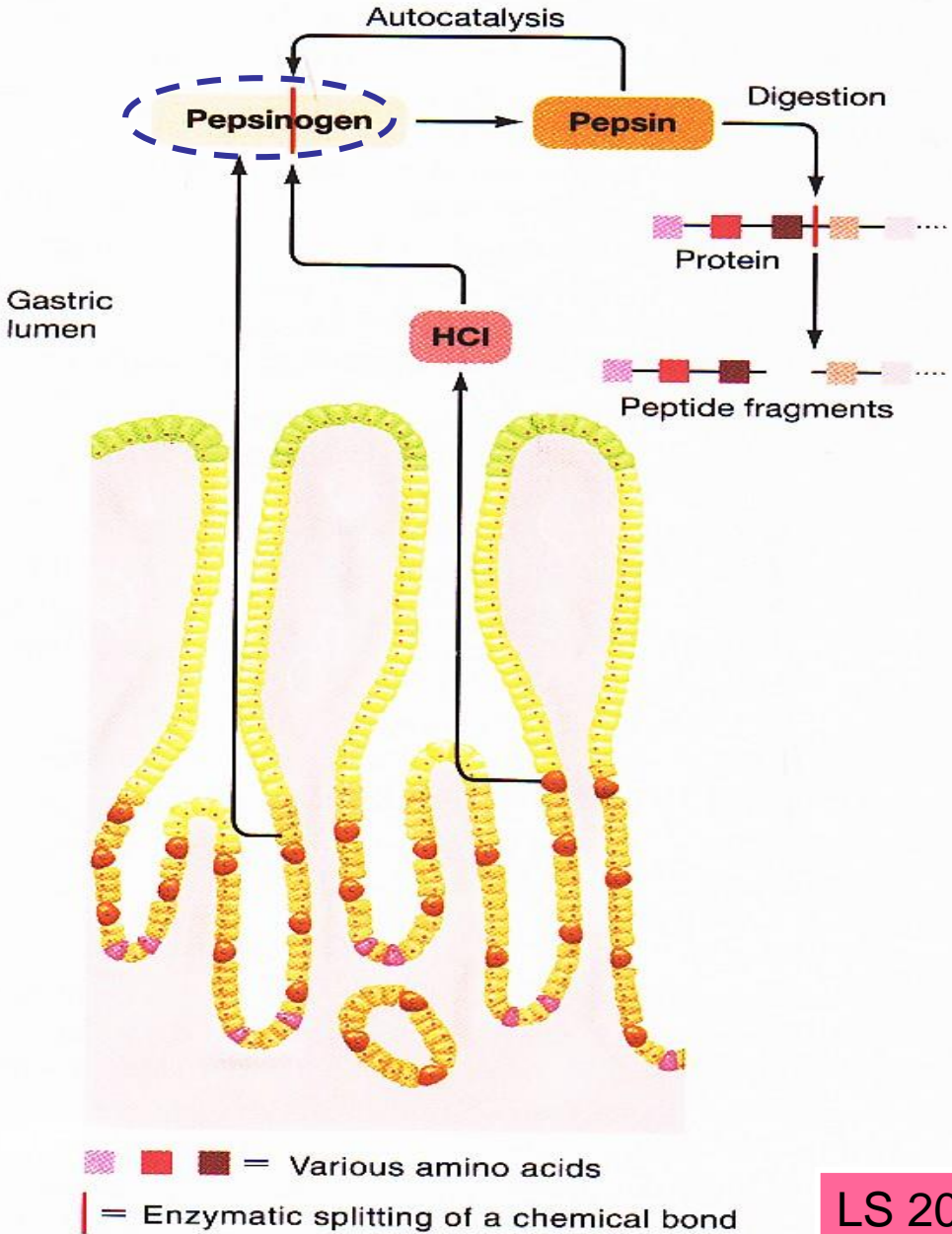
Dehydration
secretion + absorption
storage + peristalsis

Where does
enzymatic
digestion of
protein
begin?

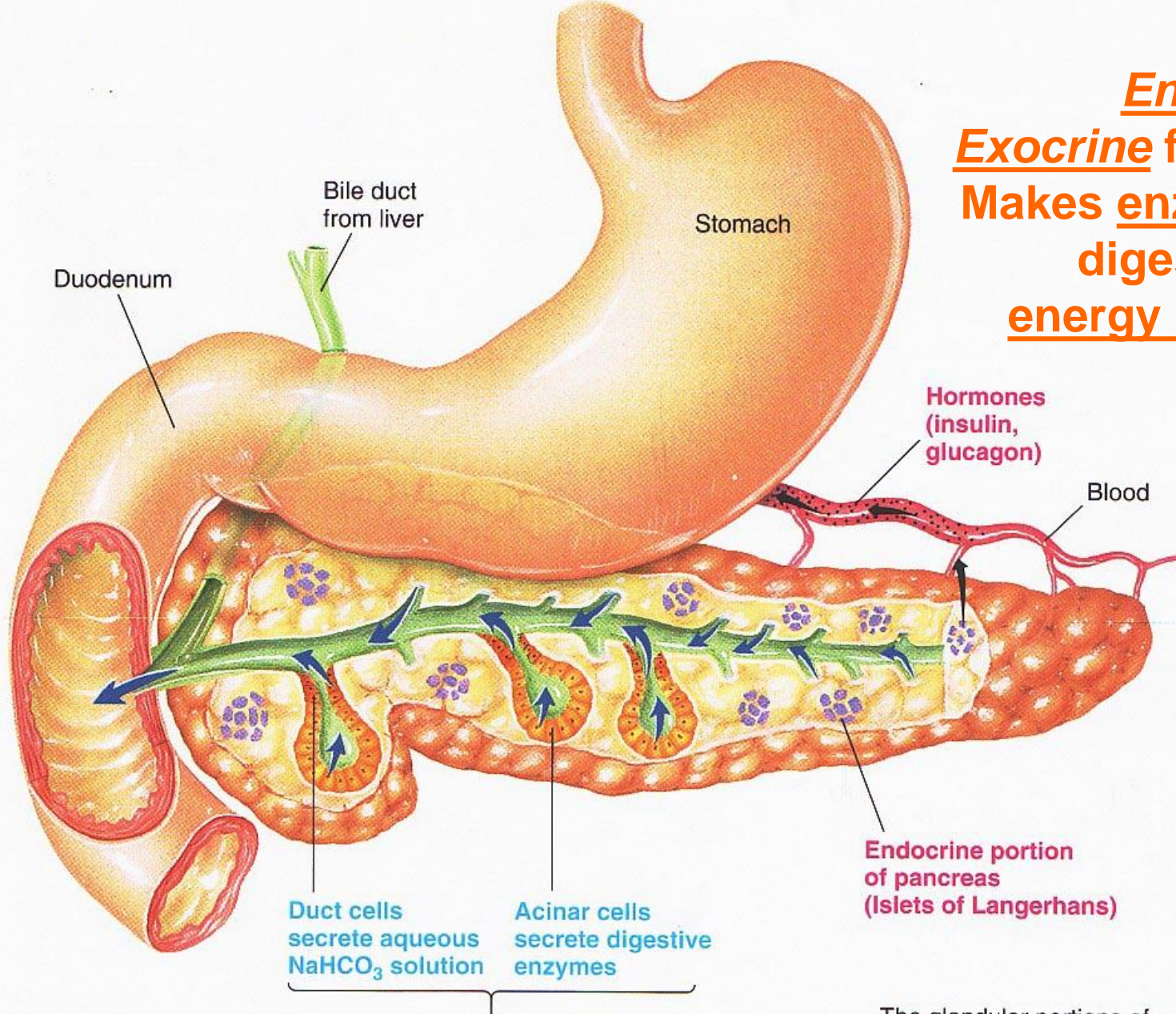


● **FIGURE 15-7**

**Zymogen =
an inactive
precursor**



Why is the
pancreas so
unique?



Endocrine + Exocrine functions; Makes enzymes for digesting all 3 energy nutrients!

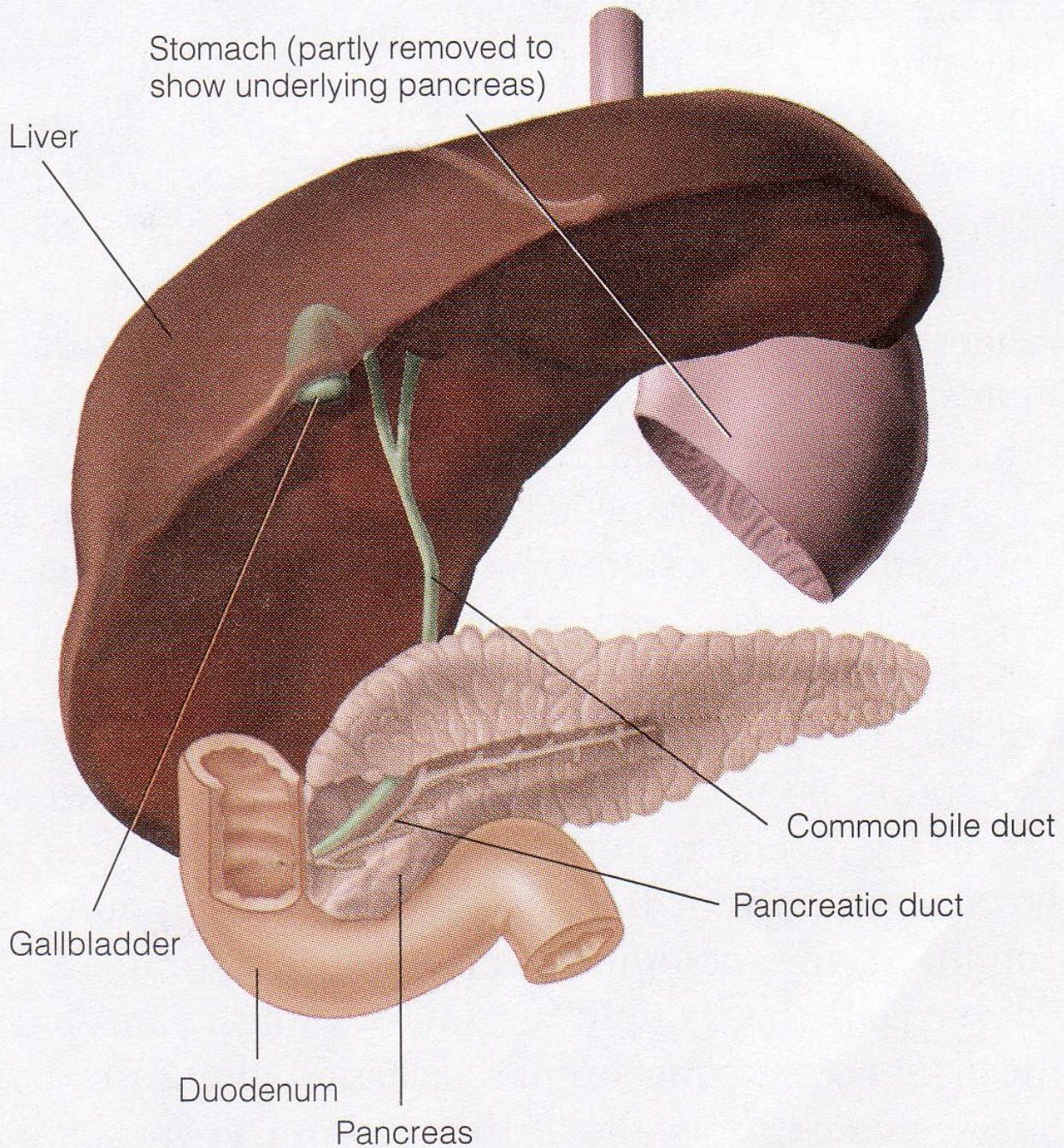
Duct cells secrete aqueous NaHCO_3 solution
 Acinar cells secrete digestive enzymes

Exocrine portion of pancreas (Acinar and duct cells)

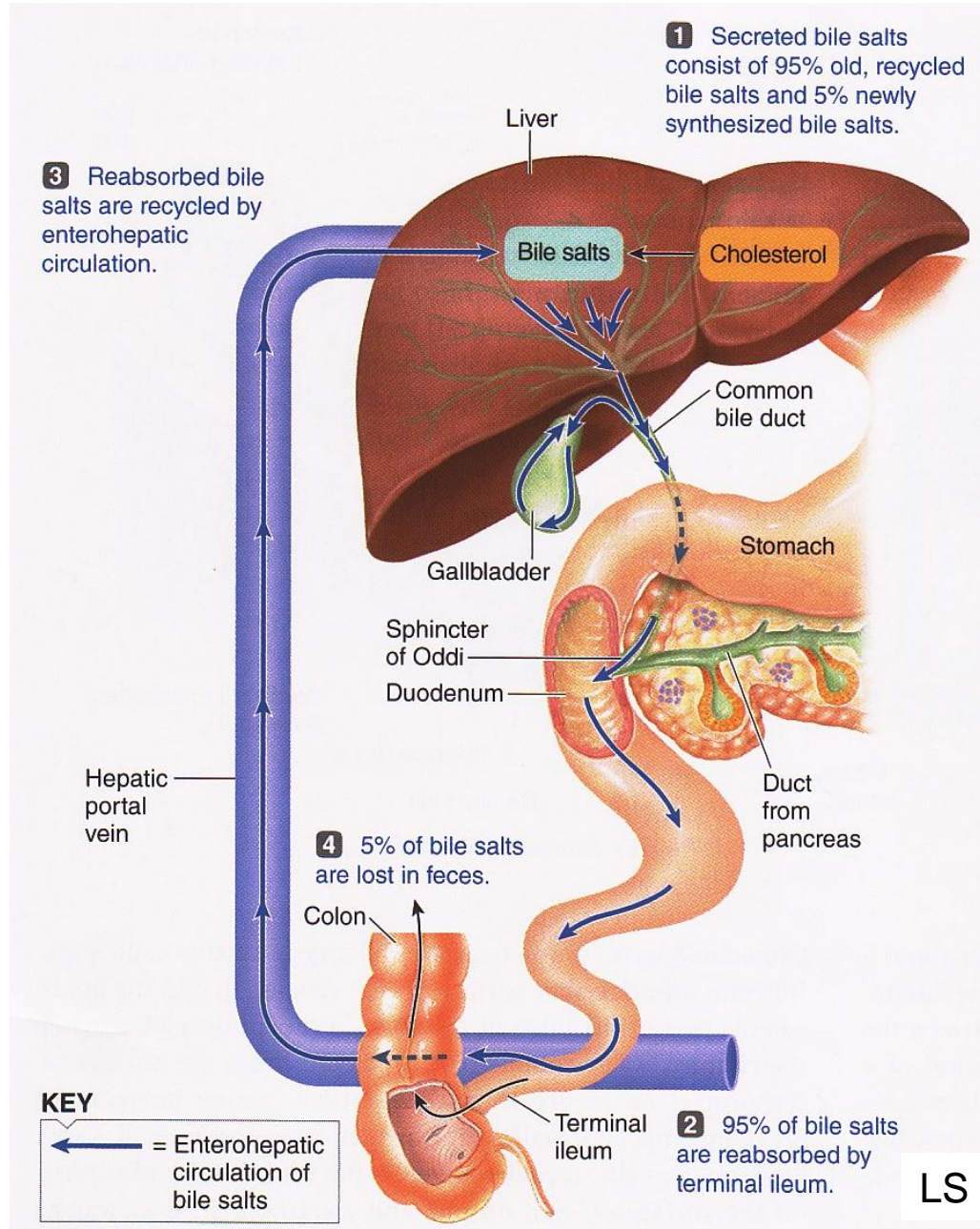
Endocrine portion of pancreas (Islets of Langerhans)

The glandular portions of the pancreas are grossly exaggerated.

**What are other
accessory organs
of digestion, that is,
off-shoots of the
primary tube?**

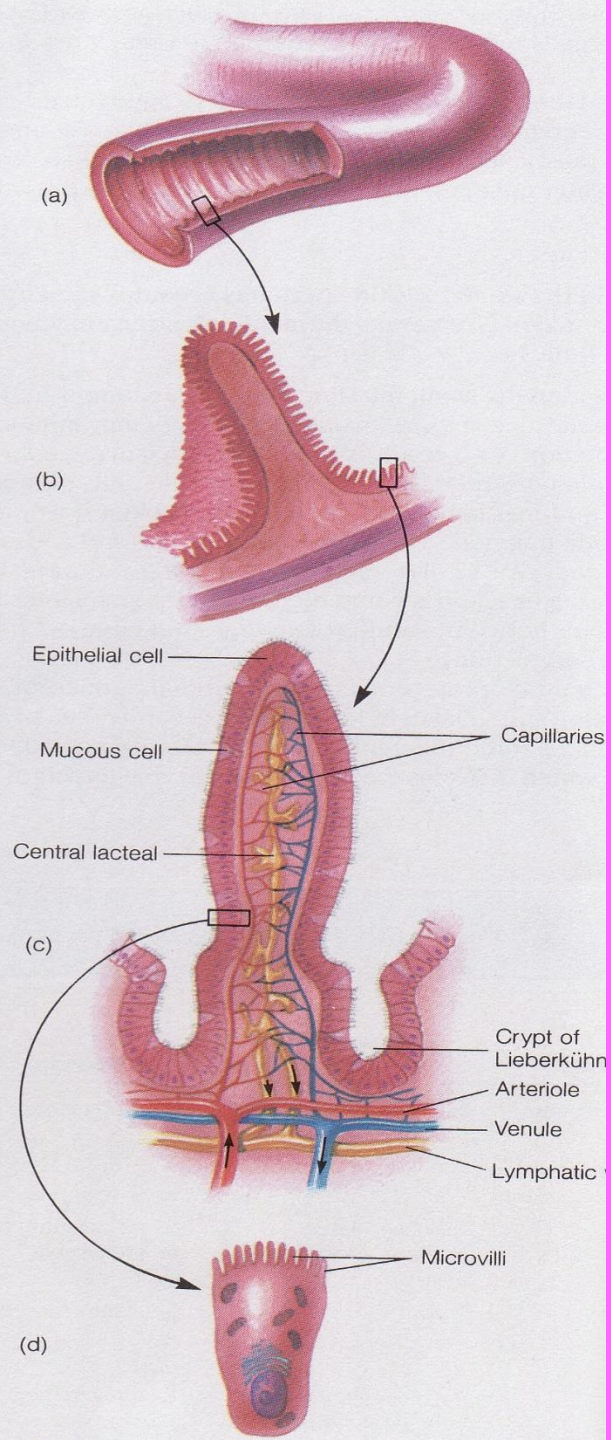


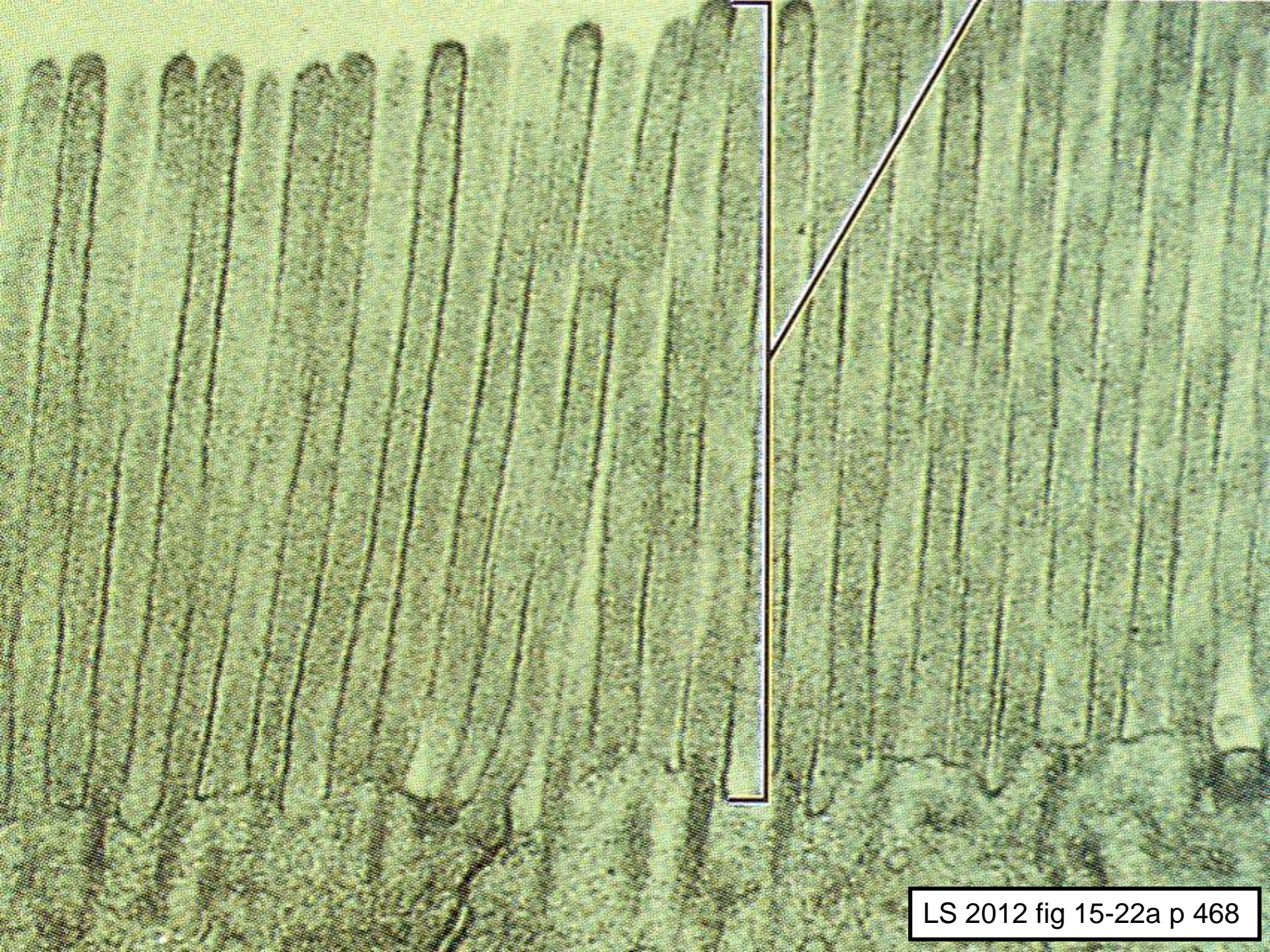
Liver: Amazing Recycling of Bile Salts!



What is the major
function of the
small intestine?

Absorption!!





Why Do Some People Have Trouble Digesting Milk?

- Ability to digest milk carbohydrates varies
 - Lactase
 - Made by small intestine
- Symptoms of intolerance
 - Gas, diarrhea, pain, nausea?
- Milk allergy?
- Nutritional consequences
- Milk tolerance and strategies





<http://www.cdc.gov/ulcer/>



Ulcer Facts

- Most ulcers are caused by an infection, not spicy food, acid or stress.
- The most common ulcer symptom is burning pain in the stomach.
- Your doctor can test you for *H. pylori* infection.
- Antibiotics are the new cure for ulcers.
- Eliminating *H. pylori* infections with antibiotics means that your ulcer can be cured for good.

Clipping a Duodenal Ulcer

Peering through the pylorus into the duodenum, we see some blood and a vessel sticking out of the wall, just at the front edge of a small but deep ulcer.

In the second photograph, a disposable metal clip is applied to the ulcer. The patient remained well and left hospital three days later.

