

BI 121 Lecture 6 **Nutrition Lab 3 today! More personal data...**



- I. Announcements** Data + flash drive/e-mail for today's lab!
To have your notebook returned to study for Exam I on Tues Oct 29th, best to submit prior to lecture next Tues Oct 22nd.
Review Session Sunday Oct 27th, 6-7:30 pm. Sample Exam Q?
Be sure to see *Active Learning Questions!* Drink your calories?
- II. Nutrition Connections** Plants, Whole Grains, Exercise, Dieting?
- III. GI (Gut) Structure & Function** DC Module 3, LS 2012 ch 15
 - A. Gut Doughnut Analogy + Secretions L Brilla WWU
 - B. Digestion Steps Dr. Evonuk + LS pp 437- 439; DC p 23
 - C. Hydrolysis + Polymer → Monomer: Central Themes!
LS p 438, SI Fox 2009 + ...
 - D. Gut control mechanisms
 - E. Histology of the gut LS fig 15-2, 15-3 p 442-3
 - F. Organ-by-organ review
 - G. Stomach protein digestion + zymogens? LS fig 15-7, 15-9
 - H. Pancreas & Liver: Accessory organs! Recycling! LS pp457-63
 - I. Small intestine? Ulcers? LS fig 15-20,15-22 pp 467-8
Beyond the Basics LS p 456, Mayo Clinic on Ulcers
 - J. Summary of chemical digestion LS tab 15-5 p 466
 - K. Large intestine? LS fig 15-24 pp 472-4

DietController Software for Personal Nutrition Analyses!



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

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.

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!***

Nutrition Action

OCTOBER 2018 \$2.50

HEALTH LETTERSM
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Carbohydrate Confusion

Should you avoid carbs
at all costs? ←

No, ↑ *complex*
↓ *simple!*
Emphasize a
plant-based
diet!

Our Planet
AT RISK

The Best
SPREADS

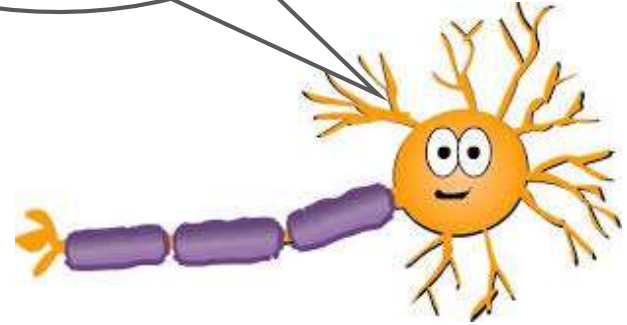
3 Veggie
Dips

Actor Halle Berry "wears by the ketogenic diet,"
according to *Women's Health* magazine.

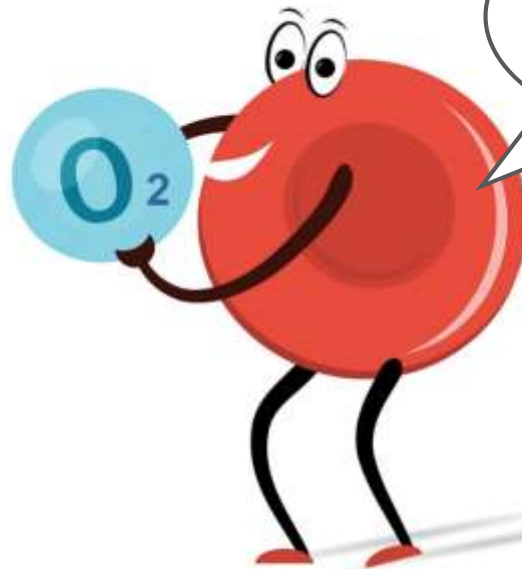
I prefer
glucose!



Me three!



Me too!



Potential regulators
of health!

10s of thousands!

① Anti-oxidants
protect DNA from
oxidative damage

② Protein synthesis
regulation/control

③ Hormone-like
action
endocrine mimicry

④ Blood effects
modify blood chemistry

Phytochemicals ≡ Plant chemicals

aroma, color, taste



*Broccoli sprouts may contain
~ 10,000 unique phytochemicals!*



≥ 5 tomato-containing meals per week may protect from cancers of the esophagus, stomach & prostate !



...but, the phytochemical candidate, lycopene with anti-oxidant activity is also in guava, papaya, pink grapefruit & watermelon!



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/eathealthy/grains>



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HEALTH LETTER®
 CENTER FOR SCIENCE IN THE PUBLIC INTEREST

Eat Real, America!

"With the right food choices, physical activity, and not smoking, we could prevent about 80 percent of heart disease, about 90 percent of diabetes, and 70 percent of stroke," says Walter Willett, chair of the nutrition department at the Harvard School of Public Health in Boston. "Those are the three pillars. They really do make a difference."

The right food choices are simple: Eat less red meat, sweets, refined grains, and salt, and drink fewer sugary beverages. Replace unhealthy foods with vegetables, fruit, beans, and whole grains, and with smaller amounts of fish, poultry, and low-fat dairy. Those foods aren't just good for our health. They can also help protect the Earth.

Here's why—and how—to eat real.

Continued on page 3.

With the right food choices, physical activity, and not smoking, we could prevent about 90% of diabetes, 80% of heart disease and 70% of strokes!

FOOD DAY

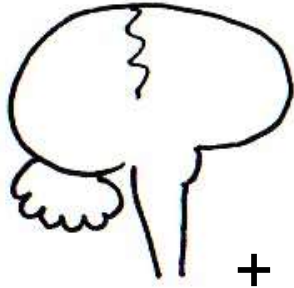
OCTOBER 24, 2011

JOIN US AT FOODDAY.ORG

40

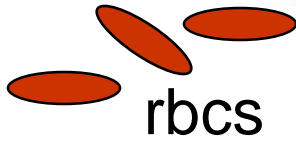
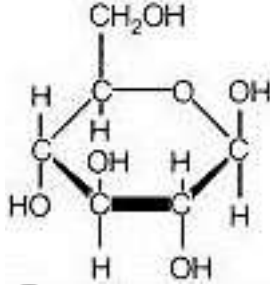
CSPI • 1971-2011

2



+

glucose



rbc



1

Negative Effects of Low Carbohydrate

4



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



+ gall stones,
↓ thermoregulation...

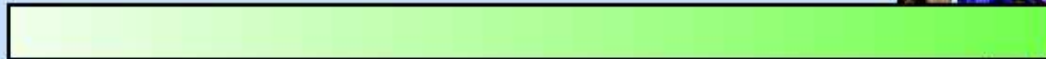
Dietary Composition & Physical Endurance

eg, Atkins!

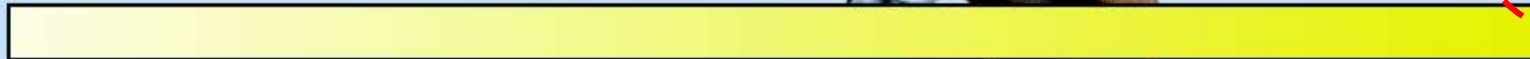
High-fat diet



Normal mixed diet



High-carbohydrate diet



~ 1/3 endurance!

Maximum endurance time:

57 min

114 min

167 min



**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>

We're better at storing fat vs carbohydrate!

Dietary Fat



3 % Kcal

Body Fat



23 % Kcal

**Dietary
Carbohydrate**



***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

HEALTH LETTER®

WITH FOOD SCIENCE IN THE PUBLIC INTEREST

APPLES TO
WATERMELON
Rating fruit

Two super
salads

Good for the
GUT?

An
Anti-Aging
Diet?

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

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>

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

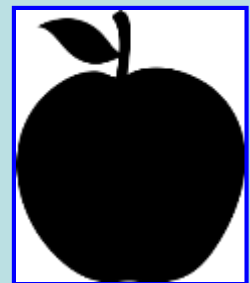
- Eight of 10 ate breakfast daily which may help better manage calories during the day

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

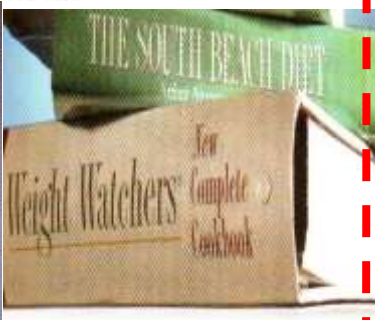
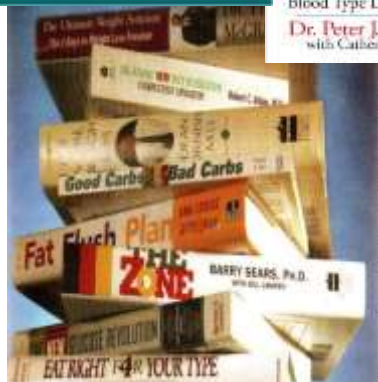
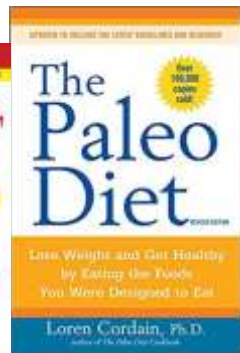
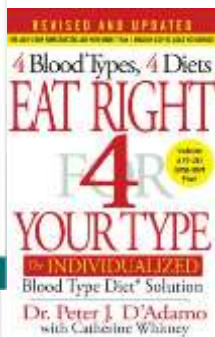
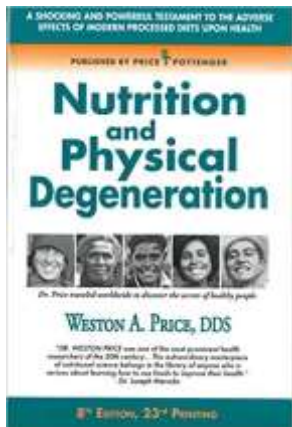
- Much planned physical activity, 60-90 min/d, 1⁰ walking + looked for other ways to be active

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

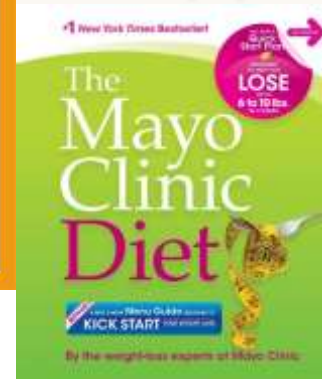
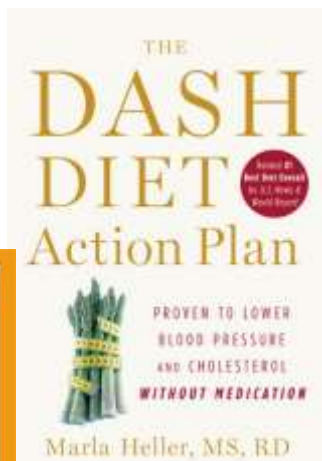
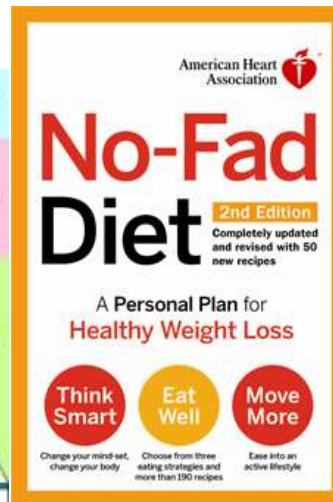
UC Berkeley Wellness Engagement Calendar, September 2013



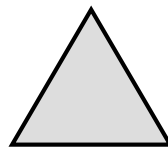
Which Diets are Best?



Mediterranean Diet



Not Plant-based
Lower Carbohydrate



Plant-based
Lower Fat



Not Peer-Reviewed = Trade Book
→ Opinion



Peer-Reviewed = Text Books
→ Research

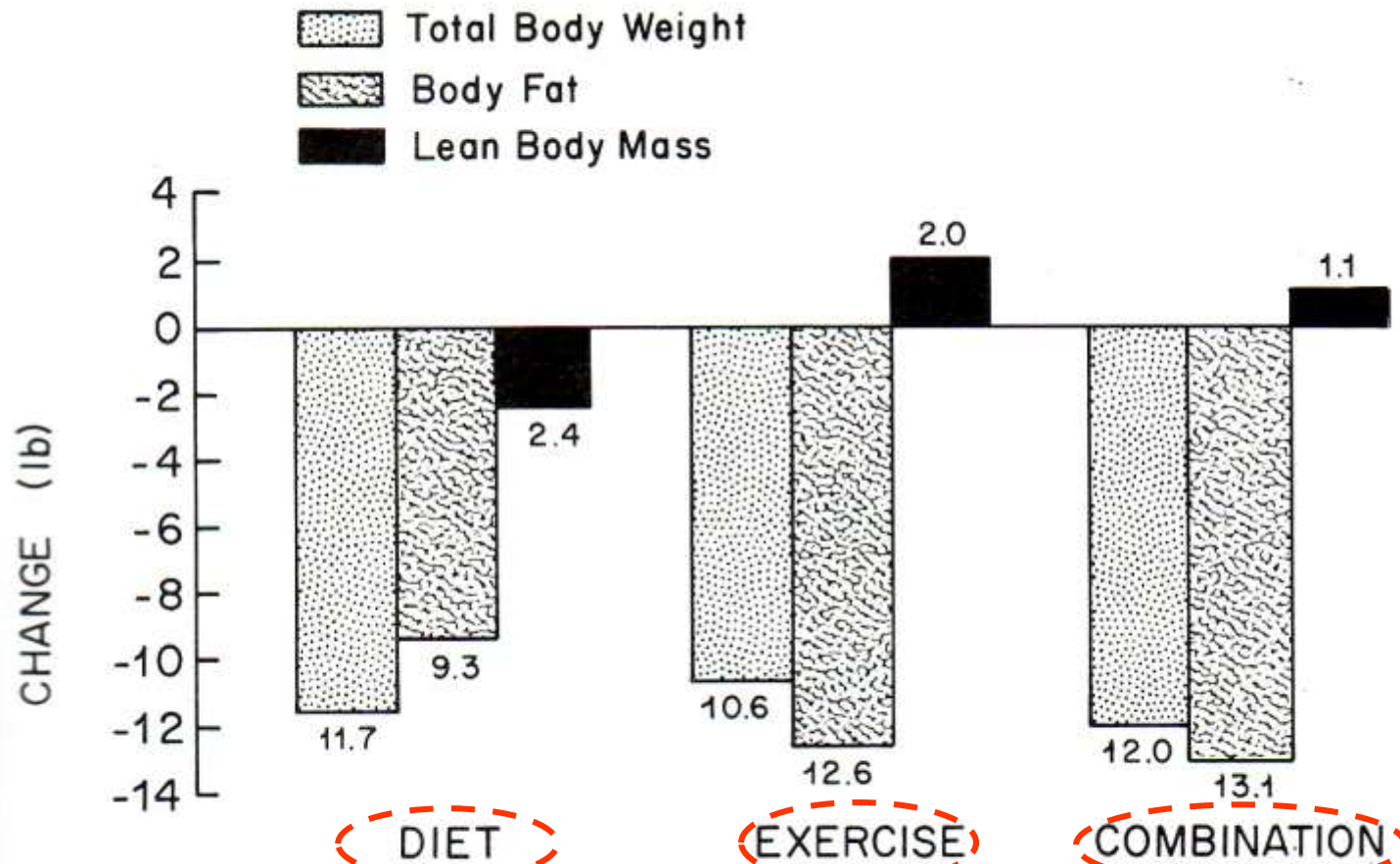


Figure 4-9. Changes in body weight, body fat, and lean body weight for diet, exercise, and combination groups. (From Zuti W. B., and Golding, L. A.: Comparing diet and exercise as weight reduction tools. *Phys. Sportsmed.* 4:49-53, 1976.)

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



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



Questions + Discussion

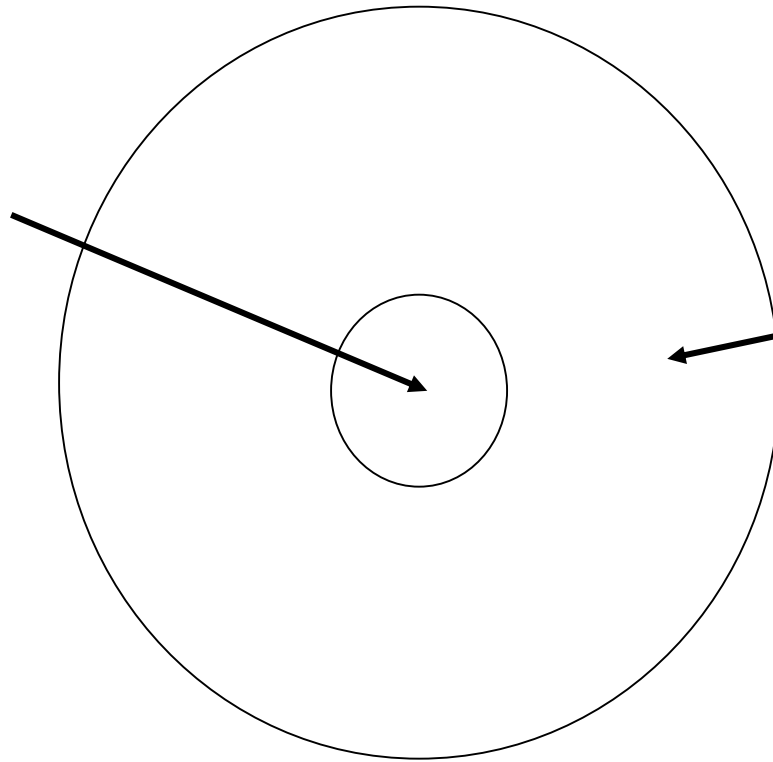




GI-Doughnut Analogy



GI Lumen



Body



Me?



Gut Secretions

Secretion

Release Site

1. Mucus

into GI Lumen

2. Enzymes

into GI Lumen

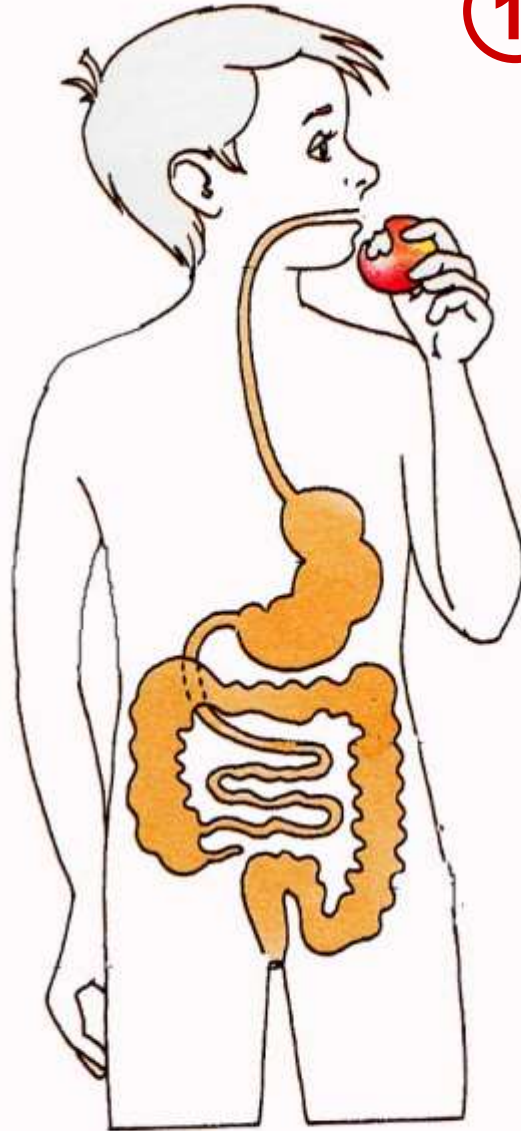
3. H₂O, acids, bases+

into GI Lumen

4. Hormones

into Blood

Digestion Steps



- ① Ingestion
- ② Mechanical Digestion
- ③ Chemical Digestion
- ④ Peristalsis
- ⑤ Absorption
- ⑥ Storage
- ⑦ Defecation

SOURCE: Dr. Eugene Evonuk, 1989. cf. L Sherwood, 2012 pp 437-8.

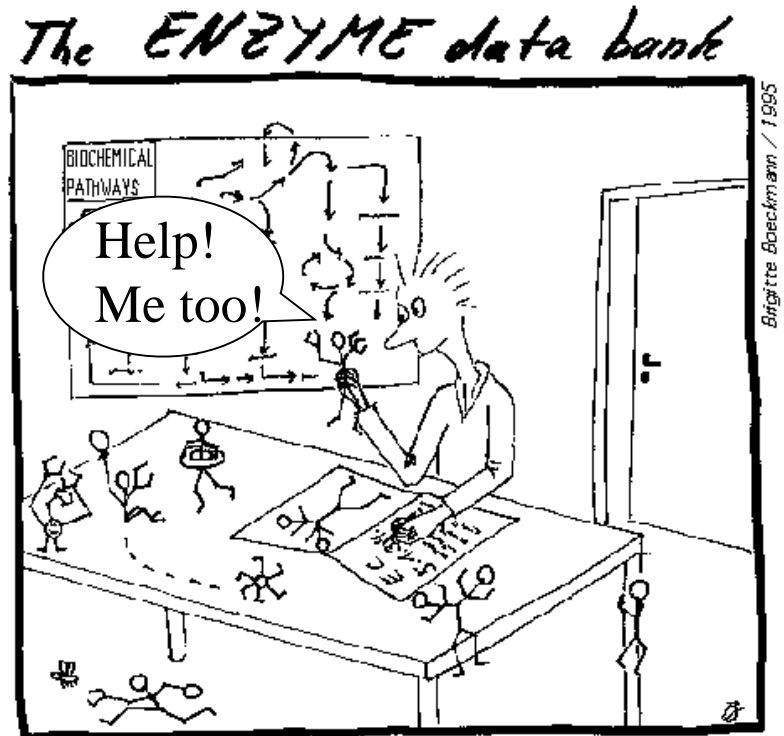
<https://www.youtube.com/watch?v=Oq5xAdC8EUI>

Hydrolysis of Energy Nutrients

Hi gang!!
You need me
for digestion!!



+

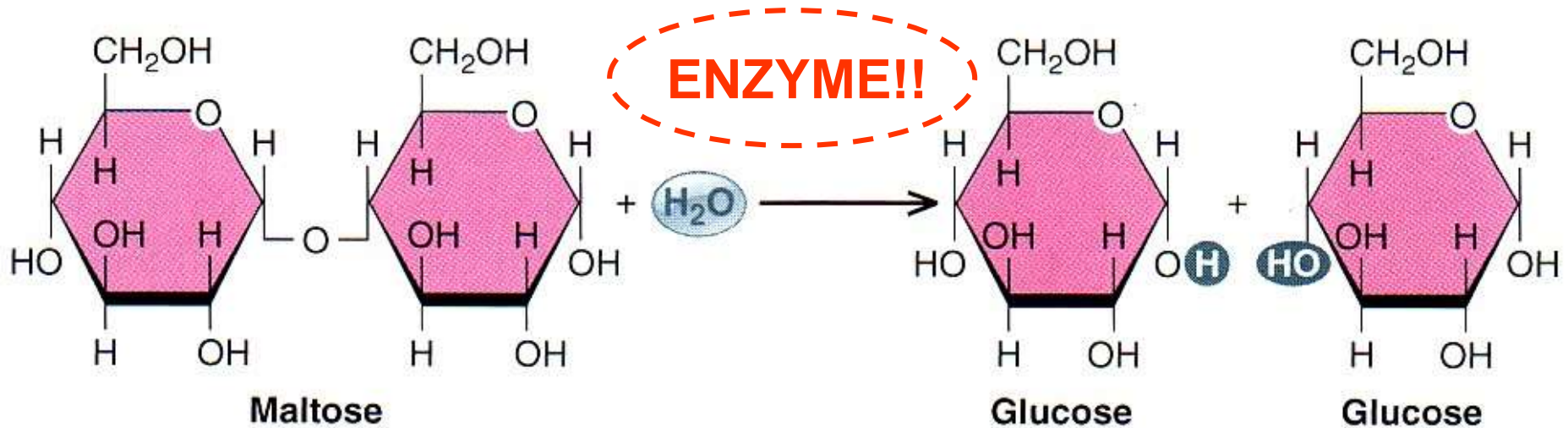


H₂O

+

Enzyme

What's missing?

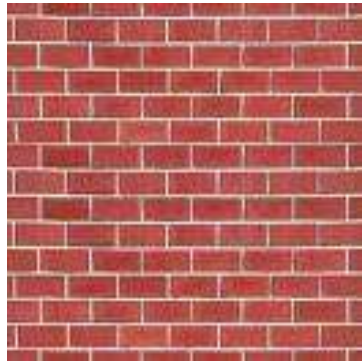


● **FIGURE 15-1 An example of hydrolysis.** In this example, the disaccharide maltose (the intermediate breakdown product of polysaccharides) is broken down into two glucose molecules by the addition of H₂O at the bond site.

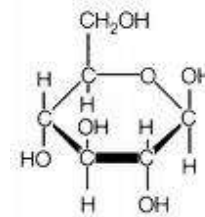
Polymer to Monomer (Many to One)



...Central-linking theme!!

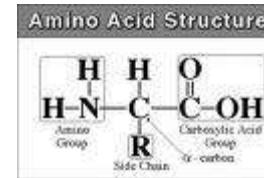


Carbohydrate

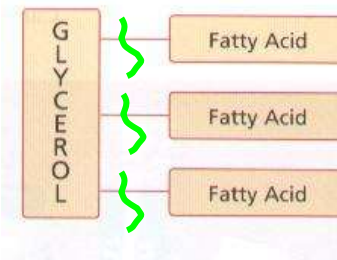
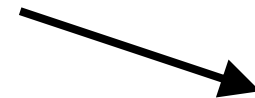


Glucose

Protein
+
Fat



Amino Acids

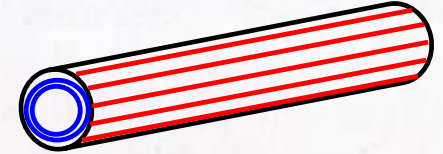


Fatty Acids
+
Glycerol

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

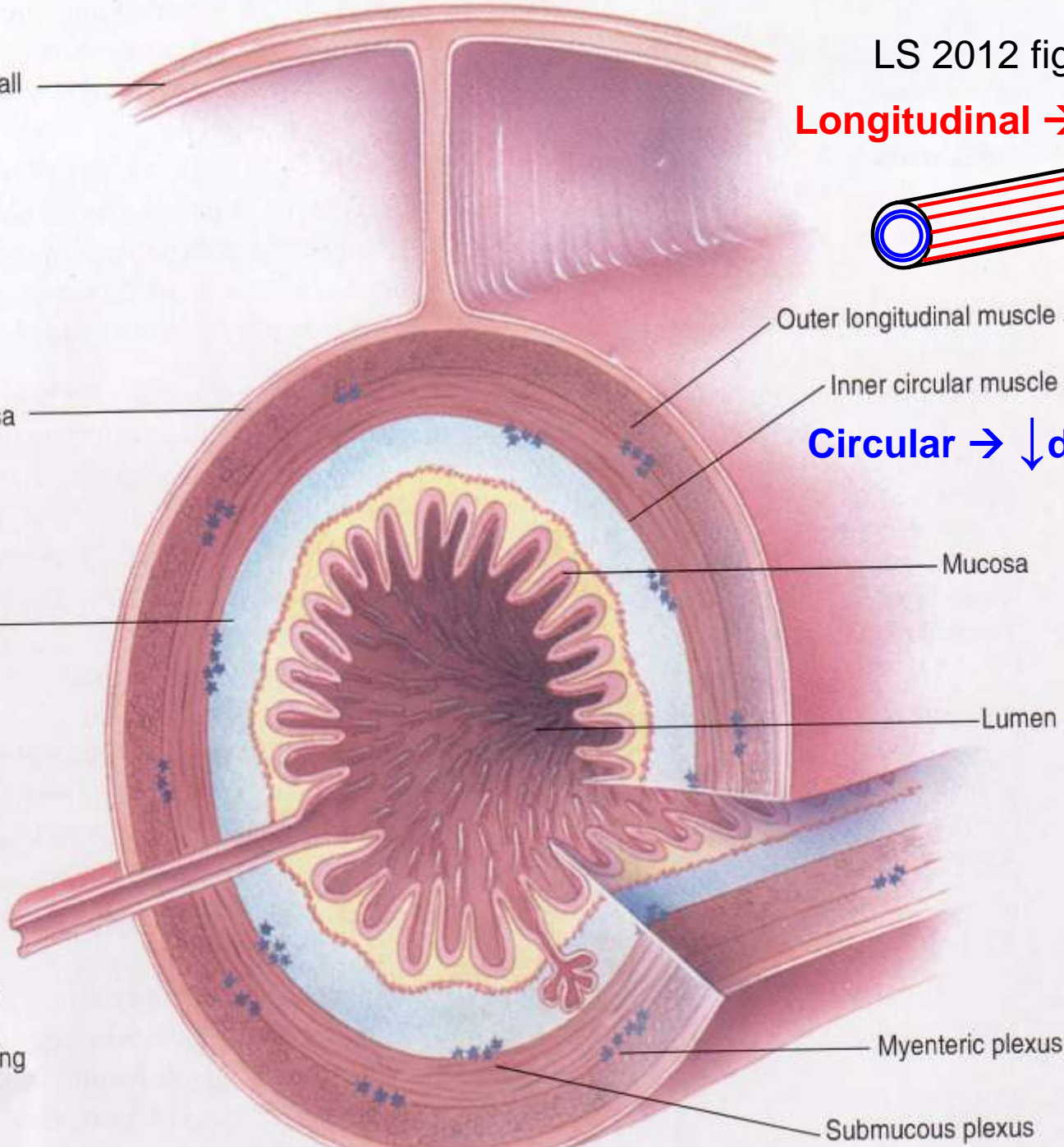
Muscularis externa

Mucosa

Lumen

Myenteric plexus

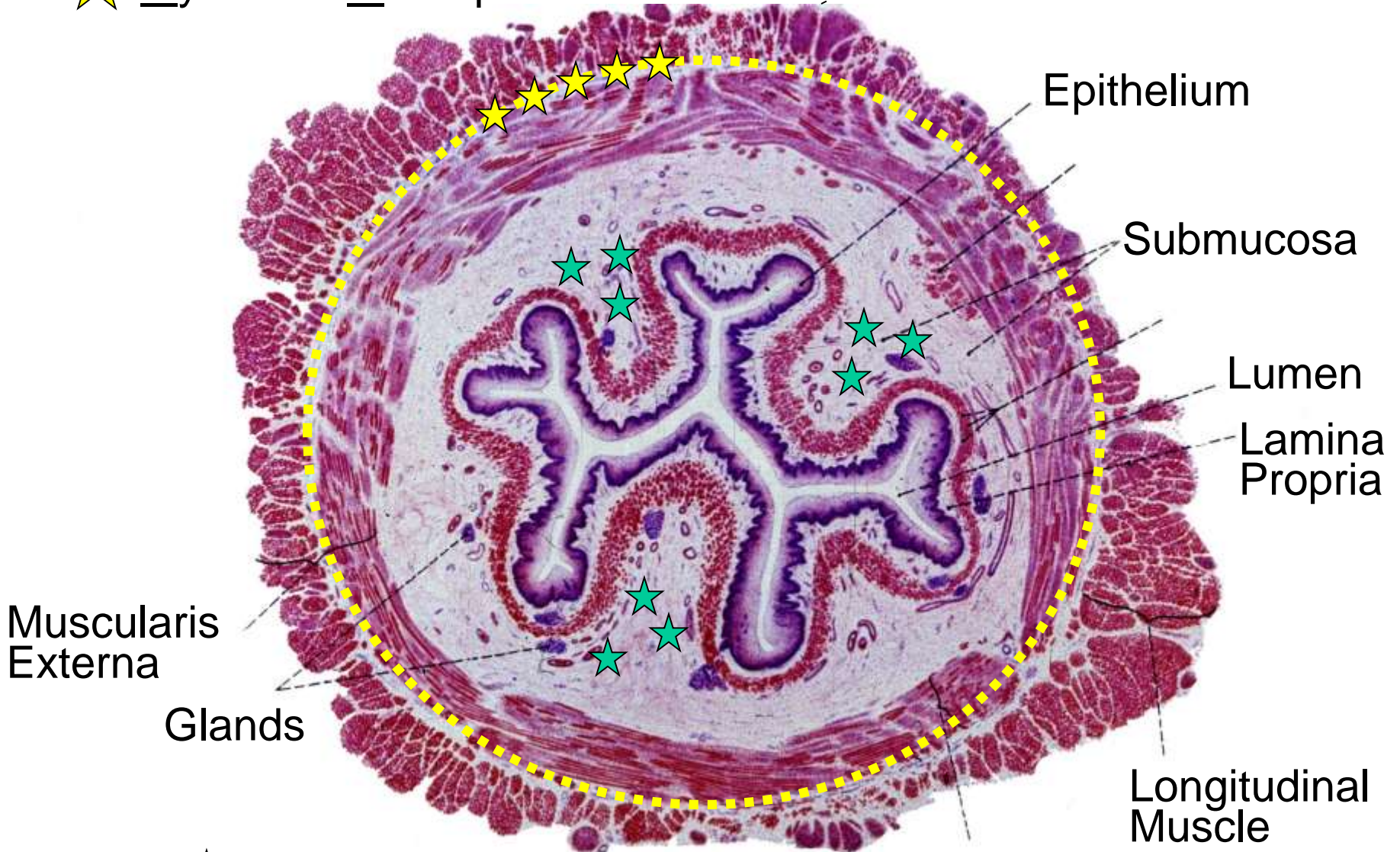
Submucous plexus



★ Myenteric motor plexus!

Serosa

cf: G&H fig 62-2



Epithelium

Submucosa

Lumen

Lamina Propria

Muscularis Externa

Glands

Longitudinal Muscle

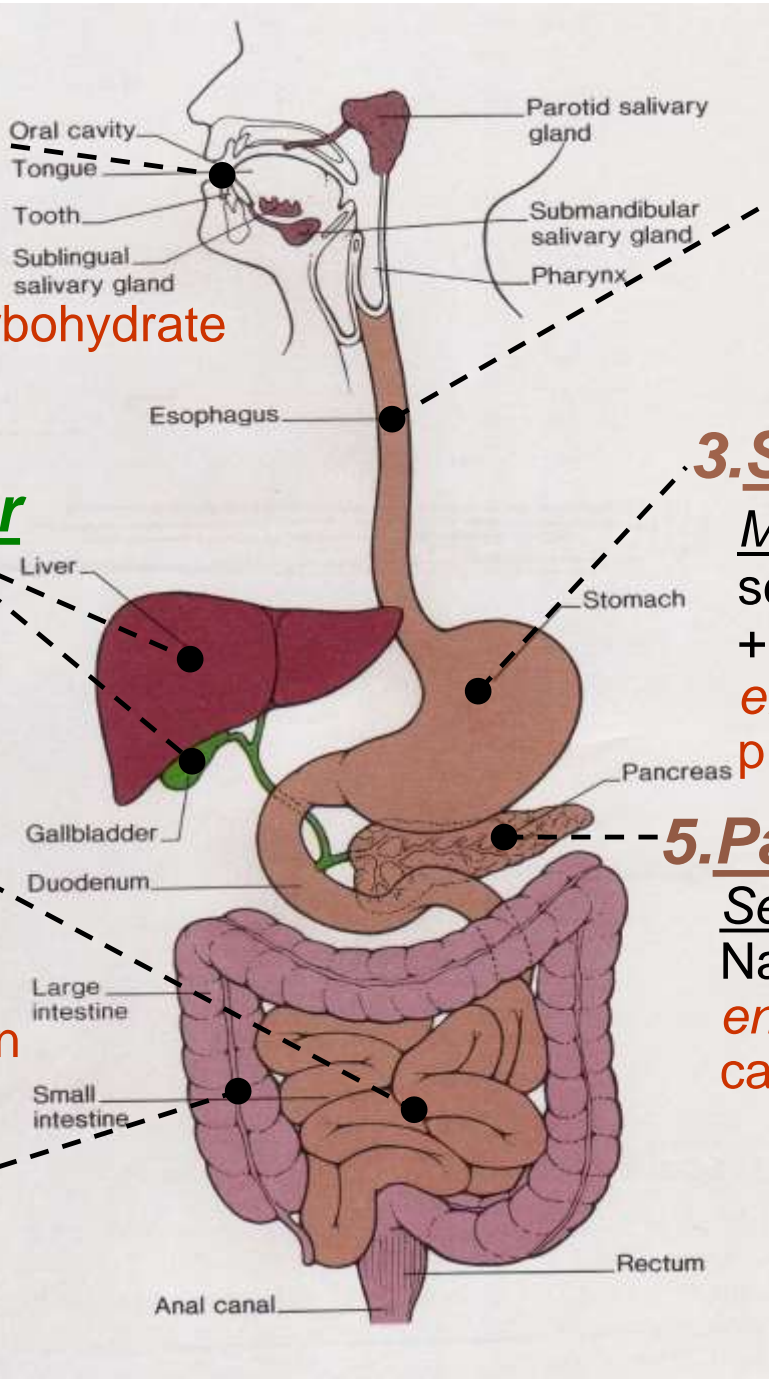
Circular Muscle

★ Meissner's sensory & secretory plexus!

H Howard 1990

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 +
 NaHCO_3 + enzymes
enzymatic digestion:
carbohydrate, fat, protein

4. Liver-Gall Bladder

Emulsification =
detergent action of bile
+ secretion

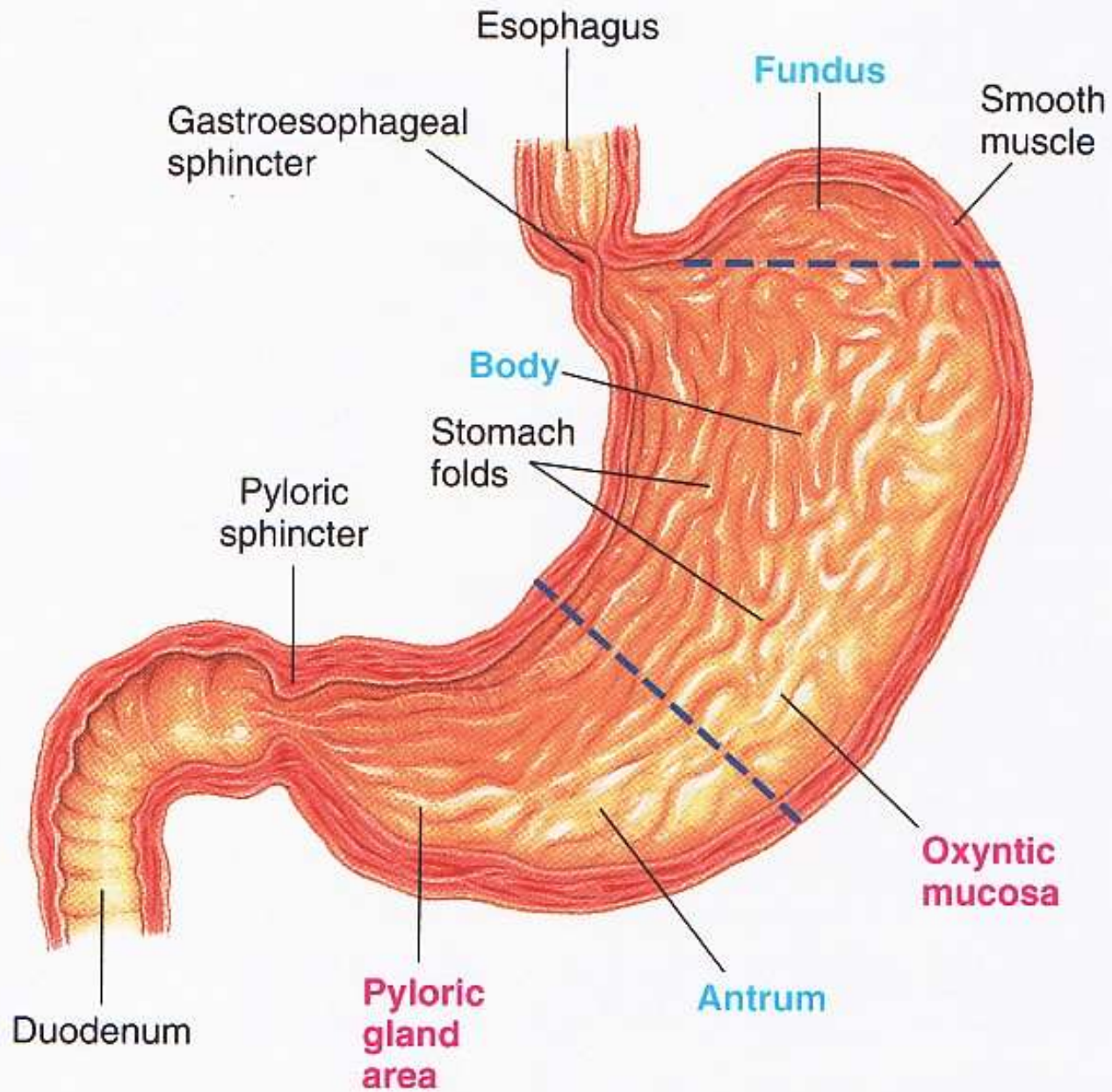
6. Small Intestine

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

7. Large Intestine

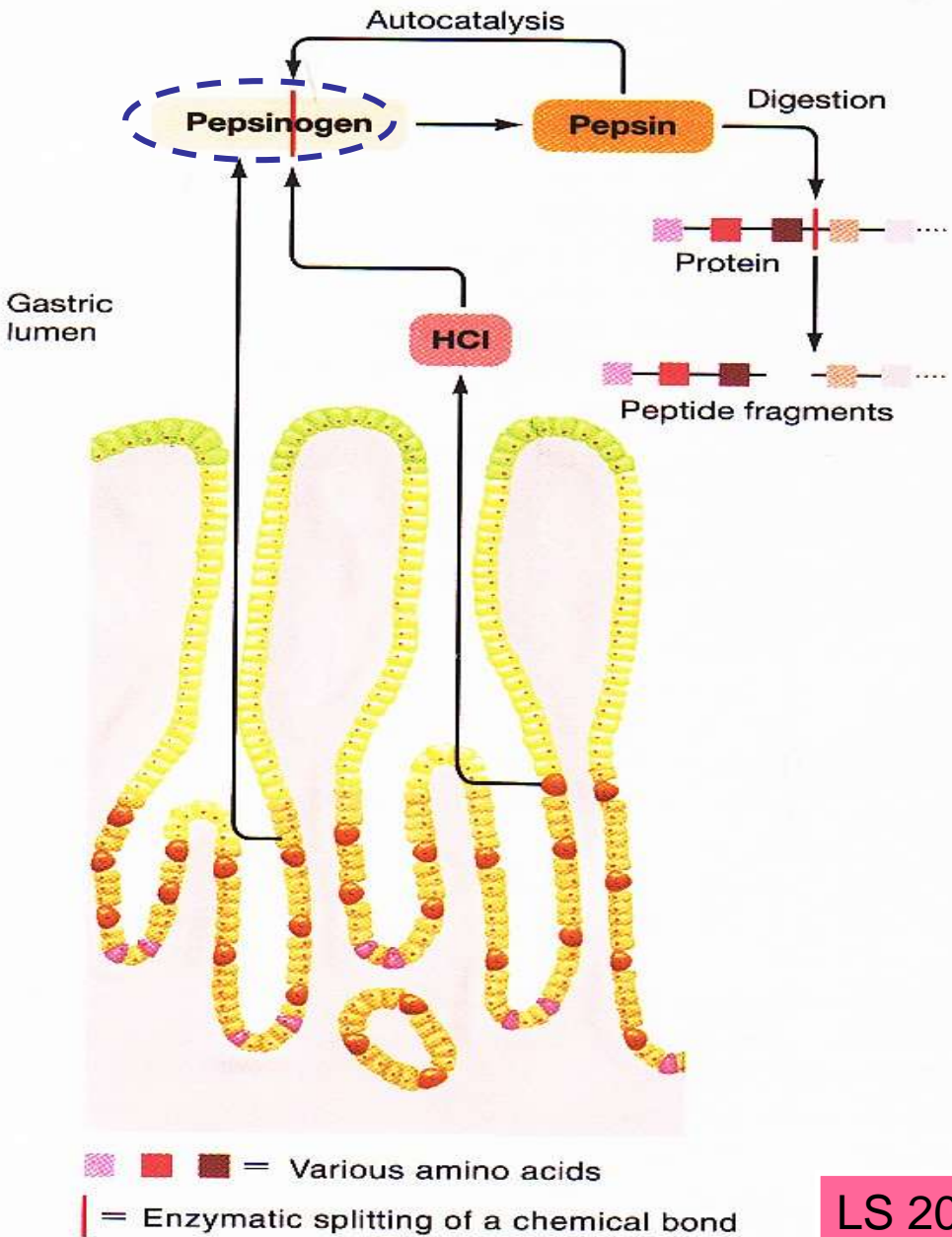
Dehydration
secretion + absorption
storage + peristalsis

Where does
enzymatic
digestion of
protein
begin?

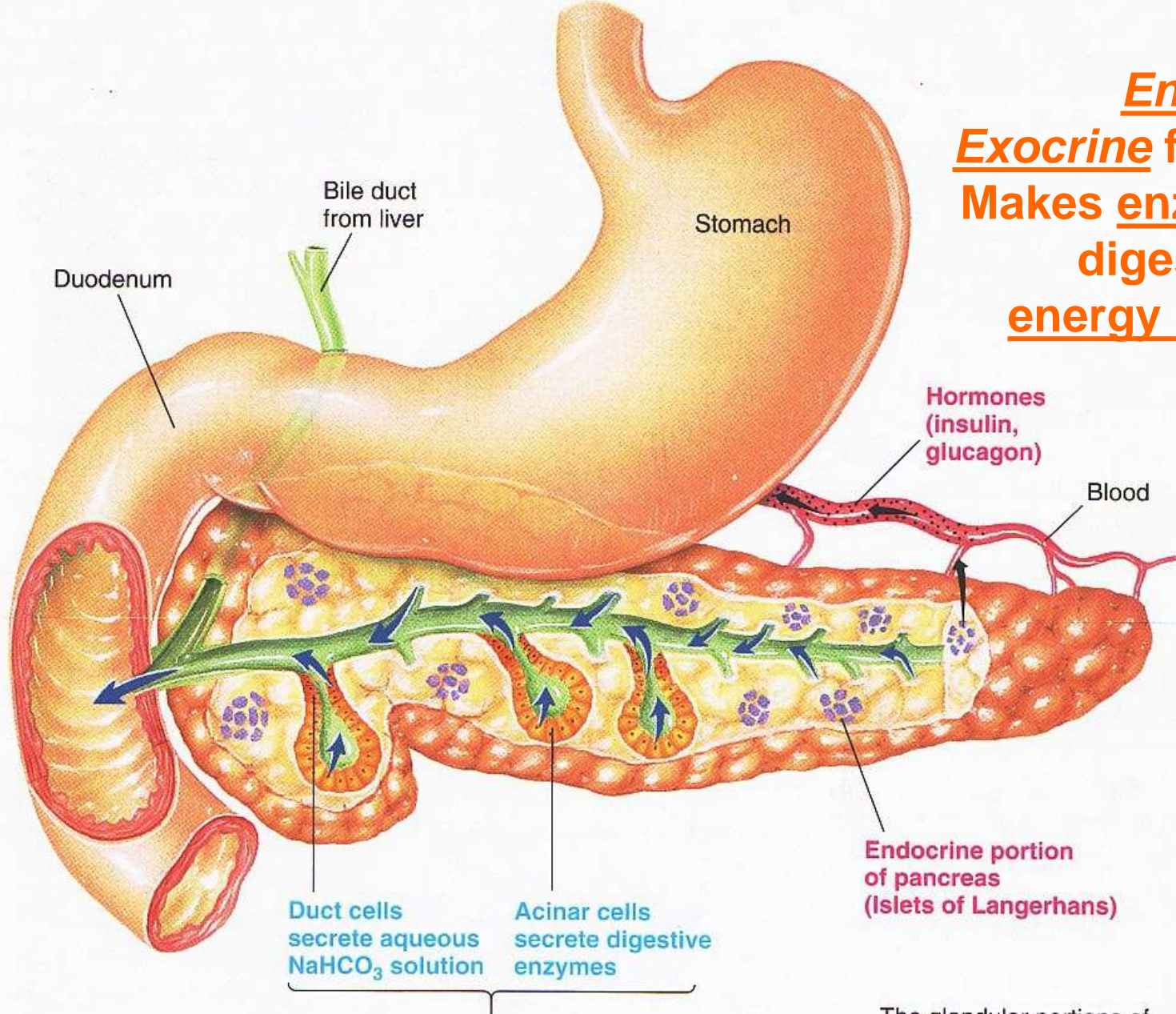


● **FIGURE 15-7**

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

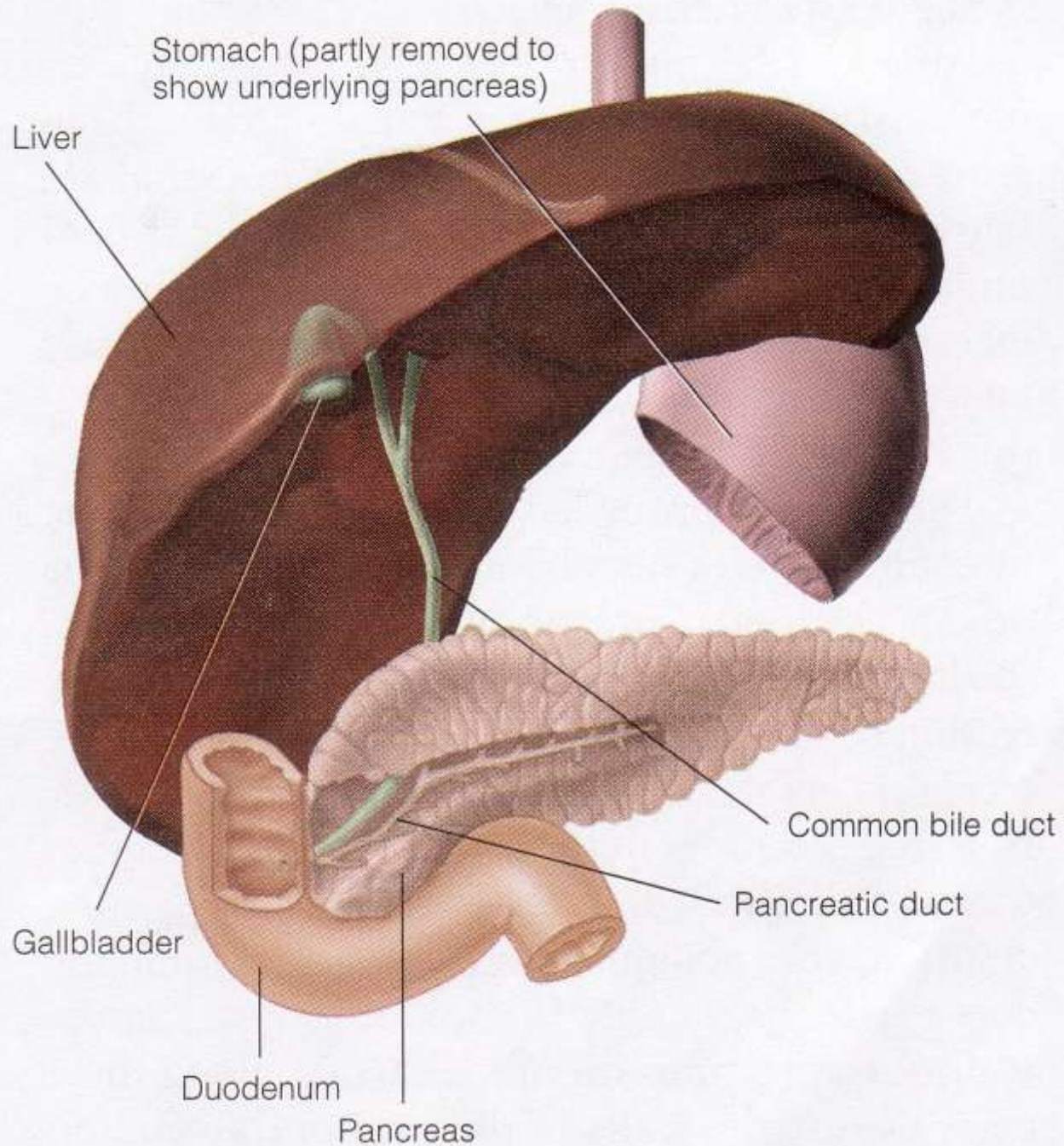
Acinar cells secrete digestive enzymes

Endocrine portion of pancreas (Islets of Langerhans)

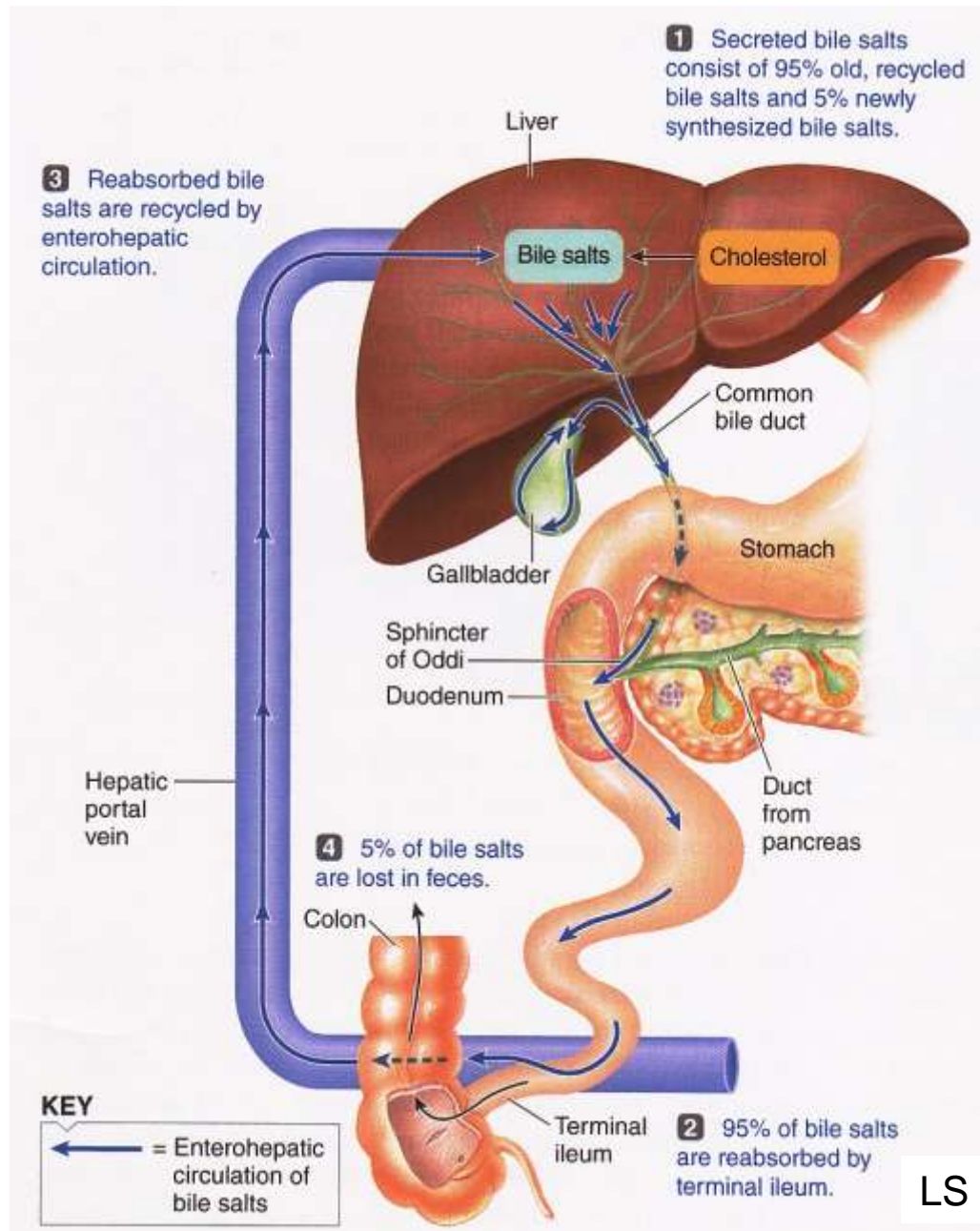
The glandular portions of the pancreas are grossly exaggerated.

LS 2012 fig 15-11 p 457 Exocrine portion of pancreas (Acinar and duct cells)

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

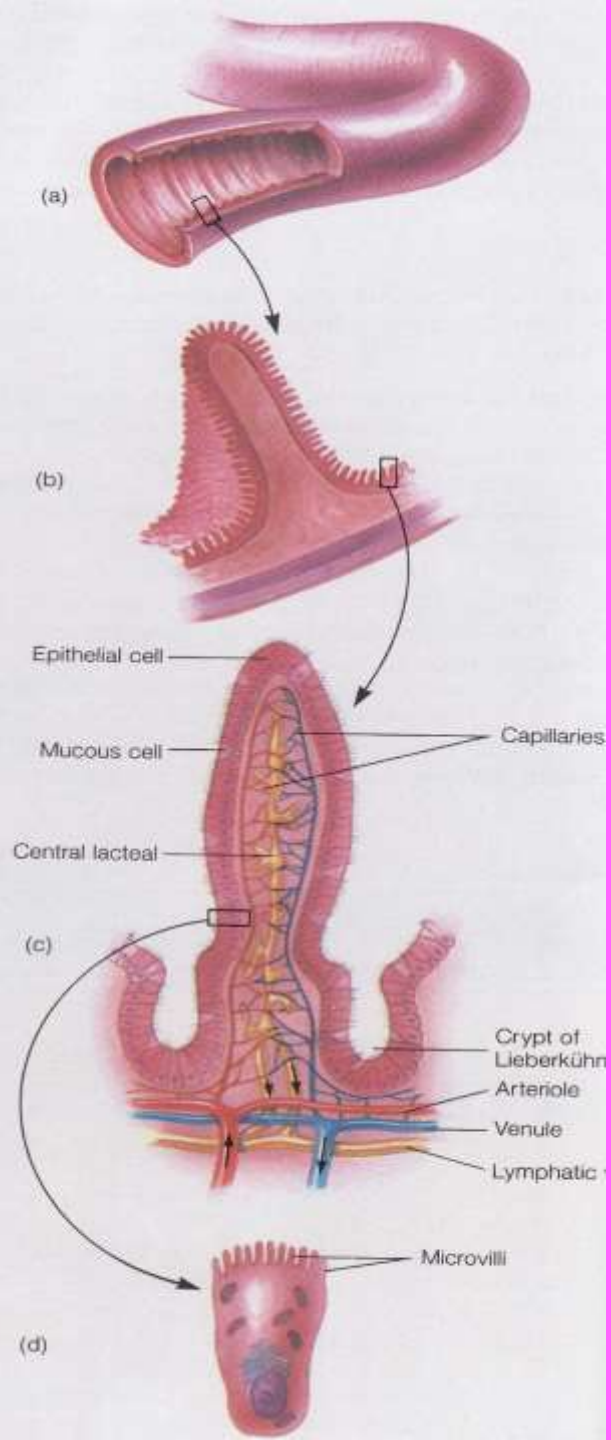


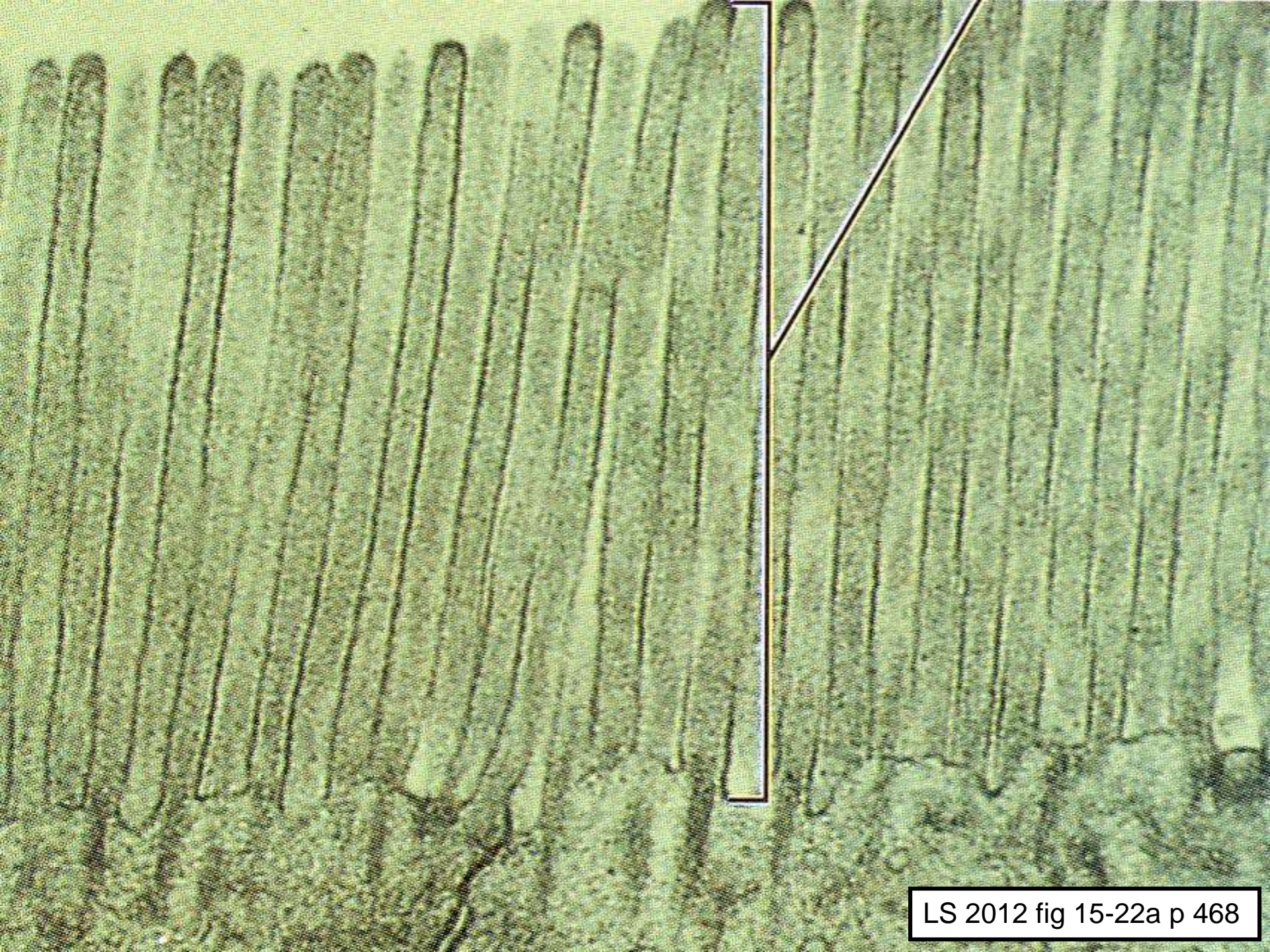
Liver: Amazing Recycling of Bile Salts!



What is the major
function of the
small intestine?

Absorption!!







<https://www.mayoclinic.org/diseases-conditions/peptic-ulcer/symptoms-causes/syc-20354223>



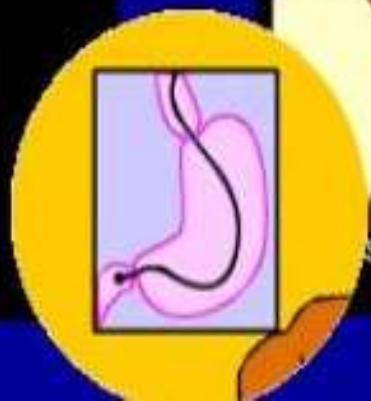
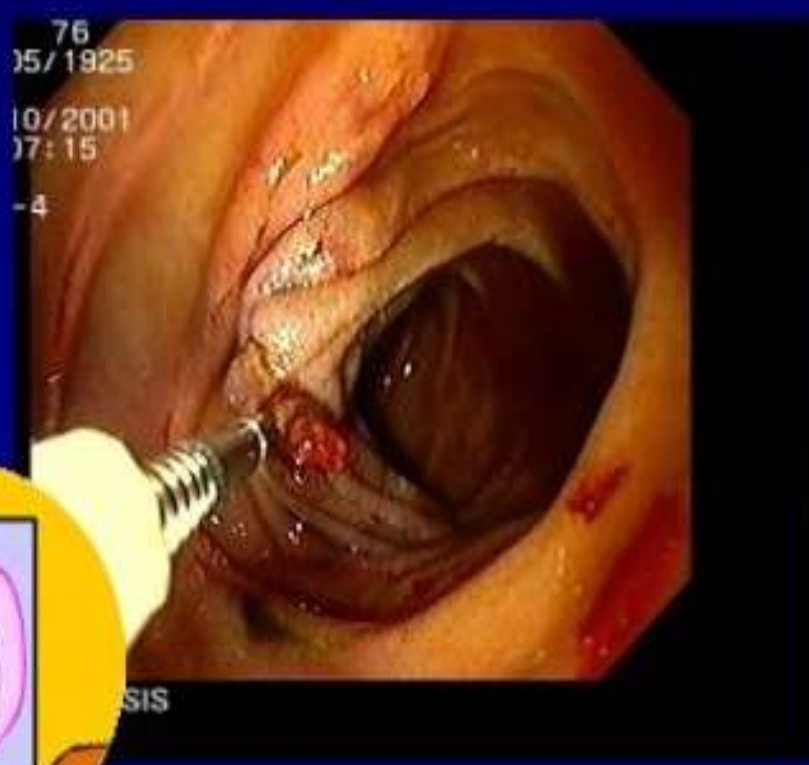
Ulcer Facts

- 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.

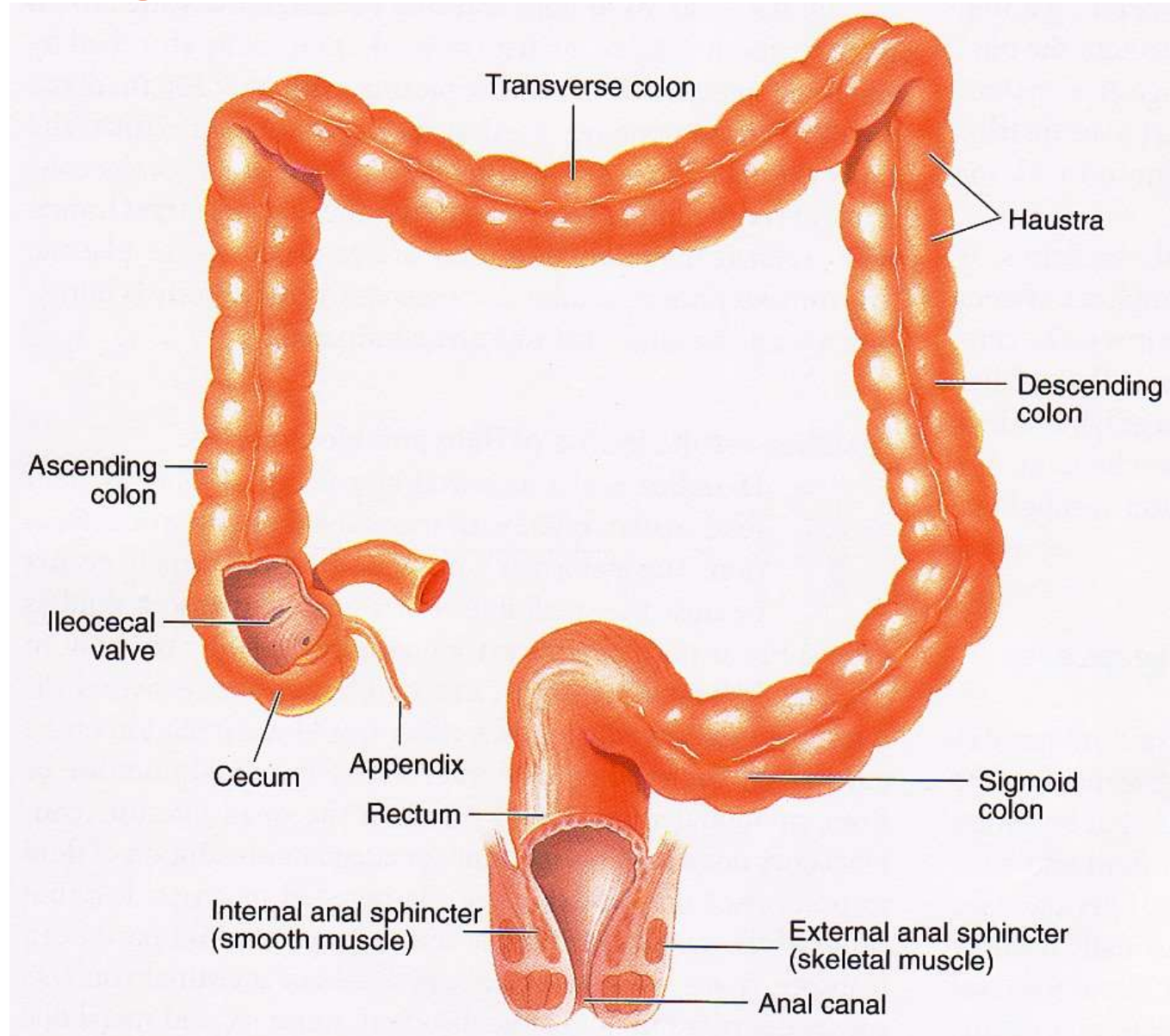
In the second photograph, a disposable metal clip is applied to the ulcer. The patient remained well and left hospital three days later.



▲ **Table 15-5 Digestive Processes for the Three Major Categories of Nutrients**

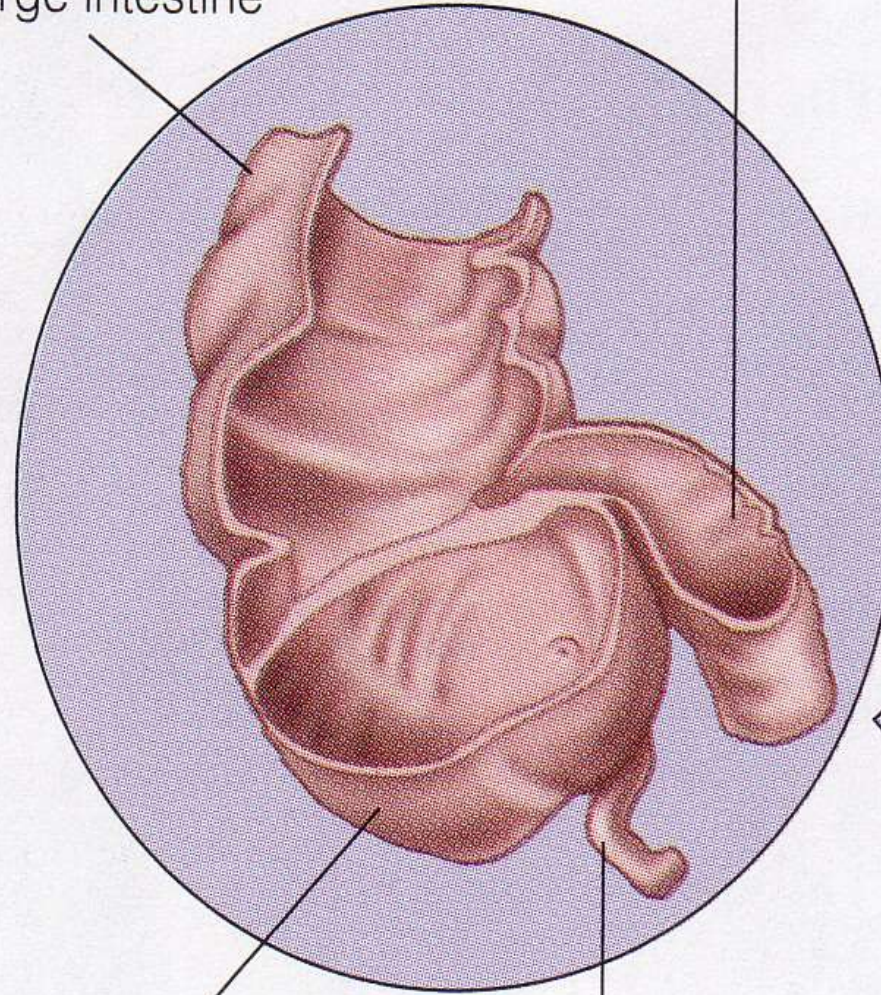
Nutrients	Enzymes for Digesting the Nutrients	Source of Enzymes	Site of Action of Enzymes	Action of Enzymes	Absorbable Units of the Nutrients
Carbohydrates	Amylase	Salivary glands	Mouth and (mostly) body of stomach	Hydrolyzes polysaccharides to disaccharides (maltose)	
		Exocrine pancreas	Small-intestine lumen		
	Disaccharidases (maltase, sucrase, lactase)	Small-intestine epithelial cells	Small-intestine brush border	Hydrolyze disaccharides to monosaccharides	Monosaccharides, especially glucose
Proteins	Pepsin	Stomach chief cells	Stomach antrum	Hydrolyzes protein to peptide fragments	
	Trypsin, chymotrypsin, carboxypeptidase	Exocrine pancreas	Small-intestine lumen	Attack different peptide fragments	
	Aminopeptidases	Small-intestine epithelial cells	Small-intestine brush border	Hydrolyze peptide fragments to amino acids	Amino acids
Fats	Lipase	Exocrine pancreas	Small-intestine lumen	Hydrolyzes triglycerides to fatty acids and monoglycerides	Fatty acids and monoglycerides
	Bile salts (not an enzyme)	Liver	Small-intestine lumen	Emulsify large fat globules for attack by pancreatic lipase	

Large Intestine Structure & Function



Ascending
portion of
large intestine

Ileum
of small
intestine



Cecum

Appendix