STUDY GUIDE - *Ch. 41.2 - The Main Stages of Food Processing in Animals are Ingestion, Digestion, Absorption, and Elimination*
- Ch. 41.3 - Organs Specialized for Sequential Stages of Food Processing Form the Mammalian Digestive System

NAME: _____

- **PHYSICALLY PRINT OUT this PDF and HANDWRITE (with a black or blue pen) your answers directly on this PDF.** *Typed or digitally-written work is **not** accepted. Do **not** answer questions on separate paper.*
- **Importantly, study guides are NOT GROUP PROJECTS!!!** *You, and you alone, are to answer the questions as you **read** your assigned textbook. You are **not** to share answers with other students. You are **not** to copy any answers from any other source, including the internet.*
- **Get in the habit of writing LEGIBLY, neatly, and in a medium-sized font.** *AP essay readers and I will skip grading anything that cannot be easily read so start perfecting your handwriting, and don't write so large you can't add all the relevant details and key elaborations in the space provided.*
- **SCAN physical documents in color and with good resolution. Then, upload your final work as PDFs to Archie.** *Avoid uploading dark, shaded, washed-out, sideways, or upside-down scans of homework. Keep completed physical study guides organized in your biology binder to use as future study and review tools.*
- **READ FOR UNDERSTANDING and not merely to complete an assignment.** ***First**, read a section quickly to get an overview of the topic covered. Then, read it a **second** time slowly, paraphrasing each paragraph **out loud** and analyzing every figure. Finally, read it a **third** time as you answer the study guide questions if assigned and start building your memory. Try to write answers out in your own words, when possible, and try to purposefully and accurately use all new terminology introduced.*

1. Explain what happens in each of these stages of food processing:
   a. **Ingestion:**

   b. **Digestion:**

   c. **Absorption:**

   d. **Elimination:**

2. Study Figure 41.5. When it comes to ingestion, describe the **four main feeding mechanisms seen in animals**?
   1. _____ =

   2. _____ =

   3. _____ =

   4. _____ =

3. a. **Digestion** involves mechanical digestion followed by chemical digestion. How does **mechanical digestion** occur?

   b. Why does **mechanical digestion** occur? What is its benefit?

c. How does **chemical digestion** occur? *(Use this moment to quickly review the chemical processes that occurs when making and when breaking down macromolecules, which you learned about in Ch.4 & Ch.5)*

d. Why does **chemical digestion** occur? Why is it necessary?

4. **Almost all animals engage in both extracellular and intracellular digestion.** *(Marine sponges are exceptions in that they are animals that digest all macromolecules through intracellular digestion only)*. How does **intracellular digestion** occur?

5. a. **In most animals, the good portion of foreign macromolecules are hydrolyzed via extracellular digestion.** Where does **extracellular digestion** occur?

b. Why is **extracellular digestion** useful?

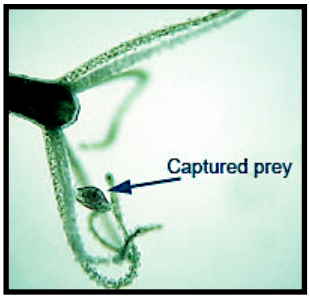
6. a. Some animals have a **gastrovascular cavity** while others have an **alimentary canal**. Describe what a **gastrovascular cavity** is or looks like?

b. What are the **two functions of the gastrovascular cavity**?

1.

2.

c. **How does the gastrovascular cavity work** in animals like the Hydra? Describe, in order, the processes of ingestion, extracellular chemical digestion, absorption, intracellular chemical digestion, and elimination.



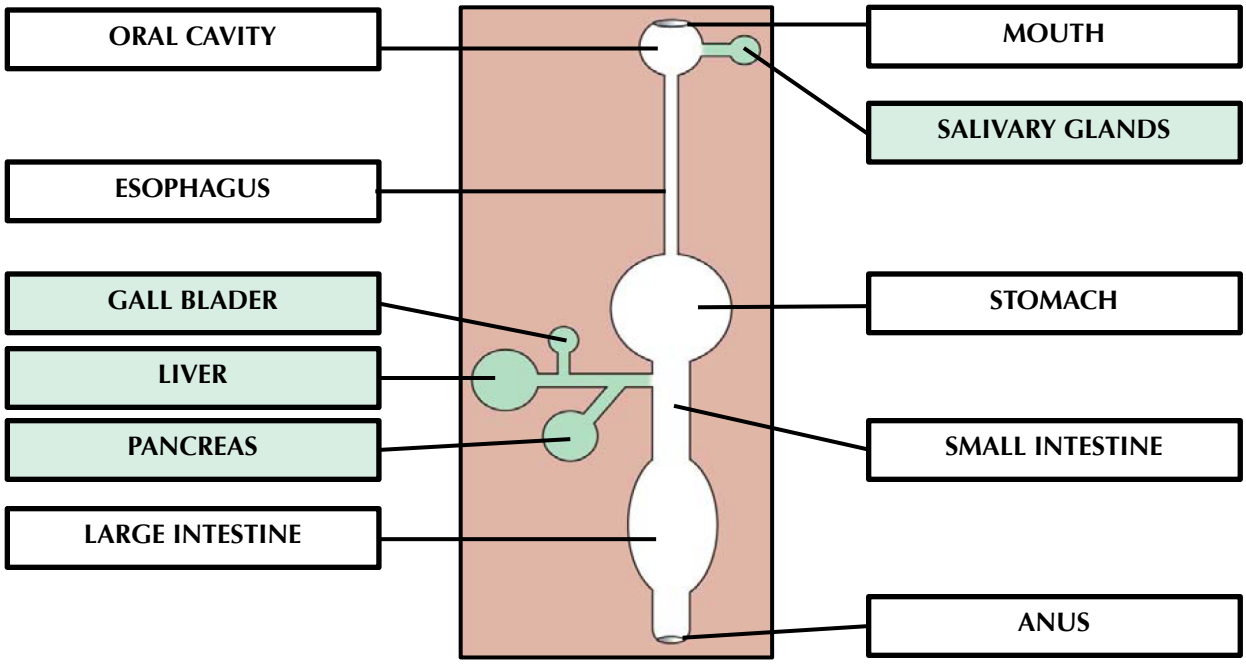
7. a. Complex animals have *complete* digestive tracts. Describe the basic structure of these **alimentary canals**?

   b. Describe the basics of what happens to **ingested food inside an alimentary canal**.

   c. Why is **having an alimentary canal** *(a complete digestive tract)* **evolutionary beneficial**?

8. In what sense are nutrients from a recently ingested meal not really "inside" the body of an animal prior to the absorption stage of food processing? *(Check your answer by going to **Ch.41.2 Concept Check Question #2** in Appendix A)*

9. a. Along the alimentary canal or digestive tract of complex animals, one will find various organs involved in the process of ingestion, digestion, absorption, and elimination. This greatly simplified sketch shows the alimentary canal in white, where food will actually pass. Off to the side, in green, are the **accessory glands**, organs that make secretions to lubricate and digest the macromolecules in food, though food never enters them. Study the figure below so you learn the basics of the mammalian digestive tract.



10. a. **Digestion begins in the oral cavity** where teeth cut and grind chunks of food, mechanically breaking them down into smaller pieces. This increases each pieces' surface=area-to-volume ratios so the hydrolytic enzymes involved in the chemical breakdown of the macromolecules in food can be exposed to more of the food, thereby, breaking down the pieces of food at faster rates.

    In addition to mechanically digesting food placed in the oral cavity, chemical digestion starts in the mouth too. Your brain anticipating food, sends a signal to cells of the **salivary glands to secrete saliva**. Saliva contains salivary amylase. Explain the purpose of **salivary amylase**? *(Remember, enzymes are **proteins** and **catalysts,** their names often ending in **-ase**)*

   b. Of course, amylase is not the only substance in saliva.
      i. What is **mucus**?

ii. What are the three main **functions of mucus**?

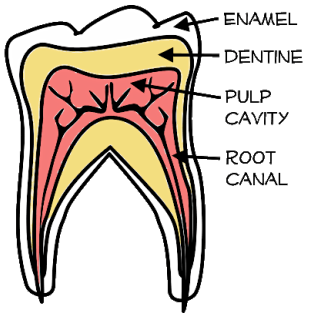
1.

2.

3.

iii. What is the **function of salivary buffers**?

iv. What is the **function of antimicrobial agents like lysozyme enzymes**?



F.Y.I. - Dental cavities are holes in teeth that form when **acids** in the mouth erodes tooth enamel, the tooth's hard outer layer. After the enamel is gone, decay progresses more quickly through the dentin (middle layer) to pulp (innermost layer). Pulp contains a tooth's nerve endings and blood supply that keep the cells inside your teeth alive.

Where does this acid that causes enamel erosion come from?

Bacteria cause plaque to form on and between teeth. Dental plaque is a biofilm that contains microorganisms (mostly bacteria, but also fungi) that grows on surfaces within the mouth. **A biofilm is a community of bacteria, protected by a matrix of self-produced and self-secreted exopolysaccharides that help adhere the bacteria to a biotic or abiotic (living or nonliving) surface, like the tooth.** It is a sticky colorless deposit at first, but if it is left on your teeth for too long, it will harden into brown or pale yellow tartar and is much more difficult to remove.

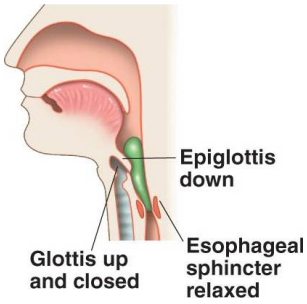
Oxygen levels may be lower deep within plaque and tartar, close to the tooth enamel, so bacteria that live there are often **anaerobic respirators**. These layers of bacteria (and yeast, who are facultative anaerobes themselves) in this biofilm feed on the sugars/carbohydrates deposited on your teeth when you eat. The bacteria and yeast convert these carbohydrates into acids *(pyruvate / pyruvate acid is the product of glycolysis remember and lactate / lactic acid is the product of glucose fermentation)*. When these acids are secreted by these microorganisms, they change the pH of the solution at the surface of the tooth, lowering its pH (acidifying the solution). Enamel starts to dissolve when bathed by a low pH solution.

Oral pain or tooth loss from cavities and tooth rot could mean that an animal can no longer catch prey or eat. Bacteria can also cause infection in the mouth, which can even, if they get into the blood stream, cause life-threatening systemic infections in the whole body.

11. What do we call the ball of food that forms after the **food is chewed and mixed**, *with the help of the muscular tongue,* **with saliva**? _____

12. a. Review Figure 41.9. At the base of the throat region (pharynx), two passage ways start, the **trachea (wind pipe)** which takes air to your lungs and the **esophagus**, a muscular tube that connects to the throat to the stomach. Food and liquids mixed with saliva must proceed to the stomach and not the lungs. What **keeps food from entering the lungs when we swallow**?

b. Is the person in the following illustration able or unable to breath at this very moment? Why?



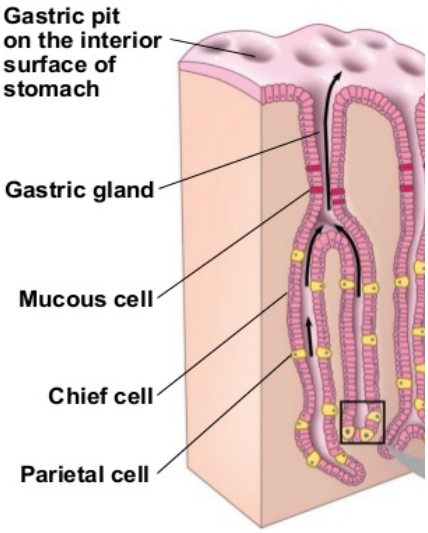
13. **Mammals have a complete digestive tracts or alimentary canal,** which ingested food passes through. The walls of this digestive tract, (and thus the organs that make up the digestive tract: the esophagus, stomach, small intestine, and large intestine), include a **layer of smooth muscle tissue in their walls** that engages in a process called peristalsis.

    a. What is **peristalsis**?

    b. What do you think the purpose of peristalsis activity is?

14. Food is kept within compartments along the length of the digestive tract during digestion by muscular valves called _____.

15. The stomach can expand to store recently ingested food and liquid, and secretes digestive fluid called **gastric juice**, which it mixes with the ingested food through muscle contractions that causes a **churning action** *(a coordinated series of muscle contractions in the stomach)*.



    Gastric juices help digest proteins. The stomach's walls contain openings to tubular gastric glands, which are lined with three types of specialized cells, two of which, chief and parietal cells, produce gastric juice. **Gastric juice contains inactive pepsinogen protein secreted by chief cell. It also contains H+ and Cl- ions pumped out from parietal cells.** H+ and Cl- form HCL, hydrochloric acid. As the extracellular concentration of ions builds up, water diffuses through osmosis out of cells via aquaporins as well since the external environment becomes hypertonic to the cells. Gastric juices start filling the stomach compartment.

    The gastric juice, therefore, once inside the lumen of the stomach, contains water, inactive pepsinogen, and HCl (a strong acid), which dissociates to make the gastric juice very acidic (pH = 2). **This change in acidity of the solution in the stomach converts the inactive pepsinogen protein into the active enzyme called pepsin** (changes in pH remember cause changes in the shape and structure of a protein and, thus, the function of that protein).

    a. In what **two ways does the low pH** caused by the dissociation of HCl **helps "liquify" food (separate cells)** and make it so **proteins in the extracellular matrix of cells, cell walls of cells, membranes of cells, and released from lysed cells can more easily be broken down into their monomers**?

        1.

        2.

    b. **How** does **pepsin function in digesting proteins**? *Don't just say "it's an enzyme" - let's be specific about what chemical process this enzyme catalyzes and where exactly the effect is seen in the protein, based on what you learned in Ch.5. After all, knowledge is cumulative!*

16. The stomach has adaptations to protect its own cells and proteins from proteolytic damage.
    a. If hydrochloric acid were produced inside parietal cells, it would change the pH of the cell and, thus, denature proteins inside the cell just like it denatures the proteins in the food you ingest. If pepsin was active inside the chief cells, their proteins would be hydrolyzed. Both these scenarios would be devastating to these stomach cell. Outline below once again **how parietal cells and chief cells specifically avoid being digested in the process of secreting gastric juice**?

    Parietal Cell Adaptation to Avoid Self-Injury:

    Chief Cell Adaptation to Avoid Self-Injury:

17. Once HCl and active pepsin are formed in the lumen of the stomach, in what **two ways** does the **stomach further ensure that the cells lining the interior cavity of the stomach are not damaged or destroyed by gastric juice**?
    1.

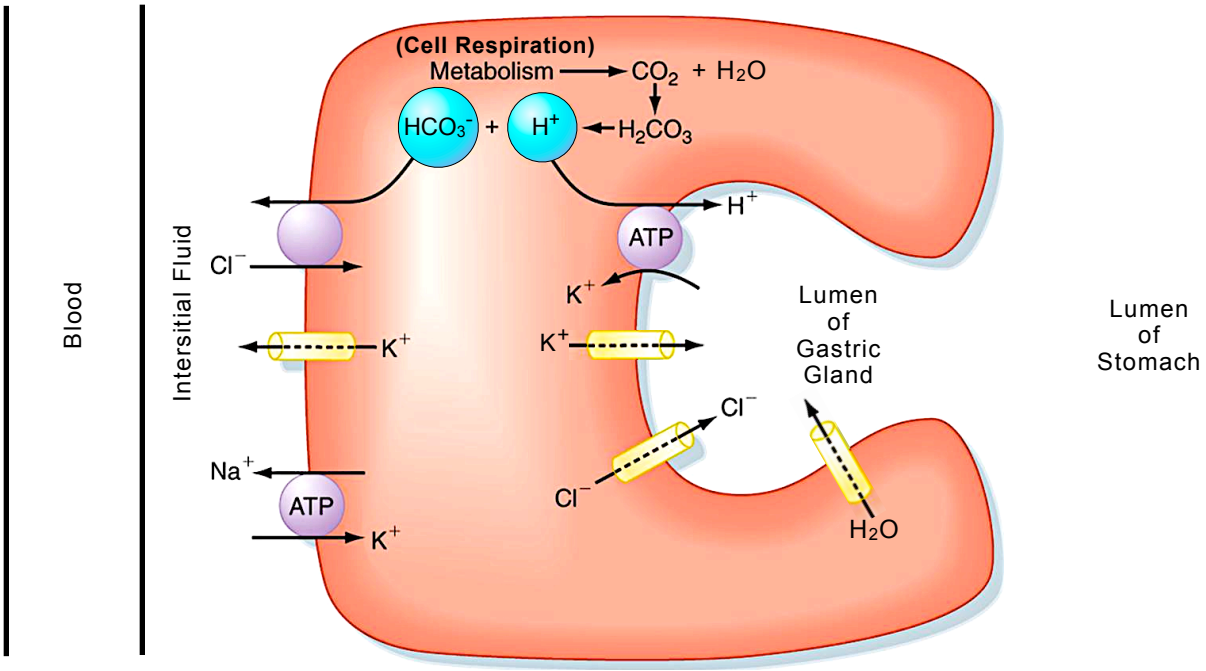
    2.

18. In **Feedback Regulation**, **the PRODUCT or END BEHAVIOR of a process regulates whether more (positive feedback) or less (negative feedback) of that product or end behavior keeps occurring.** Describe the positive feedback mechanism involved in the formation of pepsin in the stomach when it is time for the organism to digest proteins in ingested food?

19. Questions on the AP Exam require that you apply your understanding of concepts learned across multiple chapters. Concepts may be visualized through an illustrated model of a particular cellular process that you may be asked to interpret. Remember, **a model is an explanation of a process.** Models can be step-by-step lists of how a process occurs, Venn diagrams, drawings, flow charts, etc. Let's practice interpreting (and making sense of) a visual representation.

    Below, find a model illustrating the mechanism of acid (H^+ & Cl^-) secretion of parietal cells. **How do you make sense of such a complex illustration?** *First,* carefully analyze every part of the figure, understanding what is happening in each individual area. *Then,* contemplate how each of the events work together to achieve an overall outcome.

    For this exercise, **try to explain to yourself out loud what is happening in EACH part of the figure AND how active and passive transport are used to achieve acid secretion by analyzing the model below.** The purple transport proteins are pumps. The yellow transport proteins are channels. *It will help to first review your Ch.7 and Ch.11 slides before beginning.*



And.....where you able to explain, in a logical order, what is happening in each part of the figure and tie those activities into how they contribute to the cell's ability to secrete H^+ & Cl^- ions?

You will be asked to interpret similar illustrations on all sorts of possible physiological processes in organisms and cells. If this was a **Free Response** question, your answer should **carefully describe** what is happening in each part of the model and **explain** how those events contribute to the overall task trying to be performed.

To see if you were on the right track, read carefully each bullet below, which explains a particular aspect of the model. Importantly, **after reading each bullet, pause and please return to the model to see if your interpretation of what was happening in that portion of the model was correct and to see if you explained it using accurate terminology.**

1. Carbon dioxide (CO_2), the product of cellular respiration, reacts with water (H_2O) to form carbonic acid (H_2CO_3).

2. **Carbonic acid (H_2CO_3) dissociates into products Hydrogen ions (H^+) and bicarbonate ion (HCO_3^-)**

3. When the cell received the signal to secrete acid, it must secrete hydrogen ions (H^+) and chloride ions (Cl^-) into lumen of the gastric gland and, thus, lumen of the stomach.

4. **Hydrogen ions (H^+) are pumped out of the cell into the lumen of the stomach by using an active transport hydrogen ion-potassium pump** (an ATPase), which uses the energy from ATP. When the pump is activated, potassium ions (K^+) are pumped into the cell and protons (H^+) are moved out of the cell where they begin existing in higher and higher concentration in the lumen of the gastric gland, and thus stomach, relative to the inside of the cell.

5. Chloride ions (Cl^-) must also be secreted by the cell into the lumen of the gastric gland, and thus, stomach, so they can join with the hydrogen ions (H^+) to form the hydrochloric acid (HCl) in gastric juice.

6. **Cl^- ions diffuse passively down their concentration gradient, through a Cl^- ion channel protein, from inside the cell to the outside of the cell, into the gastric gland's lumen and, thus, the lumen of the stomach**.

7. To ensure a Cl^- ions keep diffusing passively out of the cell into the gastric gland lumen (and Cl^- ions do stop diffusing outward once dynamic equilibrium is reached, which would occur when the concentration of Cl^- ions equalizes across the membrane), new Cl^- ions must keep entering the cell from the interstitial fluid and, thus, blood, to replace those diffusing from the cell into the gastric gland's lumen.

8. **Cl- ions diffuse into the cell, from the blood and interstitial fluid, through a passive transport carrier protein that also transports bicarbonate ions (HCO_3^-) passively down its concentration gradient in the opposite direction, from inside the cell to the interstitial fluid, and eventually blood**. This process does not require energy from ATP.

9. **The potassium ions (K^+) that were pumped into the cell by the proton pump (the hydrogen ion-potassium pump) leave the cell via passive transport by diffusing down their concentration gradient from inside the cell, where their concentration rose to high levels, back out to the interstitial fluid/blood and the lumen of the gastric gland,** until equilibrium is reached, using K^+ ion channels. K^+ is thus effectively recycled.

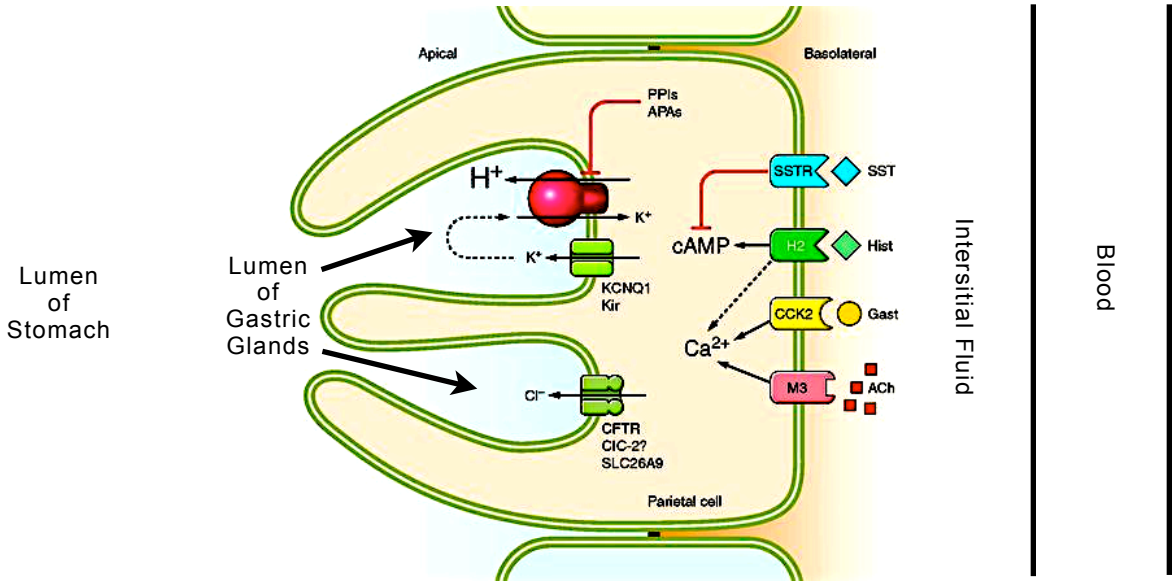
10. **The accumulation of H^+ and Cl^- ions in the gastric gland, makes the area hypertonic relative to the inside of the cell, which then causes osmosis, free water diffusing from inside the cell to the lumen of the gastric gland.** The addition of water to hydrochloric acid (HCl) in gastric juice, causes the acid to dissociate in the gastric juice, acidifying the solution, which reaches a pH of ~2.

11. To recap what happens to H^+: New H^+ are constantly generated inside the cell with the help of carbonic anhydrase, which catalyzes the break down of carbonic acid into hydrogen ions (H^+) and bicarbonate ion (HCO_3^-), the H^+ being actively pumped into the lumen of the gastric gland from the cell (from an area of lower concentration in the cell to an area of high concentration in the gastric gland lumen).

12. To recap what happens to Cl^-: Cl^- ions diffuse into the cell from an area of higher concentration in the interstitial fluid/blood to an area of eventually medium concentration inside the cell, Cl^- ions inside the cell then diffusing further from this area of medium concentration down their concentration gradient to an area with the lowest Cl^- concentration in the lumen of the gastric gland.

F.Y.I. *Proton pump inhibitors that inactivate the H^+-K^+ ATPase pump and potassium-competitive acid blockers (P-CABs) that bind reversibly to K^+ ions and thus also prevent the H^+-K^+ pump from working are drugs used therapeutically in medicine to inhibit acid secretion from parietal cells when necessary.*

By the way, a similar kind of model interpretation question could be asked instead about how the parietal cell know when to engage in acid secretion in the first place. Below, please find yet another **model illustrating part of the signal transduction mechanisms that activates acid secretion in parietal cells.**



A NOTE ABOUT ARROWHEADS IN MODELS: Whenever you are asked to explain models showing biochemical pathways, signal transduction pathways, ecosystem interactions, and more, you must remember that **different arrowheads relay different information.** *(Before continuing, review again the second-to-last page of your APB-Ch.8.5.StudyGuide, which contained a tutorial on how to draw arrows showing feedback regulation in biochemical pathways)*

→ Arrows ending in a **rectangular arrowhead** signify that one item or event activates or promotes the next item or event.

⊣ Arrows ending in a **flat arrowhead** signify that one item or event inactivates or inhibits the next item or event.

As you can see from the illustration, parietal cells contain plasma membrane receptors for three signaling molecules that act as stimulators of acid secretion. One ligand is released from **neurons** that innervate the stomach walls, one signal molecule comes from neighboring cells **(paracrine signaling),** and one is released from more distant cells, traveling as a **hormone** briefly through the blood **(endocrine signaling)** before reaching the target parietal cell.

1. Acetylcholine
2. Histamine
3. Gastrin

Though you don't have to memorize this, you should be able to follow the explanation of how these ligands activate acid secretion. All three molecules bind G-protein coupled receptors on the surface of parietal cells, which causes activate downstream protein kinases or increase cytosolic calcium levels, which trigger acid production. *How?*

Histamine (a primary messenger) activates a G-protein-coupled plasma membrane receptor, which, in turn, helps activate adenylate cyclase, leading to elevation of intracellular **cyclic AMP** concentrations (a second messenger).

Binding of **acetylcholine** and **gastrin** (primary messengers) to their receptors both result in elevation of intracellular **calcium** concentrations (a second messenger) when calcium ions are released from intracellular storage.

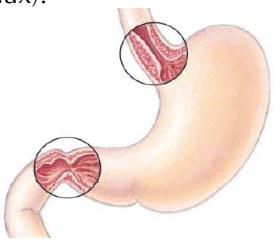
cAMPs activate protein kinase A (PKA). PKA activation results in the phosphorylation of cytoskeletal proteins involved in causing vesicles carrying the H^+ / K^+ ATPases in their membrane to move from the cytoplasm and fuse with the plasma membrane, in effect inserting these H^+ - K^+ pumps into the plasma membrane.

Ca^{2+} promotes the trafficking of Cl^- channels stored in the membranes of secretory vesicles to the plasma membrane and also helps enhance H^+ secretion by activating gated K^+ ion channels in the plasma membrane and by causing more H^+/ K^+ ATPase pumps to be inserted into the plasma membrane.

20. What do we call the **mixture of chewed food, saliva, and gastric juices** that forms in the stomach?

_____

21. **Ulcers**, wounds in epithelial tissue, can form on the interior surface of the stomach. It used to be thought that stressed caused stomach ulcers. However, in the early 2000s, research reveals that infections by *H. pylori* bacteria that grew on the interior walls of the stomach and caused injury to the lining of the tissue, antibiotics clearing the infections up. Another common gastrointestinal ailment is heart burn. What is "**heart burn**" (a.k.a. Acid Reflux)?
Use the to the right of a stomach to explain.



22. Where does **MOST** **chemical digestion** actually occur in the digestive tract? _____

23. The **duodenum is the first part of the small intestine**. What is **mixed here with the chyme exiting the stomach**?

24. Which hormone is released from endocrine cells in the duodenum when food enters the small intestine, which then stimulates the pancreas to begin secreting its digestive chemicals?

_____

25. The pancreas is made up of various tissues, with different functions. Some tissues secrete hormones into the circulatory system (blood) that help regular blood glucose levels *(we will learn about these later on)*. Other tissues secrete chemicals of importance in digestion. What **two categories of digestive chemicals does the pancreas secrete AND** what are their **function**.

1. _____ Function =

2. _____ Function =

26. Based on secondary, tertiary, and quaternary levels protein structure (Review the Ch.5 slides), the environmental variables that affect protein shape (Ch.5), and given your answer to #25 above, **why does pepsin** (the protein digesting enzyme, protease, working in the stomach) **stop functioning in the small intestine once it exits the stomach**?

27. In what **two ways** do the **cells that make up the epithelial lining of the lumen of the duodenum help in breaking down macromolecules present in the lumen of the small intestine into monomers** so that these monomers can be absorbed by the epithelial cells lining the walls of the small intestine further along the digestive tracts called the jejunum and ileum?

1.

2.

28. a. Digestive secretions contain more than just enzymes as you already learned when reading about the pancreas (some of its cells secreting bicarbonate ions to neutralize the stomach acid) and when reading about the stomach (some of its cells secreting protective mucous and H^+ and Cl^- ions in order to activate pepsin). What category of **non-enzymatic chemical, which aids in the digestion of fats and other lipids, do liver cells make and store in the nearby gallbladder**?

b. **Why are fats and other lipids** in the chyme leaving the stomach and entering the small intestines **so much more challenging to efficiently digest** (hydrolyze into their constituent monomers)?

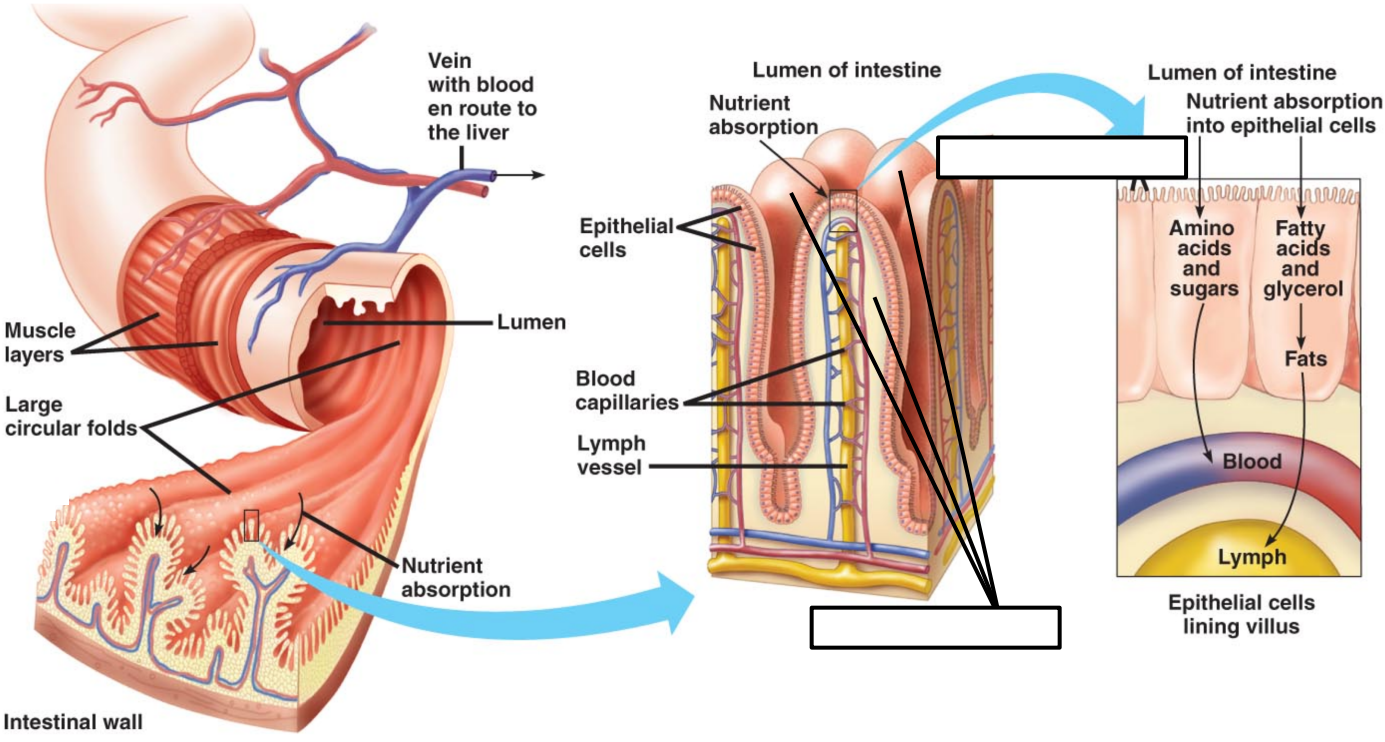
c. What are the **bile salts** in bile used for?

29. a. The surface of the small intestines provides a wonderful example of the **form fits function theme in biology**. Its organization is an important adaptation that resulted from natural selection. (Remember, an **adaptation** is a characteristic of an organism that helps it survive, and, therefore, live long enough to hopefully reproduce). The **lining of the jejunum and ileum (the second and third parts of the small intestine) are said to have a "brush border,"** a term describing the look of the inner surface due to the **villi** and **microvilli** of this part of the small intestinal wall. What are these?

Villi:

Microvilli:

b. Identify the villi and microvilli on this illustration. Notice that the **villi are large, multicellular structures** while the **microvilli are structures particular to the plasma membrane of the apical or lumen-facing side of individual epithelial cell** of the small intestine.



c. What **evolutionary benefit do villi of the small intestine and microvilli of each epithelial cell** facing the lumen of the small intestine impart on the small intestine as an organ? Explain.

30. As you now understand, enzymes that aid in breaking down large biological molecules into smaller components that can be absorbed into the body are active in your mouth (secreted in saliva), your stomach (secreted from cells that line the stomach's glands), and your small intestine (secreted either from your pancreas into your intestinal lumen or secreted from or housed in the plasma membrane of the small intestinal epithelial cells). Review Figure 41.11. Note **how and in which location the different macromolecules are digested into smaller monomers and components**.

    a. Where along the alimentary canal are **proteins and polypeptides digested**?

    b. Where along the alimentary canal are **lipids like fats digested**?

    c. Where along the alimentary canal are **nucleic acids and their nucleotides digested**?

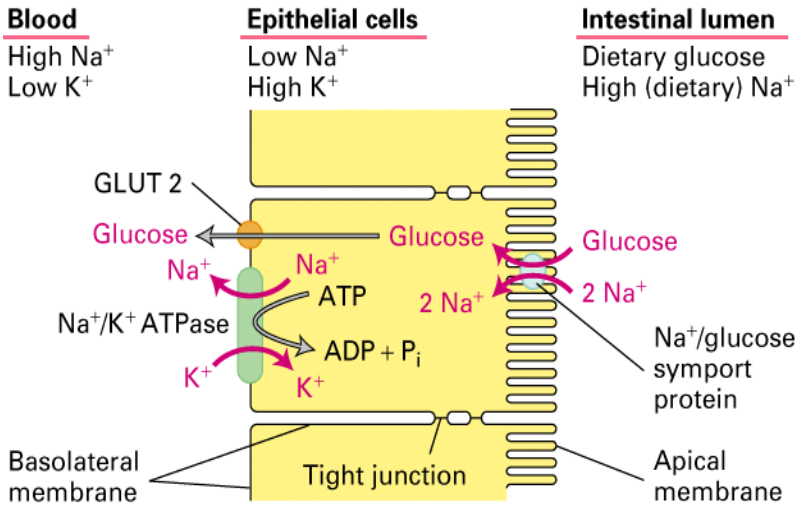
    d. Where along the alimentary canal are **carbohydrates (sugars) digested**?

31. Depending on the nutrient, **transport across the plasma membrane of the small intestinal epithelial cells can be passive or active**. The sugar **fructose**, for example, moves by facilitated diffusion down its concentration gradient from the lumen of the small intestine into the epithelial cells. Then it moves through facilitated diffusion from the epithelial cell into the microscopic **blood vessels called capillaries** inside each villus.

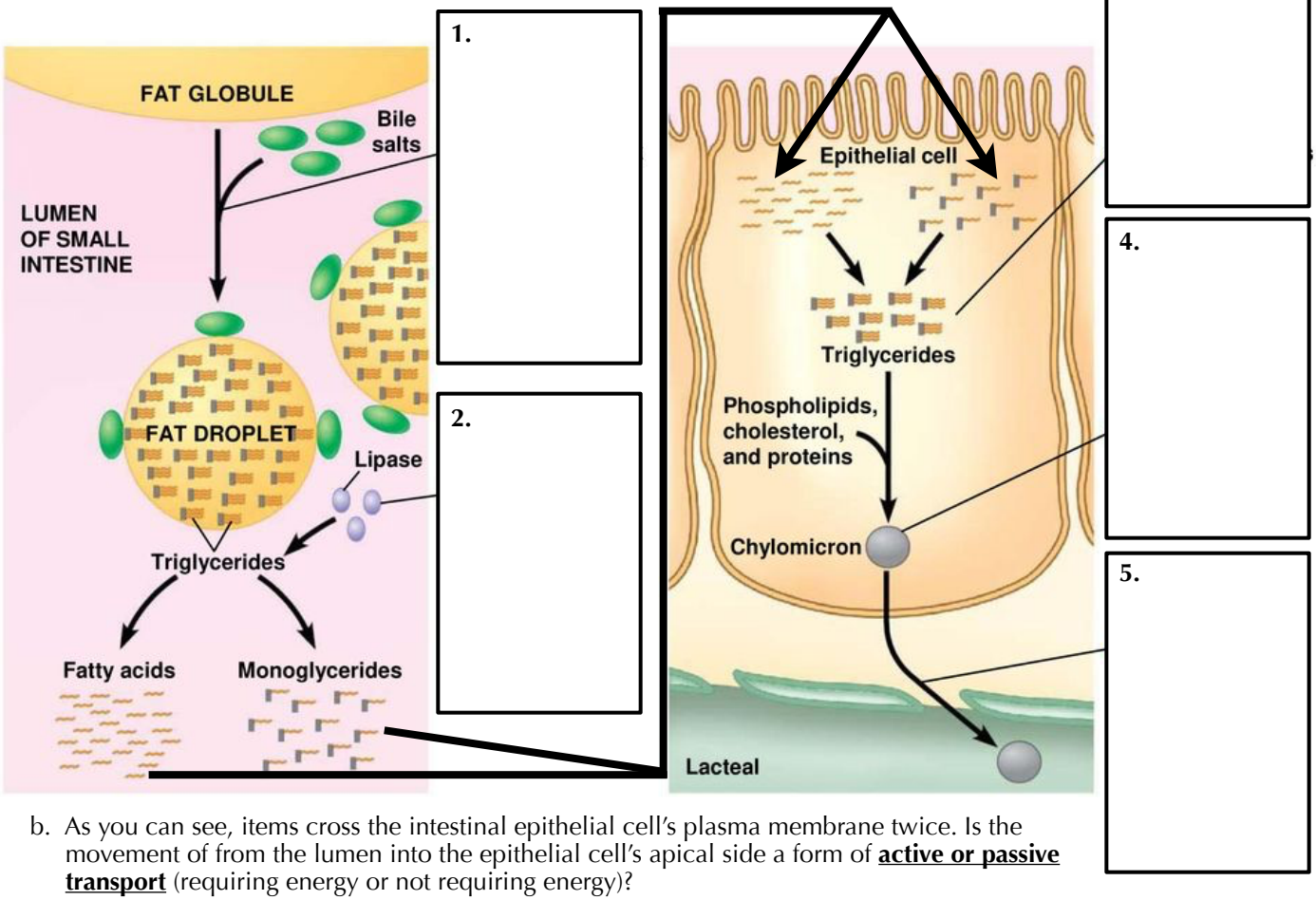
    Other simple sugars like **glucose**, move by secondary active transport in which the epithelial cells allow sodium in the lumen to diffuse into the epithelial cell, down sodium's concentration gradient through a glucose transporter, in the process, using the potential energy stored in sodium's concentration gradient to actively pump in glucose from the lumen to the cytoplasm of the epithelial cell. The sodium gradient between the lumen and the epithelial cell cytoplasms is maintained by sodium/potassium pumps, which actively transport sodium out of the epithelial cells' cytoplasms. The glucose once inside the intestinal cell, then diffuses by facilitated diffusion out of the epithelial cell and into the capillary (blood).

    Amino acids, small peptides, and certain vitamins are also actively transported into the cell in similar ways.

    Let's practice again interpreting a visual model. Try to describe, out loud, using all the terminology you learned in Ch.7 on membrane transport, **what is happening in each part of the model below, if the solutes in each region are moving passively or actively, and how all activities together accomplish the task of moving glucoses from the lumen of the small intestines into the interstitial fluid and, thus, blood.** Start by carefully analyzing the concentrations of solutes in the different regions as indicated along the top edge of the illustration and note **how** sodium gradients **and** glucose gradients are produced **between each side of the small intestinal epithelial cell's membrane and either the intestinal lumen or the blood** to help absorb glucose into the body.



32. a. **Digested triglycerides (monoglycerides & fatty acids)** diffuse past the microvilli and into epithelial cells that make up the villi of the small intestines. Complete the labels of the illustration below to review the **absorption of fats** from the intestinal lumen into the body.



b. As you can see, items cross the intestinal epithelial cell's plasma membrane twice. Is the movement of from the lumen into the epithelial cell's apical side a form of **active or passive transport** (requiring energy or not requiring energy)?

c. Is the movement of from the epithelial cell's basal side into the interstitial fluid (then the lacteal of the lymphatic system) **a form of active or passive transpor**t (requiring energy or not requiring energy)?

d. Most ions, water, and monomers (like simple sugars - monosaccharides -, amino acids, and nucleotide components) absorbed **by the small intestines** are moved directly into the blood, being carried through the **hepatic portal vein** to the liver before traveling to the heart to be distributed to the entire body. Fat absorption works a little differently as fats (incorporated into chylomicrons) are transported into the lymphatic system. Where do the **chylomicrons eventually end up**?

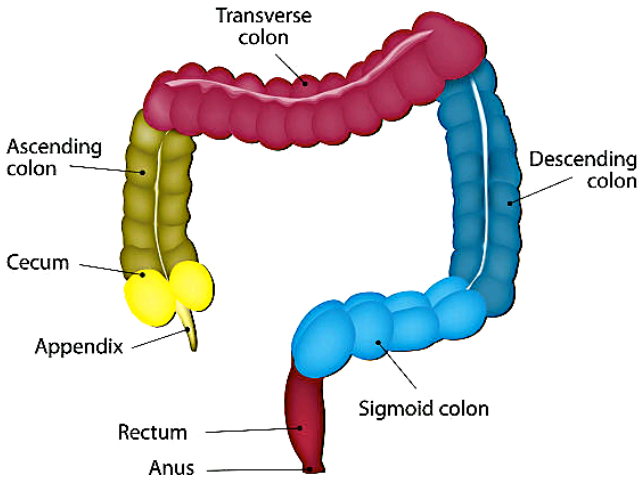
33. The **acids in bile salts** have both lipid-soluble (hydrophobic) and water-soluble (hydrophilic) regions. They are **amphipathic,** just like phospholipids and detergents. How does this property of bile salt acids contribute to them being able to perform their function of helping pulling apart lipid molecules, like fats, so that the hydrolytic enzymes that are tasked with breaking down lipids into their monomeres can better reach each lipid molecule to do so?
*(Check your answer by going to **Ch.41.3 Concept Check Question #2** in Appendix A)*

34. What are the **two reasons the blood from the small intestines, with its newly absorbed nutrients, is taken to the liver first** before being taken to the heart to get pumped to all parts of the body in order to deliver nutrients to all cells?

    1.

    2.

35. The small intestine connects to the large intestine at a T-shaped junction. The large intestine is composed of the cecum, colon, and rectum. One arm of the "T" forms a blind pouch called the **cecum**, the other arm forming the 1.5-meter-long **colon**. The cecum is enlarged in grazing animals. What is the **role of the cecum in these herbivores**?



36. Human, as omnivores, do not have a developed cecum. Instead, what is the role of the human **appendix**?

37. What is a major **function of the colon (the large intestine)**?

38. What are all the components of **feces**?

39. What is the function of the **rectum**?

40. Where do the methane and hydrogen sulfide gases come from that are produced in your colon and released through the anus?