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Appendix A

ANSWERS TO TEST YOUR KNOWLEDGE QUESTIONS

Chapter 1

1.	d	5.	d	9.	a
2.	d	6.	c	10.	c
3.	b	7.	b	11.	c
4.	b	8.	b	12.	c

Chapter 2

1.	c	6.	b	11.	d
2.	b	7.	c	12.	b
3.	a	8.	d	13.	b
4.	d	9.	d	14.	d
5.	c	10.	b	15.	c

Chapter 3

1.	d	7.	a	12.	e
2.	b	8.	c	13.	b
3.	a	9.	a	14.	a
4.	c	10.	b	15.	b
5.	d	11.	e	16.	a
6.	a				

Chapter 4

1.	b	5.	d	8.	d
2.	d	6.	e	9.	d
3.	d	7.	e	10.	d
4.	a				

Chapter 5

1.	b	6.	c	10.	d
2.	a	7.	a	11.	b
3.	c	8.	c	12.	d
4.	e	9.	a	13.	b
5.	d				

Chapter 6

1.	c	6.	d	11.	b
2.	b	7.	a	12.	b
3.	a	8.	a	13.	c
4.	c	9.	b	14.	d
5.	b	10.	d	15.	a

Chapter 7

1.	c	7.	d	13.	d
2.	d	8.	a	14.	b
3.	a	9.	c	15.	a
4.	a	10.	c	16.	c
5.	c	11.	b	17.	a
6.	d	12.	d	18.	e

Chapter 8

1.	d	6.	e	11.	a
2.	b	7.	c	12.	b
3.	e	8.	d	13.	d
4.	a	9.	b	14.	a
5.	b	10.	c	15.	b

Chapter 9

1.	c	5.	c	9.	c
2.	c	6.	b	10.	c
3.	c	7.	b	11.	b
4.	a	8.	e	12.	b

Chapter 10

1.	d	7.	c	13.	b
2.	a	8.	c	14.	c
3.	c	9.	d	15.	b
4.	d	10.	c	16.	c
5.	c	11.	d	17.	c
6.	a	12.	b	18.	b

Chapter 11

1.	d	7.	b	13.	b
2.	d	8.	e	14.	d
3.	e	9.	d	15.	c
4.	e	10.	a	16.	b
5.	d	11.	d		
6.	a	12.	c		

Chapter 12

1.	b	7.	a	13.	e
2.	d	8.	c	14.	c
3.	c	9.	b	15.	b
4.	b	10.	b	16.	d
5.	e	11.	d	17.	b
6.	b	12.	a	18.	a

Chapter 13

1.	c	7.	c	13.	d
2.	b	8.	a	14.	c
3.	e	9.	d	15.	c
4.	a	10.	b	16.	b
5.	b	11.	c	17.	d
6.	c	12.	d		

Chapter 14

1.	a	5.	b	9.	d
2.	d	6.	c	10.	b
3.	c	7.	a	11.	c
4.	e	8.	c	12.	d
13.	b	16.	e	19.	d
14.	d	17.	b	20.	c
15.	c	18.	d		

Chapter 15

1.	c	7.	d	13.	d
2.	b	8.	b	14.	c
3.	d	9.	e	15.	b
4.	a	10.	a	16.	c
5.	c	11.	d	17.	a
6.	d	12.	a	18.	d

Chapter 16

1.	c	7.	b	13.	a
2.	d	8.	a	14.	d
3.	c	9.	e	15.	b
4.	a	10.	c	16.	a
5.	c	11.	a	17.	c
6.	c	12.	c	18.	b

Chapter 17

1.	b	7.	d	13.	a
2.	a	8.	c	14.	d
3.	c	9.	d	15.	b
4.	b	10.	a	16.	e
5.	e	11.	e	17.	c
6.	d	12.	c	18.	b

Chapter 18

1.	e	7.	d	13.	b
2.	d	8.	a	14.	d
3.	b	9.	d	15.	d
4.	c	10.	e	16.	b
5.	d	11.	e	17.	a
6.	b	12.	d	18.	a

Chapter 19

1.	c	7.	a	13.	a
2.	b	8.	d	14.	d
3.	c	9.	c	15.	d
4.	a	10.	b	16.	c
5.	b	11.	b	17.	d
6.	d	12.	c	18.	c

Chapter 20

1.	b	7.	d	13.	d
2.	d	8.	a	14.	b
3.	a	9.	d	15.	a
4.	c	10.	a	16.	e
5.	a	11.	b	17.	d
6.	c	12.	c	18.	c

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SECTION 10—DIGESTION AND NUTRITION

EXERCISE 10.1 HISTOLOGY OF THE GASTROINTESTINAL TRACT, LIVER, AND PANCREAS

Approximate Time for Completion: 1–2 hours

Introduction

This exercise is designed to introduce students to the histology of the gastrointestinal tract, liver, and pancreas. Students will understand and recall the functions of these systems much better if they study and can visualize the structure of these tissues. This exercise may be combined with Exercise 10.2 whose procedures require long incubation periods.

Materials

1. Microscopes
2. Prepared tissue slides of the digestive system

Textbook Correlations: Chapter 18—From Mouth to Stomach; Small Intestine; Large Intestine; Liver, Gallbladder, and Pancreas

Clinical Applications

1. **Describe the normal structure of the intestinal mucosa, identifying the lamina propria.**

   There are three layers to the intestinal mucosa:
   Epithelium—innermost layer.
   Lamina propria—a layer of connective tissue.
   Muscularis mucosae—a thin layer of smooth muscle.

2. **Describe the functions of the liver that relate to the measurements described and propose a possible relationship between these observations.**

The child has edema and a decreased blood plasma but normal levels of urea and liver enzymes. This suggests that there is a leakage of protein into the small intestine causing an increase in intestinal protein. This basically sets up an osmotic scenario resulting in excess fluid entering the lumen of the intestine. This accumulation of fluid manifests itself as edema. A test (not discussed in this manual) would for the presence of fecal excretion of alpha-1-antitrypsin. The presence of alpha-1-antitrypsin in the feces is a clue that leads to protein-losing enteropathy.

The blood test revealed a decrease in albumin. Since other tests showed the liver functioning fine, albumin must have been leaving the blood and entering (leaking) into the small intestine lumen.

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Answers to Questions

1.
   (a) parietal cells
   (b) chief cells
   (c) enterochromaffin-like cells
2. epithelium; lamina propria; muscularis mucosa
3. villi
4. microvilli
5. hepatic portal vein
6. sinusoids
7. pancreatic acini; (pancreatic) islets of Langerhans
8. Brunner's glands
9. The surface area of the small intestine is increased by the presence of plicae circulares, villi, and microvilli (brush border).

10. Pancreatic juice is a blend of water, bicarbonate, and a variety of digestive enzymes, including trypsin, lipase, and amylase among others. Bicarbonate ions from the pancreatic duct cells help buffer the acidic contents from the stomach, trypsin hydrolyzes polypeptides to amino acids, dipeptides, and tripeptides, and pancreatic amylase digests starch to maltose, maltriose, and oligosaccharides.
    Pancreatic juices leave the pancreas and enter into the small intestine (duodenal portion) and perform their function there.

11. The liver is composed of a plate-like arrangement of hepatocytes in which each plate is only one cell thick. Blood travels in sinusoids between these plates allowing intimate interaction between the blood and the hepatocytes. Because of this intimate contact and because the sinusoids are lined by phagocytic Kupffer cells, the liver can modify the chemical composition of the blood. In contrast, bile travels between the hepatic plates in separate vessels called canaliculi and so is kept separated from the blood.

12. The epithelial cells that face the lumen of the small intestine produce many digestive enzymes. These enzymes are fixed within the microvilli along the apical membrane surface of these epithelial cells and work to digest polymers into monomers as food passes by. These fixed "brush border" epithelial enzymes such as enterokinase, activate trypsin that, in turn, activates many of the inactive pancreatic juice enzymes as they enter the duodenum, thereby enhancing the digestive activity

13. No. Grinding up the pancreas will release hormones from the islets of Langerhans (pancreatic islets—endocrine) but also will release many powerful digestive enzymes (exocrine) into the homogenate. Since insulin is a protein hormone (and a small one), the digestive action of the released trypsin, chymotrypsin, carboxypeptidase, and others

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polypeptidases would fragment any insulin molecules into products unrecognizable as the hormone.

14. The lamina propria is a layer of connective tissue underlying the mucous membrane. The lamina propria consists of small blood vessels and lymphatic vessels. It also consists of lymph nodules and Peyer's patches. It is located in the mucosa of the lining of the intestine. The mucosa lining lines the lumen of the small intestine.

    Due to the allergy reaction (perhaps due to a food allergy), the eosinophils of the intestine are activated. Activated eosinophils release a host of chemicals that can affect the intestines resulting in excess mucus production, vomiting, and diarrhea. The activated eosinophils release chemicals that stimulate smooth muscle contraction resulting in diarrhea.

15. Leakage of protein into the small intestine causes an increase in intestinal protein. This basically sets up an osmotic scenario resulting in excess fluid entering the lumen of the intestine. This accumulation of fluid manifests itself as edema. A test (not discussed in this manual) would for the presence of fecal excretion of alpha-1-antitrypsin. The presence of alpha-1-antitrypsin in the feces is a clue that leads to protein-losing enteropathy.

    The blood test revealed a decrease in albumin. Albumin was leaving the blood and entering (leaking) into the small intestine lumen.

    An excess of eosinophils found upon the biopsy, indicates a food allergy.

    The doctor most likely is looking into the possibility that the patient has Crohn's disease or Celiac disease.

EXERCISE 10.2 DIGESTION OF CARBOHYDRATE, PROTEIN, AND FAT

Approximate Time for Completion: 2–3 hours

Introduction

This exercise is designed to demonstrate the activity of selected digestive system enzymes on carbohydrate (starch), protein (albumin), and fat (oil). The enzymes observed are amylase (saliva), pepsin (stomach), and lipase (pancreas). Students will also see how pH and temperature affect enzyme activity. Reviewing principles of enzyme activity at this time would be very helpful to students.

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Materials

1. Water bath (set at 37°C), Bunsen burners, test tubes, droppers, test tube clamp, graduated cylinders
2. Starch solution: dissolve 1.0 g/100 ml water, over heat
3. Iodine (Lugol's reagent): dissolve 1.0 g iodine and 2.0 g potassium iodide in 300 ml of water
4. Benedict's reagent: dissolve 50.0 g sodium carbonate, 85.0 g sodium citrate, and 8.5 g copper sulfate in 5.0 l of water
5. As an alternative to saliva, α-amylase (type VI-B from porcine or human pancreas), or fungal amylase, may be used. Dilute to a concentration of about 300 units per ml, equivalent to saliva. Amylase may be purchased as a solid with 500,000 units of activity (order A-3176) from Sigma Chemical Company.
   You can also purchase pancreatin from Ward's Scientific. Pancreatin consists of several digestive enzymes, one of which is amylase.
6. Freezer or ice bath; white of hard-boiled eggs
7. Pepsin (5 g/100 ml), 2N HCl, 10N NaOH
8. pH meter or short-range pH paper
9. Pancreatin solution (1 g/100 ml), dairy cream or vegetable oil

Textbook Correlations: Chapter 18—Digestion and Absorption of Carbohydrates, Lipids, and Proteins

Clinical Investigation

1. **Identify what produced the yellowish discoloration and explain what could account for this symptom and steatorrhea.**

   The yellowish colored molecule discussed in this patient's scenario is bilirubin. This patient was taking Prilosec and Zantac. Both of these drugs are metabolized in the liver and can inhibit some of the liver enzymes. By inhibiting some of the enzymes, bilirubin might not be incorporated into bile for removal. Therefore, bilirubin accumulates and appears in higher than normal concentrations in the bloodstream. This accumulation in the bloodstream causes the skin to become yellowish.

   Under normal conditions, bilirubin is incorporated into the formation of bile. Bile is used to emulsify fat thereby making it easier for lipase to digest it. In this patient's scenario, bilirubin was not becoming incorporated into the formation of bile. Therefore, the concentration of bile is reduced. A reduced level of bile results in less fat being digested. Therefore, the fecal material has more fat in it than normal. This is called steatorrhea.

2. **Explain the actions of Zantac and Prilosec and whether or not these actions relate to the patient's probable need for surgery.**

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Zantac and Prilosec are proton inhibitors. The patient is experiencing acid problems associated with the stomach. The acid problem is due to excess production of hydrogen ions. A hydrogen ion is a proton. Therefore, Zantac and Prilosec inhibit the production of hydrogen ions, thereby reducing the acid problem.

There are cells in the stomach that are involved in the production of acid, which of course involves hydrogen ions. If the use of Zantac and Prilosec does not reduce the acid production, perhaps surgery is needed. Surgery will remove the acid producing cells.

Answers to Questions

1. amylase
2. pepsin; 2.0
3. lipids
4. liver hepatocytes; gallbladder
5. emulsify lipids
6. chylomicrons

7. Following incubation, Tubes 1 and 4 in Exercise "A" contained the most starch and Tube 2 contained the most reducing sugar. Salivary amylase therefore, functions best at a neutral pH and is at least partially destroyed by boiling.

8. Following incubation, the most digestion of egg albumin (protein) in Exercise "B" occurred in Tube 2. This shows that the enzyme pepsin has both a pH optimum (pH 1–2) and a temperature optimum (37°C).

9. Hydrochloric acid (HCl) stimulated the digestive action of pepsin, whereas HCl inhibited the digestive action of salivary amylase. This is due to the difference in chemical composition and structure that determines the pH optima of these two enzymes. Pepsin is adapted to work best in the acidic environment of gastric juice, whereas salivary amylase is adapted to work optimally at the nearly neutral pH of saliva.

10. Following incubation in exercise "C," Test Tube 3 displayed the most rapid fall in pH. This tube contained not only the substrate molecules (fat or oil) but also contained emulsifying agents (bile salts), and digestive enzymes (pancreatin) that together hydrolyzed the oil into fatty acid molecules. The increase in the number of fatty acid molecules lowers the pH of the solution.

11. Dietary triglycerides (fat) are first emulsified by bile salts and then hydrolyzed by lipase into free fatty acids and monoglycerides. Once fatty acids and monoglycerides enter the intestinal epithelial cells, they are reassembled into triglycerides and packaged as chylomicrons. These chylomicrons are then secreted into the central lacteals and enter the lymphatic drainage for return to the blood via the thoracic duct. Dietary carbohydrates and proteins by contrast, are digested by hydrolysis into simple sugars and amino acids that are

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absorbed through the intestinal epithelial cells without reassembly. These smaller molecules are then secreted directly into the blood of the hepatic portal vein and taken to the liver for processing or systemic distribution.

12. The stomach doesn't normally digest itself because of the protective effects of an adherent layer of alkaline mucus, the tight junctions between adjacent epithelial cells, and the rapid rate of cell division that acts to replace damaged epithelial cells every 3 days. Gastric juice does not normally digest the duodenum because the acidic gastric juice is deterred by the adherent layer of mucus, buffered by bicarbonate secreted by Brunner's glands in the submucosa, which are unique to the duodenum, and rapidly neutralized by the arrival of buffers from the pancreas; and to a lesser extent by the alkaline bile arriving from the liver.

13. In part "A," if the tests for both starch (substrate) and reducing sugar (product) are positive at the end of a 1-hour incubation, one can conclude that the starch was only partially digested. If the incubation had proceeded for 2 hours and the test for starch was negative, one can conclude that all starch was digested by the enzyme amylase.

14. While chewing on the bite of bread, amylase from saliva acts on the bread starch forming reducing sugars. After swallowing the bite however, the acidic gastric juice would inactivate salivary amylase. This was observed in Tube 3, where the addition of HCl severely reduced the activity of amylase (less starch digestion). The bread will be further digested in the small intestine.

15. As shown in part "B" Tube 3, freezing inhibits the action of enzymes. With regard to foods, the enzymes that are especially important are those enzymes that hydrolyze protein. Food that is frozen keeps longer because the enzymes in organisms that promote decomposition (bacteria and fungi) at room temperature are inhibited under freezing conditions.

16. When gallstones block the excretion of bile from the liver, bilirubin will accumulate in the blood because it cannot be adequately excreted through the bile. The subsequent rise in tissue bilirubin levels causes jaundice. Furthermore, if the secretion of bile into the intestine is blocked, normal fat digestion and absorption will be impaired. This could reduce the absorption of fat-soluble nutrients and vitamins including vitamin K. A deficiency in vitamin K will impair the normal formation and action of plasma clotting factors; thereby accounting for the prolonged clotting time.

17. The yellowish colored molecule discussed in this patient's scenario is bilirubin. This patient was taking Prilosec and Zantac. Both of these drugs are metabolized in the liver and can inhibit some of the liver enzymes. By inhibiting some of the enzymes, bilirubin might not be incorporated into bile for removal. Therefore, bilirubin accumulates and appears in higher than normal concentrations in the bloodstream. This accumulation in the bloodstream causes the skin to become yellowish.

    Under normal conditions, bilirubin is incorporated into the formation of bile. Bile is used to emulsify fat thereby making it easier for lipase to digest it. In this patient's scenario, bilirubin was not becoming incorporated into the formation of bile. Therefore, the

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concentration of bile is reduced. A reduced level of bile results in less fat being digested. Therefore, the fecal material has more fat in it than normal. This is called steatorrhea.

18. Zantac and Prilosec are proton inhibitors. The patient is experiencing acid problems associated with the stomach. The acid problem is due to excess production of hydrogen ions. A hydrogen ion is a proton. Therefore, Zantac and Prilosec inhibit the production of hydrogen ions, thereby reducing the acid problem.

    There are cells in the stomach that are involved in the production of acid, which of course involves hydrogen ions. If the use of Zantac and Prilosec does not reduce the acid production, perhaps surgery is needed. Surgery will remove the acid producing cells.

EXERCISE 10.3 NUTRIENT ASSESSMENT, BMR, AND BODY COMPOSITION

Approximate Time For Completion: 3 days at home; plus discussion and analysis of data

Introduction

This exercise is designed to introduce students to methods of measuring caloric intake and expenditure, and the effects of caloric balance on body weight and composition. This exercise requires students to measure both their caloric intake and expenditure over 3 days and then examine how this affected their body weight. It may be easiest to assign students to perform this exercise individually and then analyze their results during the laboratory period. Alternatively, this exercise can be used as a take-home project or expanded into an individual research project with nutrition references as required reading.

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Materials

1. Home scale or physicians height–weight scale
2. Tape measure, fat calipers (if available)
3. Calorie counting guide such as the U.S. Department of Agriculture Handbook, cookbooks, or popular diet books
4. Alternatively, the caloric value of foods, and the caloric expenditure of exercise, can be obtained from the Web. Once good source is www.caloriecontrol.org
5. A great deal of nutritional information, in addition to the caloric value of many foods, can be obtained from the Web site of the Nutrient data Laboratory at www.ars.usda.gov/nutrientdata. Look under the heading "database products" on the home page, then click on "Nutritive Value of Foods." You must have Adobe Acrobat Reader, which can be downloaded from this site.

Textbook Correlations: Chapter 19—Nutritional Requirement; Regulatory Functions of Adipose Tissue; Caloric Expenditures

Clinical Investigation

1. **Calculate this man's waist-to-hip ratio and body mass index (BMI) and indicate if he is normal, overweight, or obese.**

Waist-to-hip ratio: 1.1 (waist circumference/hip circumference) : 44 in./40 in. = 1.1.

BMI: Calculation method: 32.2 (wt × 703/ht^2): 218 × 703 / 69 in.^{2}): 153,254/4,761 = 32.2

A BMI less than 18.5 is considered underweight.

A BMI between 18.5 and 24.9 is considered normal.

A BMI between 25 and 29.9 is considered overweight.

A BMI over 30 is considered obese.

Based on the calculation method, this patient is obese. This patient also has a waist-to-hip ratio over 1.0. This indicates that this patient is at risk for heart problems. In males, a value over 1.0 increases the chances of heart problems. In females, a value over 0.80 increases the chances of heart problems.

2. **Explain the health significance of this man's measurements and family history.**

This patient is a candidate for diabetes mellitus due to being overweight and the fact that there is a history of it in his family. This patient's overweight issue can lead to atherosclerosis. This can lead to high blood pressure. The patient is taking medicine to keep the blood pressure under control. The patient needs to continue with the medication. This patient needs to lose weight by exercising and eating properly.

Answers to Questions

1. catabolism

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2. about 9; about 4
3. carbohydrates
4. fat-soluble
5. basal metabolic rate (BMR)
6. body mass index (BMI)
7. *Anabolism* is the part of metabolism in which larger, energy-reserve molecules are produced; *catabolism* is the part that breaks down larger molecules into smaller ones to release energy. You can tilt your body toward anabolism by eating. After eating, the secretion of insulin is increased while the secretion of glucagon is decreased.

8. The *basal metabolic rate* (BMR) is the minimum rate of caloric expenditure by the body shortly after awakening and at least 12 hours after the last meal. Physical activity increases metabolism and thus burns more calories to maintain or decrease body weight. Physical activity usually raises the total energy expenditure by at least 30%.

9. Obesity has been defined by the health agencies in different ways. The World Health Organization classifies people with a BMI of 30 or over as being at high risk for the diseases of obesity. The National Institutes of Health (NIH) states that a BMI over 30 is *obese*, whereas *overweight* is defined as having a BMI in the range of 25.0–29.9. Obesity, especially involving visceral fat, promotes insulin resistance and type 2 diabetes mellitus. These conditions, in turn, are associated with other problems, including hypertension and dyslipidemia: high blood triglyceride levels and low levels of HDL. This leads to a greater risk of coronary artery disease, stroke, and hypertension. This constellation of symptoms surrounding type 2 diabetes and obesity has been termed the *metabolic syndrome*.

10. Saturated fats are lipids whose fatty acid chains have carbon atoms completely saturated with hydrogen atoms—thereby having no double bonds. Unsaturated fats refer to fatty acid chains with carbon atoms that have hydrogen atoms removed and thus forming double bonds. Unsaturated fats in nature almost always are *cis fatty acids* in that the single hydrogen remaining on each carbon of a double bond are on the same (cis) side of the chain, thereby forming a repeating bent pattern at each double bond.

    Trans fats, by contrast, are produced artificially by partially hydrogenating the double bonds of polyunsaturated vegetable oils to make a “spreadable” form of oil called margarine. However, trans fats have the single hydrogen atom of each double bond on opposite (trans) side of the bond with the chain forming a repeating straight pattern of fatty acid.

    Saturated fats, such as those in animal fats, coconut oil and palm oil, among others have been shown to raise LDL cholesterol and lower HDL cholesterol and thereby to increase the risk of coronary heart disease. The Food and Drug Administration (FDA) now requires all manufacturers to list trans fats on their food labels and countries such as

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Canada are passing laws to prohibit the use of trans fats in government-subsidized food preparation.

11. Since body mass index (BMI) = weight/(height),^{2} both Person A and Person B have the same BMI. However, with a higher bioelectric impedance recording, Person A has less electrolyte-rich body fluids or roughly translated, has less lean body mass; and therefore, has a greater percentage of body fat tissue than Person B.

12. With a higher percent body fat, Person A would have a waist-to-hip ratio greater than 1.0 and therefore has a greater amount of visceral fat than Person B. Excess visceral fat promotes insulin resistance and type 2 diabetes mellitus. Furthermore, accumulated visceral fat is associated with hypertension and dyslipidemia and other cardiovascular disorders. This constellation of symptoms surrounding type 2 diabetes and obesity has been termed the *metabolic syndrome*.

13. Since one pound of fat is equivalent to 3,500 kcal, 20 pounds of fat is equivalent to 70,000 kcal. This is 7,000 kcal/month for 10 months. Dividing 7,000 kcal/month by 4 weeks/month gives 1,750 kcal/week. The student must thus eat 1,750 kcal/week less than is consumed by metabolism or increase metabolic expenditure by the same amount to lose 20 pounds by graduation.

14. Dividing 1,750 kcal/week by 7 days/week gives 250 kcal/day. *Yes*, this is certainly a practical weight loss program, as 250 kcal/day might be saved by merely substituting low-fat food for their equivalents (e.g., baked potato instead of French fries, nonfat milk for whole milk, and others), or by eliminating a high-calorie snack (such as a candy bar, or chocolate malt, and others). Furthermore, any extra activity and increased caloric expenditure each day would help reduce the total number of kilocalories needed to be eliminated from the diet alone.

15. Dividing 250 kcal/day by 9 kcal/g of fat gives about 28 g of fat. Yes, this is a practical weight loss program for the average American student. Assuming that the average American diet is approximately 2,500 calories/day and approximately 36% of these calories are derived from fat (900 calories), the average intake of fat per day is 100 g. A decrease of 28 g of fat would be well tolerated (e.g., a bowl of ice cream, the double cheese on a cheeseburger, and others). Note that even a 2,000 calorie/day intake at 36% fat (720 calories) represents 80 g of fat per day and is still a prudent approach to weight loss without compromising the intake of fat-soluble nutrients and vitamins. The key definition to this problem is in the clinical significance section, Part B.

16. Waist-to-hip ratio: 1.1 (waist circumference/hip circumference): 44 in./40 in. = 1.1.
BMI: Calculation method: 32.2 (wt × 703/ht^2): 218 × 703/69 in.^{2}): 153,254/4,761 = 32.2
Nomogram: 28.5 × (I'm not sure the manual has an accurate nomogram. When using other nomograms, the value comes out to be 32–33. Using this manual's nomogram, the value is only 28.5.

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A BMI less than 18.5 is considered underweight.
A BMI between 18.5 and 24.9 is considered normal.
A BMI between 25 and 29.9 is considered overweight.
A BMI over 30 is considered obese.

Based on the calculation method, this patient is obese. This patient also has a waist to hip ratio over 1.0. This indicates that this patient is at risk for heart problems. In males, a value over 1.0 increases the chances of heart problems. In females, a value over 0.80 increases the chances of heart problems.

17. This patient is a candidate for diabetes mellitus due to being overweight and the fact that there is a history of it in his family. This patient's overweight issue can lead to atherosclerosis. This can lead to high blood pressure. The patient is taking medicine to keep the blood pressure under control. The patient needs to continue with the medication. This patient needs to lose weight by exercising and eating properly.

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