Chapter 40—Animal Nutrition

I. Nutritional Requirements
   A. Meeting Basic Needs
      1. Recommended daily allowances are an estimate of the basic nutritional needs of humans. Figure 40.1
         a. Some amino acids and vitamins must be obtained in the diet.
         b. Essential elements, such as calcium, iron, and sodium, are used in a variety of ways in the body.
      2. Chemical energy in food is measured in calories or kilocalories.
   B. Nutrition and Athletic Performance
      1. Glycogen, not fatty acids, provides the fuel for extended exertion.
         a. The Bergström experiment tested endurance and glycogen stores in nine humans. Figure 40.2a
         b. Greater endurance was strongly linked to the amount of stored glycogen and a high carbohydrate diet. Figure 40.2b
      2. Carbohydrate loading has become a standard part of endurance training.

II. Obtaining Food: The Structure and Function of Beaks, Teeth, and Mouthparts
   A. The size and shape of mouthparts correlates to the size and shape of foods ingested.
      1. Animals that swallow food whole lack elaborate mouthparts. Figure 40.3a
      2. Animals that chew food have sharp teeth for tearing food and/or molars for grinding food. Figure 40.3c
   B. The Cichlid Fish of Africa and the Pharyngeal Jaw
      1. The pharyngeal jaws of cichlids give them an adaptive advantage compared to others with pharyngeal jaws. Figure 40.4
         a. The cichlid pharyngeal jaws are stronger and hinged in a way that enables them to participate in tearing and chewing food. Figure 40.5a
         b. The pharyngeal jaw supplements the actions of the oral jaw.
      2. Tooth-like protuberances on the cichlid pharyngeal jaw differ in cichlids that are adapted to different food sources. Figure 40.5b

III. Digestion
   A. The Mouth and Esophagus
      1. Salivary amylase begins the process of carbohydrate digestion.
      2. A combination of smooth and skeletal muscle moves food down the esophagus by peristalsis. Figure 40.6
   B. The Stomach Figures 40.8a, b & c
      1. The enzyme pepsin digests proteins to short polypeptides.
      2. Pepsin is produced in chief cells and secreted in an inactive form.
      3. The acid in the stomach activates pepsinogen to pepsin.
4. Stomach acid is secreted from parietal cells, which produce acid by converting CO₂ and H₂O to carbonic acid.
5. Gastrin stimulates secretion of acid from parietal cells.

C. The Small and Large Intestines Figure 40.7
1. Pancreatic enzymes digest foods to completion in the small intestine.
   a. Pancreatic enzymes are produced and secreted in an inactive form.
   b. Enterokinase in the small intestine activates trypsin, which activates the other enzymes. Figure 40.9
2. Secretion and cholecystokinin stimulate the secretion of pancreatic enzymes and bile into the small intestine.
3. Bile salts emulsify fats so they can be digested by lipases. Figure 40.10
4. The epithelium of the small intestine is highly folded, providing a large surface area for absorption. Figure 40.11
5. Glucose is absorbed through a Na⁺-glucose cotransporter, and water is absorbed by osmosis.
6. The large intestine is a site of water absorption and feces formation.

IV. Achieving Nutritional Homeostasis: Glucose as a Case Study
A. Diabetes mellitus is a disease of glucose homeostasis.
   1. Diabetics have abnormally high levels of glucose in the bloodstream and urine.
   2. The pancreas was implicated in the disease by experiments that showed removal of the pancreas initiated diabetes.
B. The Role of Insulin in Glucose Homeostasis
   1. The pancreatic hormone insulin binds to receptors on body cells and stimulates them to increase uptake and processing of glucose.
   2. Type I diabetics have a defect in insulin synthesis.
   3. Type II diabetics have defective insulin receptors. Figure 40.14
   4. Insulin and glucagon work together to maintain homeostasis of glucose levels in blood. Figure 40.13