For example, biomechanics uses engineering concepts to analyze structure and function in biological systems. Geophysics uses the concepts of physics (eg. electricity and magnetism) to study the Earth.

89. Scientists can inject radioactive material into a patient and trace its movement through the digestive system. They may want to use the radioisotope carbon-14 to track the digestion of starch into maltose, and then into glucose. By analyzing the path that the carbon takes, scientists can determine where carbohydrate digestion takes place in the body. Since nitrogen is found in proteins, scientists can use the radioisotope nitrogen-15 to track the digestion of proteins into peptides, and then into amino acids.
90. **a.** By restricting the consumption of carbohydrates, the body will not convert excess carbohydrates into fat. The body will also start to burn body fat instead of carbohydrates for fuel. This will result in weight loss.

    b. Your body would start to burn fats rather than carbohydrates as fuel.
91. A lack of proteins would not give the body the amino acids it needs to build important proteins for the body (eg. enzymes for metabolic reactions, keratin, collagen, etc.).
92. Diagram
93. Header: Organic Compounds

    First column: Carbohydrates; polysaccharides; dissacharides; monosaccharides

    Second column: Lipids; triglyceride; fatty acids; glycerol

    Third column: Proteins; peptides; amino acids

    Fourth column: Nucleic acids; RNA; DNA; nucleotides

    Fifth column: High-Energy Compounds; ATP; nucleotide; phosphate groups

Chapter 3 Diagnostic Questions

1. **a.** A red blood cell is larger than a virus.
2. **c.** the plasma membrane
3. **b.** to control all of the cell's activities
4. **d.** a cell wall
5. **c.** water + carbon dioxide + sunlight → oxygen + glucose
6. **d.** $C_6H_{12}O_6 + O_2 \rightarrow CO_2 + H_2O + ATP$
7. **d.** Mitochondria are found in both plant and animal cells, while the chloroplasts are found only in plant cells.
8. **b.** by diffusion
9. A cell is the basic unit of life.
10. **A.** nuclear envelope; **B.** nucleolus; **C.** nuclear pore; **D.** water vacuole; **E.** chloroplast; **F.** mitochondrion; **G.** microtubules; **H.** microfilaments; **I.** plasma membrane; **J.** granum of the chloroplast; **K.** cell membrane (cell membrane); **L.** cytoplasm; **M.** Golgi apparatus; **N.** vesicle; **O.** smooth endoplasmic reticulum; **P.** rough endoplasmic reticulum; **Q.** ribosome
11. **1.** nucleus; **2.** chromosome; **3.** mitochondria; **4.** ribosome; **5.** chloroplast; **6.** vacuole; **7.** endoplasmic reticulum; **8.** plasma membrane; **9.** lysosome
12. Students might say that they could not find everyday examples for every cell structure.
13. DNA and RNA are found in the nucleus.
14. Answers may vary. When you are travelling through a crowded hallway at school into an empty classroom, you are going from an area of high concentration to an area of low concentration.
15. Answers may vary. The diffusion of food aroma molecules comes from the kitchen as someone is cooking.

Chapter 3 Review Questions

1. **a.** The cell is the basic unit of life.
2. **b.** a cell with a surface-area-to-volume of 3:2
3. **d.** cell structure 12
4. **d.** organelle 11
5. **d.** 7
6. **b.** the plasma membrane
7. **c.** cholesterol
8. **c.** diagram of polypeptide chain
9. **d.** it is a double membrane structure that has pores and separates the contents of the cytoplasm from the nucleus
10. **b.** DNA
11. **d.** rough endoplasmic reticulum
12. **c.** rough endoplasmic reticulum
13. **d.** a plastid that has the ability to capture light energy and convert it into organic molecules
14. **b.** peroxisome – fatty acids
15. **d.** mitochondria
16. **c.** membrane-bound vesicles that have hydrolytic enzymes
17. **a.** The secretion of peptidase would not occur.
18. **c.** glucose
19. **d.** cellular respiration
20. **c.** to produce ATP for active transport of calcium ions
21. **a.** cell division
22. **c.** I, II and III only
23. **a.** They both use a carrier protein.
24. **c.** pinocytosis
25. **c.** exocytosis
26. **c.** glycoprotein
27. **d.** the plasma membrane and the nuclear envelope
28. **c.** the number of amino acids entering the cell would decrease
29. **d.** only certain substances can move across it
30. **d.** the excretion of hydrogen ions in the distal convoluted tubule of the kidneys
31. **a.** IV (DNA replication)

    b. V (protein synthesis)

    c. VII (intracellular digestion)

    d. III (rRNA synthesis)

    e. I (photosynthesis)

    f. V (protein synthesis)

    g. II (lipid synthesis)

32. **a.** VI (mitochondrion)
b. I (nucleus)
c. II (nucleolus)
d. VI (mitochondrion)
e. V (chloroplast)
f. VII (Golgi Apparatus)
g. IX (smooth endoplasmic reticulum)
h. III (ribosome) and VIII (rough endoplasmic reticulum)
i. III (ribosome) and VIII (rough endoplasmic reticulum)
j. IX (smooth endoplasmic reticulum)
k. IX (smooth endoplasmic reticulum)
l. VI (mitochondrion)
m. IV (centriole)
n. VII (Golgi apparatus)
o. VIII (rough endoplasmic reticulum)
p. III (ribosome) and VIII (rough endoplasmic reticulum)

33. **a.** to provide movement in the cell
b. to provide structural support for the plant cell
c. to produce mitotic spindles during cell division
d. to produce ribosomal subunits
e. to break down fats and produce bile salts from cholesterol
f. to allow movement in the cell
g. to modify, package and sort proteins
h. to regulate what enters and exits the cell

34. to provide support and protection for plant cells

35. Cellulose makes up cell structure AE (cell wall).

36. Photosynthesis occurs at cell structure A (chloroplast).

37. Products of reactions at cell structure D (rough endoplasmic reticulum) are transported to cell structure AC (Golgi apparatus) in transport vesicles.

38. The functions of cell structure B (central water vacuole) are to control turgor pressure, to maintain the structural integrity of the plant cell, and to exert pressure against the cell wall.

39. A (chloroplast) and AE (cell wall)

40. carbon dioxide, water, and light energy

41. Centrioles and lysosomes are found in animal cells, but not in plant cells.

42. Plant cells have a cell wall, chloroplasts and a central water vacuole.

43. The endoplasmic reticulum produces proteins that are then sent to the Golgi apparatus in transport vesicles. At the Golgi apparatus, the proteins are then modified, sorted and packaged and sent off in secretory vesicles to the plasma membrane.

44. The plasma membrane takes in dissolved solutes or bigger macromolecules by producing an invagination around the molecules. This forms a vesicle. The vesicle then fuses with a lysosome in the cytoplasm and the contents of the vesicle are digested by the hydrolytic enzymes of the lysosome.

45. Cardiac muscle cells are very active and require huge amounts of energy. Mitochondria will produce enough energy for the muscle cells. The testes have lots of smooth endoplasmic reticulum because they produce the steroid hormone testosterone.

46. Without the enzyme catalase, the body could not break down toxic hydrogen peroxide into water and oxygen gas. The buildup of hydrogen peroxide could be fatal.

47. [Centre CIRCLE] Similarities between chloroplast and mitochondrion: both found in plant cells, are double-membrane organelles, and contain their own DNA. Differences between chloroplast and mitochondrion: [LEFT CIRCLE chloroplast] The chloroplast has chlorophyll, thylakoid, grana, and stroma. The chloroplast is involved in photosynthesis and is only found in plant cells. [RIGHT CIRCLE mitocondrion] The mitochondrion has cristae and a fluid-filled matrix. The mitochondrion is involved in cellular respiration.

48. Both are membrane-bound sacs that transport material around the cell. They produce transport vesicles that send materials to the Golgi apparatus. The rough ER is covered with ribosomes and synthesizes proteins. In contrast, the smooth ER has no ribosomes and synthesizes lipids, phospholipids, cholesterol and steroid hormones.

49. Centrioles have a 9 + 0 arrangement of microtubule triplets, while both cilia and flagella have a 9 + 2 pattern of microtubules doublets.

50. The cell membrane (plasma membrane) of the macrophage forms a vesicle around the bacterium. The vesicle with the bacterium in it fuses with a lysosome. The hydrolytic enzymes of the lysosome break down and digest the bacterium.

51. When there is not enough water, turgor pressure decreases and the central vacuole shrinks and pulls away from the cell wall.

52. The products of photosynthesis (oxygen and glucose) are the reactants of cellular respiration; the products of cellular respiration (carbon dioxide and water) are the reactants of photosynthesis.

53. Microtubules and microfilaments both maintain cell shape, are involved in cell division, and are protein fibres in the cytoskeleton.

54. Carbohydrate chains are exposed on the surface of the plasma membrane to serve as recognition sites and to facilitate adhesion between the cells.

55. The white blood cells would not recognize the cancer cells because the white blood cells depend on the glycolipids to recognize the cancer cells.

56. The asymmetry gives the two surfaces of the plasma membrane different properties.

57. It must divide.

58. The cell with the largest surface area to volume ratio, 3:1, is the most effective.

59. Active transport must overcome the concentration gradient and transport the sodium ion in the opposite direction of its tendency to move.

60. These organisms tend to take in water from the environment because their body fluids are more concentrated than the environment. These organisms adapt by having structures that pump out excess water. Organisms can excrete dilute urine to get rid of the excess water. Other solutions may involve having an impermeable membrane.

61. Factors that affect the rate of diffusion: size of molecule, temperature, concentration gradient and polarity of the molecule.

62.

	Diffusion	Osmosis	Facilitated Transport	Active Transport
Energy Required?	no	no	no	yes
Protein Carrier Required?	no	no	yes	yes
Driving Force	concentration gradient	concentration gradient	concentration gradient	ATP hydrolysis
Direction of Movement	high concentration to low concentration	high concentration to low concentration	high concentration to low concentration	low concentration to high concentration
Specificity	no	no	yes	yes
Types of Molecules	carbon dioxide, oxygen	water	glucose, amino acids	sodium ions, potassium ions

63. The smaller the molecule, the larger the diffusion coefficient.

64.

	Observation	Will it cross the cell membrane easily? Why?	Method of Transport
a.	The concentration of the plasma protein albumin is higher in the plasma.	No, because albumin is too big to cross the plasma membrane.	N/A
b.	The concentration of carbon dioxide is higher in the cytoplasm of the liver cell.	Yes, because carbon dioxide is non-polar and is small enough to diffuse across the membrane from high concentration to low concentration.	Diffusion
c.	The concentration of low-density lipoproteins is higher in the cytoplasm of the liver cell.	No, because a low-density lipoprotein is a large polar molecule. It will not cross the non-polar membrane.	N/A
d.	The concentration of glucose is higher in the blood plasma.	Yes, glucose will cross the membrane using a protein carrier down the concentration gradient.	Facilitated Transport
e.	The concentration of oxygen is higher in the blood plasma	Yes, oxygen will diffuse across the plasma membrane from an area of high concentration to an area of low concentration.	Diffusion
f.	The concentration of sodium ions lower in the cytoplasm.	Yes, the sodium ions will move against the concentration gradient using a sodium ion channel.	Active Transport
g.	The concentration of water is higher in the cytoplasm of the liver cell.	Yes, water will diffuse across the plasma membrane through osmosis from an area of high concentration to an area of low concentration.	Osmosis

65. Slide #1 has the hypotonic solution and slide #2 has the hypertonic solution.

66. Since the central water vacuole is filled with water and it takes up most of the room in the cell. It pushes the cytoplasm, including the chloroplasts right up against the plasma membrane.

67. Water left the Elodea cells.

68. When the plant was placed in salt water, the central water vacuole lost water. Chloroplasts that were found around the perimeter of the cell will be drawn toward the centreof the cell because of the collapsed central water vacuole has less water in it now.

69. No, the plant cells do not get smaller, only the water vacuole does.

70. plasmolysis

71. Water would flow into the cell, causing the water vacuole to swell. This creates turgor pressure and the plasma membrane pushes against the rigid cell wall.

72. test tube 1 – isotonic; test tube 2 – hypertonic; test tube 3 - hypotonic
73. The red blood cells would shrivel up because water leaves the cells. This process is called crenation.
74. The red blood cells would swell because water moved into the cells. The cells would burst due to hemolysis.
75. Pancreatic amylase is synthesized at the ribosome. The data shows that at time 5 minutes and 10 minutes, the ribosomes show the largest percentage of amylase.
76. ribosomes → ER → Golgi apparatus → secretory vesicles
77. Pancreatic amylase is a protein that is going to be excreted from the cell. There is a high percentage of amylase found in secretory vesicles which are bound for the plasma membrane. This data shows large amounts of pancreatic amylase in the secretory vesicles.
78. It showed that membrane proteins were free to migrate throughout the plasma membrane. The plasma membrane has a fluid consistency.
79. The rate of protein movement would increase as temperature increases. The concepts investigated are diffusion and membrane fluidity.
80. Osmosis was responsible for the potato cells gaining and losing water.
81. Potato cells were placed in a hypotonic solution in test tube 2. Water entered the potato cells, increasing the mass of the cells.
82. Potato cores that lost mass were placed in hypertonic solution and therefore lost water. Potato cores that gained mass were placed in hypotonic solution and therefore gained water.
83. test tubes 4 and 5
84. about 15% sucrose concentration
85. Graph
86. The molarity of the glucose solution is directly proportional to the percent change in mass. As the molarity increases, so does the percent change in mass.
87. The selectively permeable membrane does not allow the sugar molecules to pass through because they are too big. Because the right side has the dilute solution, there are more water molecules on the right side than the left side. Water diffused from an area of higher concentration (right side) to an area of lower concentration (left side) through the process of osmosis. This results in the rise in the solution level on the left side.
88. Graph
89 **a.** Both the surface area and volume increase as the cell gets bigger, but the volume increases at a faster rate.

b. As the cell gets bigger, the surface area to volume ratio decreases.

c. The 3-mm cube has the smallest surface-area-to-volume ratio.
90. The Blob would not have an adequate surface area for exchanging nutrients and wastes and it would not be able to survive for long.
91. Without a properly functioning cell wall, the bacterium is not protected by the outside environment and is susceptible to attacks by other organisms like viruses.

Chapter 4 Diagnostic Questions

1. **b.** sequence of amino acids in the polypeptide chain.
2. **d.** the sequence of nitrogenous bases in the DNA molecule of an organism.
3. **a.** There are more genes than chromosomes.
4. **b.** DNA controls the production of proteins in the cell.
5. **a.** nucleotide.
6. **d.** adenine, cytosine, guanine, and thymine
7. **a.** genes
8. **a.** The gene for albumin has a different sequence of nitrogenous bases than the gene for melanin.
9. **a.** a gamete.
10. **d.** it cannot be passed on from one generation to the next.
11. **c.** change the arrangement of the genetic material.
12. It carries the genetic information of an organism and is passed on from one generation to the next.
13. Genes are found on chromosomes, which are found in the nucleus of a cell.
14. mutagens, radiation, drugs
15. rabbit
16. No, just because there are 10 amino acids different, doesn't mean the amino acids are in the exact same order for both whales and kangaroos.

Chapter 4 Review Questions

1. **b.** are nucleic acids.
2. **a.** adenine and guanine.
3. **c.** C-A-T-G-T-A-C
4. **c.** T-A-G
5. **a.** uracil
6. **b.** replication
7. **a.** ribosome.
8. **b.** The primary structure of Molecule 2 would be different.
9. **a.** adenine pairs with thymine by forming two hydrogen bonds
10. **a.** a gene.
11. **c.** to carry specific amino acids to the ribosome
12. **b.** the nucleolus.
13. **b.** to read the codons on the mRNA
14. **b.** histidine
15. **c.** anticodon
16. **d.** GTC
17. **c.** mRNA nucleotide bases.
18. **b.** 4
19. **a.** insulin
20. **b.** peptide bonds