Lesson 12 – Animal Anatomy and Physiology II
Biology 182-Pima Community College, Downtown Campus

Lesson 12 Learning Objectives
After completing this lesson, you should be able to:
Briefly describe the structure and functions of the central nervous system and the peripheral nervous system - differentiate between sensory and motor neurons and identify the different branches of the peripheral nervous system. Describe an action potential and how it moves through a cell – include the function of the sodium-potassium pump. Describe how nerve impulses travel across a synapse. In vertebrate brains, describe the functions of the cerebellum, medulla oblongata, thalamus, hypothalamus and cerebrum. Describe a reflex arc. Define receptors and effectors. Describe how ears permit gravity sensation and hearing. Compare human hearing to sonar in bats. Describe the structures of the eye that permit vision. Compare the functions of eyespots in flatworms, compound eyes in insects, and cephalopod vs. human eyes. Define hormone. List the functions of anti-diuretic hormone, thyroxine, insulin and glucagon – know where these hormones are produced and how production is regulated. Describe blood glucose regulation in humans. Know how different vertebrates maintain osmotic balance. Identify nitrogenous wastes of different vertebrates, and the advantages and disadvantages of each type. Define parthongenesis and hermaphroditism. Describe fertilization for different vertebrates. Define oviparity, ooviviparity and viviparity. Compare estrus of most mammals with monthly sexual cycles of apes and humans.

Step 1: Textbook Questions
To answer the questions below, read Chap. 43 pgs. 887-911; Chap. 44 pgs. 916-934; Chap. 45 pg. 938-955; Chap. 42 pgs. 877-882; Chap. 50 pgs. 1038-1041 and 1043-1045, and Chap. 52 pgs. 1084-1102.

(In the interest of time, we are skipping material in these units. I’d encourage you to flip through the pages in the sections that we aren’t reading—there’s some interesting information!)

43.1 Nervous system organization
1. In order for an organism to respond to stimuli, the nervous system must link sensory receptors to motor effectors. Describe sensory receptors and motor effectors.

2. Describe functions of sensory and motor neurons.

3. What organs constitute the central nervous system (CNS)? The peripheral nervous system (PNS)?

Note: All neurons are composed of branching dendrites, a cell body, and a long axon. Some axons are over 1 meter long!
4. What is the difference between gray matter and white matter?

43.2 The mechanism of nerve impulse transmission
5. Describe the resting membrane potential.

6. Describe what happens when a nerve or muscle cell is stimulated.

7. How does the sodium potassium pump work to maintain the resting potential?

8. What is an action potential? What generates an action potential?

9. How does an action potential move along a cell?

43.3 Synapses: Where neurons communicate with other cells
10. What is a synapse?

11. What are neurotransmitters? When are they released?
43.4 The central nervous system: Brain and spinal cord
12. Name the three divisions of the brain in vertebrates, structures within each division, and what type of stimuli it receives and processes.


44.1 Overview of sensory receptors
14. Describe the three classes of environmental stimuli. Give examples of each.

15. Describe the path of sensory information.

16. List the types of stimuli received by sensory receptors.
45.1 Regulation of body processes by chemical messengers
17. What is a hormone? What is its function? Where do they originate, and where do they travel?

18. Which system usually either directly or indirectly controls the production and release of hormones?

19. List the major endocrine glands in the human body.

45.3 The pituitary and hypothalamus: The body’s control centers
20. What is the function of anti-diuretic hormone (ADH)?

21. What stimulates the release of ADH? (See fig. 46.7)

22. What hormone does the thyroid gland produce? What is the function of this hormone?

23. What hormone stimulates the thyroid to produce thyroxine? Where does this hormone originate?
24. Describe the negative feedback inhibition that controls secretion of thyroid-stimulating hormone.

25. What is a goiter? What causes it?

45.4 The major peripheral endocrine glands

NOTE: Maintaining blood sugar (or blood glucose) levels is important because the brain depends upon a consistent supply of glucose.

26. What is the function of insulin? When is it secreted?

27. What is function of glucagon? When is it secreted?

28. What organ secretes insulin and glucagon?

29. Describe the negative feedback system that lowers blood sugar after a meal.
42.8 Regulating body temperature
30. What is $Q_{10}$? What is the implication of $Q_{10} \sim 2$ for enzymes and increasing temperature?

31. Describe and compare ectotherms and endotherms.

32. What gland controls thermoregulation in mammals?

50.1 Osmolarity and osmotic balance
33. What are the two most important ions in maintaining water balance?

Note: Be sure to understand the terms hypertonic, hypotonic and isotonic, and the process of osmosis. (We covered this in Bio 181. See Chapter 5 Membranes in your text for a refresher if you need it.)

34. Are most vertebrates, including humans, osmoconformers or osmoregulators? What does this mean?

35. Does water tend to move in or out of freshwater fish? How do they maintain osmotic balance?
36. Does water tend to move in or out of marine fish? How do they maintain osmotic balance?

37. How do most cartilaginous fishes maintain osmotic balance?

50.2 Nitrogenous Wastes: Ammonia, Urea, and Uric Acid
38. Metabolism of what types of molecules generates nitrogenous wastes?

39. In what chemical form is the nitrogenous waste of fishes? Mammals? Birds and reptiles?

40. Name two advantages of producing uric acid.

50.4 Evolution of the vertebrate kidney
41. How do amphibians maintain osmotic balance?

42. How do reptiles maintain osmotic balance?

43. How do mammals and birds maintain osmotic balance?
44. What’s so amazing about the kidneys of kangaroo rats, found here in the desert?

45. What animals have salt glands near their eyes to remove excess salts?

### 52.1 Animal reproductive strategies

46. Name two types of asexual reproduction by invertebrates.

47. What is parthenogenesis? Give examples of animals that are parthenogenic.

48. What is hermaphroditism? Give examples of animals that are hermaphrodites?

49. What is sequential hermaphroditism?

50. In mammals, what determines if an embryo will be male or female?
52.2 Vertebrate fertilization and development
51. Describe external fertilization.

52. Describe internal fertilization.

53. Describe oviparity, ovoviviparity and viviparity. Give examples of each.

54. Describe fertilization of bony fishes vs. cartilaginous fishes.

55. Describe fertilization of amphibians.

56. How do eggs differ between reptiles and birds? How do they differ in parental care?

57. In mammals, what is estrus?
58. How do the sexual cycles of humans and apes vary from other mammals?

59. Why are rabbits and cats so fertile?

**Step 2: Multimedia Activity**

Use the textbook publisher's website to complete the following activities. Don't worry that the numbering is different than the units in your text – these activities are from a previous version of the text.

**54.2 – ESP – Action Potential**

60. What is the sodium-potassium pump and where is it located?

61. What is the energy source for the sodium-potassium pump?

62. How does the myelin sheath affect movement of the action potential?

63. You should be able to describe in detail how the action potential occurs.
54.3 – ESP – Nervous Tissue
64. In all neurons, information flows from ________________ to ________________.

65. ________________ convey a signal from one neuron to the next.

54.4 – ESP – Nervous System Introduction
66. What is the function of nervous tissue?

67. Describe information flow through receptors, neurons and effectors in the nervous system.

68. What is a ganglion?

54.4 – ESP – Central Nervous System
69. In which region of the brain is the cerebrum located? The cerebellum?

70. As vertebrates have evolved, which area of the brain has become larger?

71. Match the lobe of the cerebrum to the function: frontal, temporal, occipital, parietal
   conscious thought and voluntary movement : ___________________________ lobe
   temperature, touch, pressure and pain from skin: ___________________________ lobe
   hearing and smelling: ___________________________ lobe
   vision: ___________________________ lobe

72. What is the function of the thalamus?
73. What is the function of the hypothalamus?

74. What is the function of the medulla oblongata?

75. Be able to locate the following structures on a diagram of a brain:
   Cerebrum, cerebellum, thalamus, hypothalamus and medulla oblongata.

54.5 – Human Nervous System
76. The brain and spinal cord make up the ____________________________.

77. The sensory and motor neurons make up the ________________________.

54.5 – Peripheral Nervous System
78. The _______________ branch of the peripheral nervous system has control over the smooth muscles of the internal organs. The ______________ branch has control over skeletal muscles that we consciously control.

79. What are the two branches of the autonomic nervous system? Which is “fight or flight”? Which is “repose and repair” (or “rest and digest”)?

55.3 – ESP - Mechanoreceptors
80. Otoliths (oto=“ear”, lith = “stone”) help us to sense gravity and tell up from down. How do they work?

81. What is the function of the three middle ear bones?
82. Describe the structure and function of the cochlea.

83. How do bending hair cells in the cochlea translate into hearing?

55.4 – ESP - Light Receptors
84. Match the list of eye structures with their functions: lens, retina, optic nerve

refracts and focuses light: ____________________________
transmits impulses to brain: ____________________________
contains receptors for light: ____________________________
_________________ respond to dim light and ________________ respond to bright light and distinguish color.

56.2 – ESP – Human System Overview
85. The pancreas secretes what two hormones?

86. Describe in detail the production of insulin as a negative feedback loop in the human body.