CHAPTER 15
THE NERVOUS SYSTEM AND HOMEOSTASIS

IMPORTANCE OF THE NERVOUS SYSTEM (pg 350-351)

1. Which 2 body systems coordinate the actions of your body?

2. Define homeostasis.

3. Describe the 2 types of messages that the body uses to respond to the changes in the internal and external environment.

4. Define hormone.

VERTEBRATE NERVOUS SYSTEMS (pg 351)

5. Name and describe the 2 main divisions of the human nervous system.

6. Name and describe the 2 divisions of the peripheral nervous system.

7. Copy figure 15.2 into your notes and memorize the major divisions of the human nervous system.

NEURONS (pg 351-353)

8. Distinguish between glial cells and neurons.

9. Name the 3 types of neurons and describe their function.

10. Name the 3 parts that make up all neurons and explain the function of each part.

11. Draw figure 15.3 into your notes and label the major parts of the neuron.

12. What is a myelin sheath and what type of cells produce it?

13. What are nodes of Ranvier?

14. Distinguish between myelinated and unmyelinated nerves.

15. List 2 factors that affect the speed with which an impulse can be transmitted by a nerve.

16. What is the function of the neurilemma?

17. Explain the difference between white matter and gray matter and identify where each is found in the human nervous system.

NEURAL CIRCUITS (pg 353-354)

18. Outline the pathway that the nervous system would use to respond when you touch a hot stove.

19. Are reflexes involuntary or voluntary?
20. Is the brain involved in reflex actions such as when you remove your hand from a hot stove?

21. What is a reflex arc?

22. Copy figure 15.5 into your notes and label the 5 components of a reflex arc.

**ELECTROCHEMICAL IMPULSE (pg 356-361)**

23. Differentiate between an ECG and a EEG.

24. List 3 differences between how electricity travels along a wire and a nerve impulse travels through a nerve.

25. What is the electrical charge on a resting membrane?

26. When a nerve becomes excited what happens to the electrical charge of the cell membrane?

27. Define action potential.

28. How long does an action potential occur for?

29. Unlike most cells, what do nerve cells have to help create an electrical current?

30. What 2 ions are responsible for the charge on a nerve?

31. In a resting neuron, where are the majority of potassium ions found and where are the majority of sodium ions located?

32. Define polarized.

33. What happens to the permeability of the neuron cell membrane when it becomes excited?

34. Define depolarization.

35. What happens to the neuron once the inside of it is positively charged?

36. How is the concentration of sodium and potassium ions restored to normal (polarized)?

37. Define repolarization.

38. How long does it take for a neuron to become repolarized and what is this period of time known as?

39. Why and how do sodium ions move into the neuron during an action potential (depolarization)?

40. Explain why the wave of depolarization moves down the neuron.

41. What follows after a wave of depolarization?

42. Define threshold level.

43. What does it mean that a nerve has an “all-or-none” response?
43. If neurons have an all-or-none response, how then does the brain differentiate between a warm object and a hot object?

THE SYNAPSE (pg 362-364)

44. What is a synapse?

45. Explain the difference between a presynaptic neuron and a postsynaptic neuron.

46. Explain how an impulse travels across the synapse from one neuron to another.

47. How do synapses affect the speed with which a nerve impulse is transmitted?

48. What role does acetylcholine play in a nerve impulse?

49. How are the effects of acetylcholine removed so that a neuron can recover and prepare for another impulse?

50. What effect do inhibitory transmitters have on the membranes of postsynaptic neurons?

51. Define hyperpolarization.

52. Define summation.

53. How do excitatory and inhibitory transmitters work together when you throw a baseball?

54. What causes Parkinson's disease and Alzheimer's disease?

HOMEOSTASIS AND THE AUTONOMIC NERVOUS SYSTEM (pg 366-367)

55. Differentiate between autonomic and somatic nerves.

56. The autonomic and somatic nerves belong to which nervous system, the CNS or PNS?

57. In times of stress or emergency what response does your autonomic nervous system coordinate?

58. How are the sympathetic and parasympathetic nervous systems of the ANS different?

59. Where do sympathetic nerves in the body originate from? .....parasympathetic nerves?

60. What is the vagus nerve and what does it control?

CENTRAL NERVOUS SYSTEM (pg 367-372)

61. What 2 things make up the central nervous system?

62. What are meninges and identify the 3 layers that make it up?

63. Where is cerebrospinal fluid found and what are its 2 main functions?
64. What is a spinal tap?

65. What 2 types of nerve messages does the spinal cord relay?

66. What is the foramen magnum?

67. Differentiate between white matter and gray matter.

68. Which type of information is carried in the dorsal nerve tract and ventral nerve tract?

69. Name the 3 regions of the human brain.

70. Where are the olfactory lobes located and what is their function?

71. Where is the cerebrum located and what are its main functions?

72. What is the outer layer of the cerebrum called?

73. Which side of the brain is associated with verbal skills, and which side is associated with visual patterns?

74. Can the 2 sides of the cerebrum communicate with each other, if so, explain how?

75. Copy table 15.2 into your notes. Know the 4 lobes of the brain and their functions.

76. Explain the functions of the thalamus and the hypothalamus of the forebrain.

77. What function does the midbrain provide?

78. Name the 3 main areas of the hindbrain.

79. What are the main functions of the cerebellum?

80. What function does the pons serve?

81. What 2 nervous systems are connected by the third region of the hindbrain: the medulla oblongata?

82. Which nervous system is coordinated by the medulla oblongata and list a few actions that the medulla may regulate?

83. Is there a relationship between the size of your brain or skull and intelligence?

84. How are strokes caused?

85. Is there a relationship between the number of nerve tracts leading to an area of the body and the functions of that area of the body?

**FRONTIERS OF TECHNOLOGY: BEAMS (pg 374-375)**

86. What is BEAM technology used for by doctors?
87. Name 2 types of natural painkillers.

88. Explain how the feeling of pain is produced.

89. How do endorphins and enkaphalins reduce the feeling of pain?

90. What are the effects of taking artificial pain killers such as heroin, cocaine, and morphine?

91. Explain why it is hard for people to quit taking artificial pain killers once they have become addicted to them?

92. What effects do depressants such as Valium and Librium have on the human nervous system?

**THE HUMAN NERVOUS SYSTEM - Fill in the following blanks (1 TO 11)**

*Your Nervous System*

- Depends on
- Has two divisions
- Neurons
- Peripheral
  - 4
- Assisted by
  - Depolarize
  - And create
- Schwann Cells
  - Action
  - Potential
  - 5
- Which
- travels
- Along
- 6
- Divided into
- Motor
- 7
- Has separate function
  - Hind Brain
  - Mid Brain
  - Fore Brain
- Synapse
  - Releases
  - 10
- 11
- 3

**NATURAL AND ARTIFICIAL PAINKILLERS (pg 375)**
THE NEURON

<table>
<thead>
<tr>
<th>TYPE OF NEURON</th>
<th>LOCATION (nervous system)</th>
<th>FUNCTION</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sensory</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Motor</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Interneuron</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Label the following neuron:

THE SYNAPTIC CLEFT

The following list represents a series of events that occurs during the transmission of a nerve impulse along a neural pathway. Arrange the events in their correct sequence by establishing a new sequence of numbers in the blanks to the left.

1. The combining of the chemical transmitter substance and the receptor molecules alter the permeability of the membrane of the next neuron to sodium ions.

2. The nerve impulse stimulates the sacs in the synaptic knobs of the axon terminals.

3. The stimulation of the postsynaptic neuron ceases.

4. The chemical transmitter substance diffuses across the synaptic cleft.

5. The chemical transmitter substance is destroyed by an enzyme such as cholinesterase if the transmitter substance is acetylcholine.

6. The nerve impulse arrives at the terminal ends of the axon fiber.

7. The chemical transmitter substance combines with the receptor molecules in the cell membrane of the dendrite or cell body of the next (postsynaptic) neuron.

8. The chemical transmitter is released from the vesicles in the synaptic knobs of the axon terminals.
1. If a neurotransmitter reached this cell, in which structure would permeability to sodium ions first change?
2. If the cell shown above carries impulses from the bottom of the foot, then the next cell in the nerve pathway would be a(n):
3. The next cell after the cell mentioned in question 2 would be located in the:
4. Which structure contains storage vesicles?
5. Which structure is enclosed by a myelin sheath?
6. Which structure includes the nodes of Ranvier?
7. In which structure is the cell’s nucleus located?
8. Which structure secretes neurotransmitters?
9. If the cell shown in the diagram carries impulses to the muscles of the hand, then that cell would be a(n):
10. Which structure contains receptor sites for neurotransmitters to bind to?

The graph below shows the transmission of an impulse along a neuron. Use the numbers to indicate where the following are occurring:
   a) the threshold is met
   b) polarization exists
   c) depolarization is occurring
   d) the refractory period
   e) repolarization is occurring
### Match the term on the left to the correct description on the right.

<table>
<thead>
<tr>
<th>Term</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. neurilemma</td>
<td>a. specialized cells that make up the nervous system, have membranes that can change their permeability</td>
</tr>
<tr>
<td>2. Schwann cells</td>
<td>b. the main mass of the cell which contains the nucleus</td>
</tr>
<tr>
<td>3. sensory neuron (afferent neuron)</td>
<td>c. a type of cell that surrounds a neuron and appears to nourish and protect the neuron</td>
</tr>
<tr>
<td>4. nodes of Ranvier</td>
<td>d. special glial cells surrounding the axon of many neurons, aids in the production of myelin</td>
</tr>
<tr>
<td>5. nerve</td>
<td>e. gaps between adjacent Schwann cells, help transmit the impulse</td>
</tr>
<tr>
<td>6. motor neuron (efferent neuron)</td>
<td>f. a delicate membrane covering myelinated nerve fibers outside the CNS, helps regenerate damaged neurons</td>
</tr>
<tr>
<td>7. interneurons (association)</td>
<td>g. transmits impulses from sensory to motor neurons or other neurons located in the brain or spinal cord</td>
</tr>
<tr>
<td>8. neurons</td>
<td>h. transmits impulses from receptors to the CNS</td>
</tr>
<tr>
<td>9. dendrite</td>
<td>i. carries impulses away from the cell body towards another neuron or tissue</td>
</tr>
<tr>
<td>10. axon</td>
<td>j. brief interval after an impulse for which the neuron cannot fire</td>
</tr>
<tr>
<td>11. myelin sheath</td>
<td>k. a branched nerve fiber, carries the impulse towards the cell body</td>
</tr>
<tr>
<td>12. threshold</td>
<td>l. a fatty material surrounding axons of some nerve cells</td>
</tr>
<tr>
<td>13. refractory period</td>
<td>m. minimum intensity of a stimulus to which a neuron will respond to</td>
</tr>
<tr>
<td>14. synapse</td>
<td>n. the difference in charge on either side of a membrane that is not firing at the moment</td>
</tr>
<tr>
<td>15. resting potential</td>
<td>o. transmits impulses to effectors</td>
</tr>
<tr>
<td>16. action potential</td>
<td>p. a bundle of hundreds to thousands of axon fibers</td>
</tr>
<tr>
<td>17. cell body</td>
<td>q. the measurable electrical changes associated with the conduction of an impulse</td>
</tr>
<tr>
<td>18. glial cells</td>
<td>r. gap between two neurons across which the nerve impulse is transmitted</td>
</tr>
<tr>
<td>19. hyperpolarization</td>
<td>s. a chemical that diffuses across the synapse and binds to receptor sites of the postsynaptic neuron</td>
</tr>
<tr>
<td>20. neurotransmitter</td>
<td>t. when the neuron has a higher negative charge than normal, caused by a loss of positive ions or a gain of negative ions</td>
</tr>
</tbody>
</table>
THE NERVOUS SYSTEM

Match the term on the left with the correct description on the right.

<table>
<thead>
<tr>
<th>Term</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. ganglia</td>
<td>a. a quick, involuntary response that does not involve the brain</td>
</tr>
<tr>
<td>2. reflex arc</td>
<td>b. nerves originating from the spinal cord</td>
</tr>
<tr>
<td>3. meninges</td>
<td>c. nerves originating from the brain</td>
</tr>
<tr>
<td>4. cranial nerves</td>
<td>d. membranous tissue coverings around the brain and spinal cord</td>
</tr>
<tr>
<td>5. spinal nerves</td>
<td>e. an aggregate of cell bodies</td>
</tr>
<tr>
<td>6. CNS</td>
<td>f. nerves that stimulate organs of the body for the fight or flight</td>
</tr>
<tr>
<td>7. PNS</td>
<td>g. neurons that connect sensory and motor neurons</td>
</tr>
<tr>
<td>8. cerebrospinal fluid</td>
<td>h. nerves that inhibit or relax the organs of the body</td>
</tr>
<tr>
<td>9. sympathetic nerves</td>
<td>i. fluid that protects the CNS from shock</td>
</tr>
<tr>
<td>10. grey matter</td>
<td>j. brain stem that controls heart rate and breathing rate</td>
</tr>
<tr>
<td>11. white matter</td>
<td>k. controls blood temperature, thirst, and hunger</td>
</tr>
<tr>
<td>12. parasympathetic</td>
<td>l. large part of the human brain that controls thought nerves</td>
</tr>
<tr>
<td>13. autonomic NS</td>
<td>m. relays and sorts sensory and motor information in the brain</td>
</tr>
<tr>
<td>14. association</td>
<td>n. part of the brain responsible for coordination of motor activity</td>
</tr>
<tr>
<td>15. medulla oblongata</td>
<td>o. neurons that have no myelin sheath</td>
</tr>
<tr>
<td>16. cerebellum</td>
<td>p. neurons that have a myelin sheath</td>
</tr>
<tr>
<td>17. cerebrum</td>
<td>q. consists of sensory and motor neurons outside of the CNS</td>
</tr>
<tr>
<td>18. hypothalamus</td>
<td>r. consists of the brain and the spinal cord</td>
</tr>
<tr>
<td>19. thalamus</td>
<td>s. special nerves that control automatic functions of the body</td>
</tr>
<tr>
<td>20. corpus callosum</td>
<td>t. connects the right and left hemispheres of the brain</td>
</tr>
</tbody>
</table>

Describe the part of the brain mainly involved in each of the following situations:

21. You studying for an upcoming biology exam.
22. You are rushing to class because you are late and almost fall on an icy patch of pavement, but manage to keep your balance.
23. You feel angry and embarrassed when you rip your pants.
24. A stroke leaves a person unable to speak, what part of the brain has probably been affected?
25. After a brain operation to remove a tumor, a person is no longer able to distinguish between sweet and sour tastes. What part of the brain has been affected?
26. Multiple sclerosis is a disease that causes the destruction of myelin. What symptoms would you expect this to produce? Explain why.
27. DDT, a poisonous biocide, affects organisms by preventing the action of the sodium pump within the neuron. How would this prevent impulse transmission?
28. Explain why there is uni-directional or only one way transmissions in neuron pathways.
29. List two ways that the brain uses to distinguish between a big "owie" and a little "owie".
30. There are two main groups of drugs: depressants and stimulants. Briefly describe how each group generally affects the nervous system.

31. The drug chlorpromazine (a tranquilizer) binds to acetylcholine receptors and norepinephrine receptors on postsynaptic dendrites. What effects does this have on the nervous system?

32. Nicotine mimics the effect of acetylcholine. How does nicotine affect the nervous system?

33. List 2 factors that which control the conduction velocities of a neuron.

34. How does a reflex arc differ from other types of neural circuits?

35. Describe the relative concentration of Na+ ions outside the neuron membrane at these given times:
   a) polarization
   b) depolarization
   c) repolarization

36. A neuron with a threshold level of 0.05 V is given 5 different stimuli: 0.03 V, 0.04 V, 0.07 V, 0.09 V, and 0.11 V.

37. Draw a graph showing the strength of the impulses sent out by the various stimuli, be sure to label both axis of the graph.

<table>
<thead>
<tr>
<th>Parts Of The Brain</th>
<th>Description</th>
<th>Major Function</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cerebrum</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Frontal Lobe</td>
<td></td>
<td></td>
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<tr>
<td>Parietal Lobe</td>
<td></td>
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<tr>
<td>Temporal Lobe</td>
<td></td>
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<tr>
<td>Occipital Lobe</td>
<td></td>
<td></td>
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<tr>
<td>Thalmus</td>
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<td>---------</td>
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<tr>
<td>Hypothalamus</td>
<td></td>
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<tr>
<td>Midbrain</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Pons</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Medulla Oblongata</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Cerebellum</td>
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</tbody>
</table>

Label the areas of the brain on the diagram below
Nervous System Crossword

Across
1 A division of the autonomic nervous system
2 Membranes of the brain
3 Projections of cytoplasm coming from nerve cells
4 The action potential
5 A delicate membrane that surrounds nerve cells
6 Extensions of cytoplasm that conducts nerve impulses
9 A nerve cell
10 _____ neurons gather information from outside the body
12 The effects caused by accumulation of transmitter chemicals
13 Restoring the membrane to resting potential
14 Transmitter chemical
15 Chemicals believed to reduce pain

Down
2 Membranes of the brain
3 Projections of cytoplasm coming from nerve cells
4 The action potential
6 Extensions of cytoplasm that conducts nerve impulses
7 Destroys transmitter chemicals
8 Division of the nervous system that carries impulses to glands
11 Minimum level of a stimulus needed to get a response
12 Space between neurons
1. What would be the name for the broken neuron indicated in diagram F?

2. How would severing the neuron as illustrated in diagram F affect the body's ability to complete a reflex?

3. How would severing the neuron as illustrated in diagram G affect the body's ability to complete a reflex?

4. Identify the type of neuron illustrated as broken in diagram J, describe how the reflex would be affected by such a break.

5. Which neuron acts as an inhibitor? Describe how this neuron inhibits the neuron indicated by the letter Q using the information provided by the graph.
6. What event is responsible for that phase of the action potential indicated by letter A?

7. What event is responsible for that phase of the action potential indicated by letter B?

8. What would be the length of the refractory period based on the action potential?

9. How would the application of a stimulus which significantly exceeded the threshold value for this neuron affect the height of the wave?

10. Evaluate the following statement based on the data provided..."if the stimulus strength exceeds the resting potential, an action potential will be produced."

11. Depolarizing of the axon membrane increases the permeability to potassium, it diffuses out of the cell helping to re-establish the resting potential. What is the value of that resting potential?

12. What is the value of the action potential?

13. Would all neurons within the human body have the same value for their action potential?

14. If the letter M indicates a nerve that causes the heart beat to decrease, then what division of the nervous system would be responsible for opposing that action?

15. From which of the 4 regions would the nerve originate that opposes the action caused by nerve impulses travelling along the nerve indicated by the letter M?

16. What would be the neurotransmitter released at the heart by the axons making up the nerve indicated by the letter M?
17. The neural pathways W, X, and Y are stimulated simultaneously above their respective threshold levels. From which pathway will organ Z first receive an impulse?

18. Why would it be the pathway you selected?

19. How many synapses occur within pathway II?

20. If the two neurons occurred along a sympathetic neural pathway, where would the cell body for neuron 2 be located?

21. Explain why the transmission would be from R to S and not S to R.

22. How would the presence of an insecticide which destroys the enzyme cholinesterase at location S affect the response of a muscle normally stimulated by the neuron indicated by the letter T?

23. The bacteria *Clostridium botulinum* causes food poisoning because it inhibits the release of acetylcholine at location R. How would this affect motor activity if T were responsible for stimulating skeletal muscles?

24. According to the information, what effect does activating Axon 2 have on Axon 1?

25. If the synaptic know of Axon 2 released a neurotransmitter which increased the permeability of Axon 3 to chloride ions which are higher concentration in the ECF, what will this have on Axon 1's ability to generate an impulse in Axon 3?

26. How would the activity of Axon 1 have to change in order to overcome the effect of the neurotransmitter released from Axon 2 to Axon 3?
27. An experimenter stimulated each of the neurons with an electrical current. What would be the minimum stimulus strength which would create an impulse in neurons 1, 2, and 3 but not 4?

28. An axon collateral of the inhibitory axon (I) synapses on the excitatory axon terminal (E). An action potential in the inhibitory axon hyperpolarizes the excitatory axon terminal. What effect will hyperpolarizing of the excitatory axon terminal have on the release of neurotransmitter in response to an action potential in the excitatory neuron?

29. How does the presence of a myelin sheath affect the speed of impulse conduction for axons with a diameter of 4 micrometers?

30. To which of the two types of axons does increasing the diameter of the axon have the greatest affect on the rate of impulse conduction?

31. Drug introduced into the synapse bonded only to the structures labeled X of the motor neuron. What would be the expected effect on the muscle?
32. If the neuron were stimulated at location 2, in which direction would the impulse travel?

33. Which of the three numbers most closely identifies the location of synaptic vesicles.

34. Destruction of the myelin sheath prohibits the normal conduction of impulses resulting in a loss of functions. What loss of function would occur if the myelin sheaths of the neurons making up the vestibulocochlear cranial nerve were destroyed?

35. What effect might a severe blow to that region of the brain indicated by the letter Y have on the heart and respiratory organs if the autonomic centres for these organs were damaged?
CHAPTER 16
SPECIAL SENSES

IMPORTANT OF SENSORY INFORMATION (pg 380-381)
1. How does the central nervous system receive information about the external and internal environment?
2. How do you differentiate between visual and auditory information if the neurons that carry these impulses are basically identical?

WHAT ARE SENSORY RECEPTORS (pg 281-382)
3. What are sensory receptors?
4. What is the advantage of grouping sensory receptors and connective tissues into specialized sensory organs?
5. Do sensory receptors feel the sensations or do they simply feel the stimulus?
6. Is it possible to feel a sensation, such as heat, even though there is no actual stimulus triggering the sensory receptors?
7. What is sensory adaptation?

TASTE AND SMELL (pg 383-384)
8. Where do insects have their taste receptors?
9. List the 4 tasks that can be sensed by the sensory receptors located in the tastebuds of the tongue.
10. What are olfactory cells and where are they located?
11. Why does a cold effect your sense of taste?

STRUCTURE OF THE EYE (pg 384-386)
13. Name the 3 layers found within the human eye.
14. What is the function of the sclera?
15. Where is the cornea found and what function does it serve?
16. How does the cornea receive the oxygen that it requires?
17. How are nutrients supplied to the cornea if it does not have a supply of blood vessels?
18. What is the middle layer of the eye called?
19. What is the function of the choroid layer?

20. Where is the iris found and what is the function of the iris?

21. What is the function of the lens?

22. How can the shape of the lens be altered?

23. What is the vitreous humor and why is it important to the eye?

24. Name the innermost layer of the eye.

25. Explain the difference between the 2 types of light sensitive cells: rods and cones.

26. Outline the pathway of the nerve message as it leaves the rods and cones on its way to the CNS.

27. What is the fovea centralis?

28. What causes your eye to have a blind spot?

**LIGHT AND VISION (pg 388-389)**

29. In what 3 ways are a camera and the human eye similar?

30. How did Wilhelm Kuhne prove that humans, like rabbits, have the images that they look at fixed on the surface of their retina?

31. Describe the 2 types of afterimages.

**FOCUSSING THE IMAGE (pg 389-390)**

32. What happens to light as it first enters the eye?

33. Which structure bends the light waves even more in addition to the original bending created by the cornea?

34. How does the eye increase the thickness of the lens so that it can focus on objects that are close to the eye?

35. What adjustments does the eye make in order to view objects that are far away?

36. Define accommodation.

37. Explain why the ability of the eye to accommodate to near and far objects decreases as you get older.

38. What secondary adjustments does your eye make to view objects that are far away? ……objects that are nearby?
CHEMISTRY OF VISION (pg 390-391)

39. Approximately how many rods are on the surface of your retina?

40. Name the light-sensitive pigment located in rods.

41. What 2 substances make up a molecule of rhodopsin?

42. Explain the steps involved from when a photon of light hits a molecule of rhodopsin to the formation of a message to the brain.

43. When are the rods most effective?

44. How are the pigments in the cones different that those in the rods?

45. Explain how the color white is seen or created by the cones of the retina.

46. How is color blindness created?

47. Name the most common type of color blindness and identify who it effects the most.

VISION DEFECTS (pg 392-393)

48. What causes glaucoma?

49. What is a cataract?

50. Identify possible treatments for a person with cataracts.

51. Define astigmatism.

52. Explain how nearsightedness is created (myopia).

53. How is the vision of a person who has nearsightedness altered?

54. How can nearsightedness be corrected?

55. Explain how farsightedness is created (hyperopia).

56. How is the vision of a person who has farsightedness altered?

57. How can farsightedness be corrected?

FRONTIERS OF TECHNOLOGY: RADIAL KERATOMY (pg 393)

58. Explain how Dr. Fydorov treats patients who suffer from myopia (nearsightedness).

STRUCTURE OF THE EAR (pg 395-396)

59. What are the 2 functions of the ear?
60. Where are the sensory cells and their tiny cilia hairs located in the ear?

61. Name and provide the functions of the 2 main parts of the outer ear.

62. What is the function of earwax?

63. What is another name for the eardrum?

64. Define ossicles.

65. Name the 3 ossicles of the inner ear and indicate the order in which sound vibrations would move through them.

66. Where do the vibrations of the stapes end up?

67. Explain how the sound is amplified as it travels from the tympanic membrane to the oval window.

68. What is the function of the eustachian tube?

69. Why do your ears pop when you fly in an airplane?

70. Name the 3 distinct areas of the inner ear.

71. Name the 2 parts that make up the vestibule and explain their function.

72. Describe the function of the 3 semicircular canals.

73. What does the cochlea contain to help it identify and respond to sound waves?

**HEARING AND SOUND (pg 397-398)**

74. What must happen to sound energy before you can interpret it?

75. Why couldn't Robert Boyle hear the alarm of the watch he suspended in a bell jar?

76. Compare how sound travels through solids, liquids, and gases.

77. How does your middle ear protect the inner ear from excessive noise?

78. What happens when the ossicles transfer the sound vibrations to the oval window?

79. What is the organ of Corti?

80. What are the rows of specialized hair cells anchored to in the organ of Corti?

81. Explain how the ear distinguishes between high-frequency and low-frequency sound waves.

**EQUILIBRIUM (pg 398-399)**

82. Name the 2 components of balance.
83. Explain how otoliths located in the sacule and utricle monitor static equilibrium, or head position.

84. Differentiate between static equilibrium and dynamic equilibrium.

85. Which part of the ear is responsible for maintaining dynamic equilibrium?

86. What is believed to cause motion sickness?

Fill in the blanks spaces below

1. What is the function of tears?

2. What is the conjunctivitis?

3. Why is it necessary to have more than one type of cone cell receptor?

4. List the 4 parts of the eye that bend and refract the light as the light passes through the eyeball:

5. How are the pupil and the iris related?

6. Identify 3 situations in which the pupil dilates (opens).

7. Why does the pupil appear black in color?

8. When you shine a light in someone's eye the pupil constricts or decreases in size. Why does the iris decrease the size of the pupil in the presence of bright light (known as the light reflex)?

9. What is night blindness?

10. When you first walk into a dark room your vision is very poor but it gradually improves as you stay in the dark. Why does it take a while for your eyes to adjust to the darkness?

11. Why do your eyes hurt at first when you walk out of a dark movie theatre on a bright and sunny day?
12. People who suffer from astigmatism have a cornea or lens that is irregular in shape. What might the image appear as for a person who is suffering from astigmatism?

13. Compare and contrast near sightedness (myopia) and far sightedness (hypermetropia), being sure to discuss their cause and how they can be corrected.

**Answer the following questions as being either true or false.**

1. As the amount of light entering the eye decreases, the iris closes to increase the light entering the eye.
2. The eyeball consists of 3 layers: sclera, choroid, and retina.
3. Rods but not cones found on the retina contain light-sensitive pigments.
4. To achieve proper focus, light is refracted by the cornea and pupil.
5. People who have near sightedness have trouble focusing on near objects.

**Match the correct term on the left with the description on the right.**

<table>
<thead>
<tr>
<th>Term</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>retina</td>
<td>a. the pigment found in rod cells</td>
</tr>
<tr>
<td>cornea</td>
<td>b. a photoreceptor that is sensitive to black and white</td>
</tr>
<tr>
<td>choroid layer</td>
<td>c. a photoreceptor that is sensitive to color</td>
</tr>
<tr>
<td>optic nerve</td>
<td>d. an area on the retina that has no photoreceptors</td>
</tr>
<tr>
<td>optic chiasma</td>
<td>e. transparent membrane that covers the eyelids and eyeball</td>
</tr>
<tr>
<td>sclera</td>
<td>f. opening in the center of the eye</td>
</tr>
<tr>
<td>pupil</td>
<td>g. makes binocular vision possible</td>
</tr>
<tr>
<td>conjunctivia</td>
<td>h. tough protective outer-layer of the eye</td>
</tr>
<tr>
<td>ciliary muscle</td>
<td>i. the tissue that transmits impulses from the eye to the brain</td>
</tr>
<tr>
<td>iris</td>
<td>j. the name of the material found in the front cavity of the eye</td>
</tr>
<tr>
<td>blind spot</td>
<td>k. a layer of the eye with a rich blood supply and dark pigmentation</td>
</tr>
<tr>
<td>cone</td>
<td>l. the name of the material found in the back cavity of the eye</td>
</tr>
<tr>
<td>fovea centralis</td>
<td>m. a structure that can control the shape of the lens</td>
</tr>
<tr>
<td>lens</td>
<td>n. transparent biconvex structure that focuses light on the retina</td>
</tr>
<tr>
<td>bipolar cells</td>
<td>o. a light-sensitive layer in the back of the eye, contains photoreceptors</td>
</tr>
<tr>
<td>rhodopsin</td>
<td>p. a light-sensitive muscle that controls the size of the pupil</td>
</tr>
<tr>
<td>aqueous humor</td>
<td>q. a light-sensitive area of the retina with a high concentration of cones</td>
</tr>
<tr>
<td>vitreous humor</td>
<td>r. cells which release chemicals that cause the nerve impulse</td>
</tr>
</tbody>
</table>
19. What structures are indicated by the letter A?

20. What structure is indicated by the letter B?

21. Explain how the structure labeled B creates binocular vision or depth.

22. What part of the brain is indicated by the letter C?

Fill in the blanks spaces below
THE EAR

Match the term on the right with the correct description on the left.

1. Sound waves hit this membrane first in the middle ear               a. pinna
2. Snail-shaped structure in the inner ear                              b. cochlea
3. Responsible for dynamic equilibrium                                 c. eustachian tube
4. Fluid found in the inner ear.                                      d. auditory canal
5. Permits changes in pressure to take place in the middle ear.        e. semicircular canals
6. Small bones found in the ear.                                      f. endolymph
7. Tube leading to the ear drum.                                       g. oval window
8. The stirrup rests against this membrane.                            h. round window
9. Membrane that separates the middle and inner ears.                 i. organ of Corti
10. Small calcium particles that help to determine the body's          j. otoliths
     position.                                                          k. ossicles
11. Part of the outer ear that collects the sound waves.               l. tympanic membrane
12. Converts vibrations to nerve impulses in the inner ear.

1. What are the functions of the bones of the middle ear?
2. What effect does prolonged loud music or noise have on the ear?
3. What is the name of the nerve that transmits information from the organ of Corti to the brain?
4. What part of the brain receives the impulse from the ear?
5. Name the two structures that are responsible for detecting body position and motion, respectively and describe how they work.
6. Explain how the sound of a ringing bell is converted into an electrical impulse that ends up in the brain. Be sure to identify all of the structures of the ear that are involved.

Answer the following questions as being either true or false.

1. Sound waves are transmitted from the outer ear, to the middle ear, and then the inner ear.
2. The inner ear contains three tiny bones known as ossicles.
3. Vibrations travel from the middle ear to the utricle and finally to the cochlea.
4. Our sense of balance is controlled by the cochlea which contains hair cells which are stimulated by movement of the body or change in position of the body.
5. Rotary direction in any direction is detected by the semi-circular canals.
1. What principle of nerve impulse conduction is best illustrated by the information provided?

2. Describe the function of the chemoreceptor cell as illustrated.

3. Which letter indicates the structure that houses the organ of corti?

4. Which letter indicates an ossicle which participates in relaying vibrations of the tympanic membrane to fluid in the inner ear?

5. Which letter indicates the structure responsible for motion sickness as a result of unusual stimulation of its receptors?

6. Which letter indicates the sensory nerve responsible for transmitting impulses from motion receptors?
7. Swallowing and yawning allow atmospheric pressure change to be equalized between what two parts?

8. Which letter indicates the structure responsible for controlling the amount of light entering the eye?

9. How would light falling only on the region labeled V affect vision in that eye?


11. Which situation would most likely happen when a person moved into a room with brighter light. Explain how this change occurs.

12. Which situation would most likely happen when a person moved into a darker room. Explain.

12. Describe the changes that occur in each of the parts of the eye as listed below and illustrated in the figure when the eye changes focus from a distant object to a near object
   a) pupil
   b) ciliary muscle
   c) suspensory ligament
   d) lens
13. Explain the perception for each position as illustrated and described.

<table>
<thead>
<tr>
<th>Position</th>
<th>Perception</th>
</tr>
</thead>
<tbody>
<tr>
<td>I</td>
<td>No object is seen</td>
</tr>
<tr>
<td>II</td>
<td>The object is seen and appears blue</td>
</tr>
<tr>
<td>III</td>
<td>The object is seen and appears grey</td>
</tr>
</tbody>
</table>

Figure II-RR

14. What is the most likely cause of near point accommodation with increasing age as illustrated in the chart below.

<table>
<thead>
<tr>
<th>Age in Years</th>
<th>Near Point Accommodation (cm)</th>
</tr>
</thead>
<tbody>
<tr>
<td>10</td>
<td>7.5</td>
</tr>
<tr>
<td>20</td>
<td>10.0</td>
</tr>
<tr>
<td>30</td>
<td>11.5</td>
</tr>
<tr>
<td>40</td>
<td>17.2</td>
</tr>
<tr>
<td>50</td>
<td>65.9</td>
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<tr>
<td>60</td>
<td>90.0</td>
</tr>
</tbody>
</table>
### Special Senses Crossword

**Across**

1. The hole in the iris  
2. Occurs when the image is focused in front of the retina  
3. A chamber at the base of the semicircular canal  
4. Chamber that identifies sound waves  
5. Fluid filled canals that provide balance  
6. Used to view dim light  
7. Responsible for equilibrium along with utricle  
8. Protects and supports the delicate photo-cells of the eye  
9. Part of the outer layer of the eye  
10. Tiny bones of ear that amplify sound  
12. Contains pigments that prevent scattering of light in the eye  
13. Regulates amount of light entering the eye  
14. Occurs when lens or cornea becomes clouded  
15. Contains photocells of the eye  
16. Most sensitive area of the retina; contains cones  
18. Abnormal curvature of the lens of the eye causes this condition  
19. Next to the saccule

**Down**

1. The hole in the iris  
2. Occurs when the image is focused in front of the retina  
3. A chamber at the base of the semicircular canal  
4. Chamber that identifies sound waves  
6. Used to view dim light  
9. Part of the outer layer of the eye  
11. Pigment in rods  
12. Used to identify color  
13. Regulates amount of light entering the eye  
14. Occurs when lens or cornea becomes clouded  
17. Tiny stones of the ear
CHAPTER 14
THE ENDOCRINE SYSTEM AND HOMEOSTASIS

IMPORTANCE OF THE ENDOCRINE SYSTEM (pg 332)

1. Define hormone.

2. What are endocrine hormones?

3. Differentiate between non-target hormones and target hormones.

4. Define target tissue.

CHEMICAL CONTROL SYSTEMS (pg 333-334)

5. What 2 organ systems help the cells, tissues, and organs of the body communicate with each other?

6. Which organ system is responsible for adjustments to quick environmental changes?.... which is responsible for long term changes?

7. Which part of the brain controls the endocrine system?

8. Which gland of the endocrine system is referred to as the master gland?

9. Why does the meat of castrated bulls and of steers taste better than that of non-castrated bulls?

10. Which hormone did Joseph von Merring and Oscar Minkowski determine was produced in the pancreas?

11. What recent technological development allows scientists to track hormones from the gland they are produced in to the target tissue they bind with?

CHEMICAL SIGNALS (pg 334-335)

12. Do hormones affect all cells, or are all cells affected by all hormones?

13. Compare and contrast the 2 main categories of hormones: steroid hormones and protein hormones.

14. Where do steroid hormones bind with their target cells?

15. What happens once the steroid hormone enters the nucleus of the cell?

16. Where on the cell do protein hormones combine with their receptors?

17. How does cyclic AMP effect cells?

NEGATIVE FEEDBACK (pg 335-336)

18. Why must hormone production be regulated?

19. Explain how the production of testosterone is controlled by luteinizing hormone (LH).
20. Define negative feedback.

21. Explain how gigantism is caused in humans.

22. What effect does epinephrine have on the body?

**THE PITUITARY: THE MASTER GLAND (pg 336-337)**

23. Why is the pituitary gland often referred to as the "master gland"?

24. Which part of the brain does the pituitary gland work closely with?

25. Name the 2 lobes of the pituitary gland.

26. Name 2 hormones released by the posterior lobe of the pituitary and identify where these hormones are produced.

27. Where are the hormones found in the anterior lobe of the pituitary gland produced?

28. How is the hypothalamus involved in the release of hormones from the anterior lobe of the pituitary?

29. Do all of the hormones released from the hypothalamus cause the pituitary gland to release its hormones?

30. Know table 14.1 on page 337. If necessary, copy it into your notes.

**GROWTH HORMONE (pg 338)**

31. What is another name for growth hormone?

32. What happens when too little growth hormone is produced? ....too much?

33. Which type of cells are most effected by growth hormone?

34. What is acromegaly?

**ADRENAL GLANDS (pg 338-339)**

35. Where are the adrenal glands located?

36. Name the 2 parts of the adrenal gland and state how they are controlled.

37. Name 2 hormones produced by the adrenal medulla.

38. Which type of nerves stimulate the adrenal gland?

39. List 4 effects that epinephrine and norepinephrine (released by the adrenal medulla), have on the body.

40. Name the 3 types of hormones released by the adrenal cortex.
41. What is the main function of the glucocorticoids?
42. What effect does cortisol have on the body?
43. Understand the negative feedback system outlined in figure 4.10 on page 339. Draw it into your notes if necessary.
44. What effect does aldosterone have on the body?

**INSULIN AND THE REGULATION OF BLOOD SUGAR (pg 340)**
45. What types of cells are found in the pancreas?
46. Which type of cells in the pancreas produce hormones?
47. Name the 2 types of hormones released by the pancreas.
48. Under what conditions is insulin released by the pancreas?
49. What effect does insulin have on the cells of the body?
50. What does the liver do with excess glucose?
51. What effect does glucagon have on the body?
52. Under what conditions is glucagon released by the pancreas?

**SUGAR DIABETES (pg 341)**
53. What is the cause of diabetes mellitus?
54. What is hyperglycemia?
55. Name 2 symptoms of people suffering from diabetes mellitus.
56. Why are diabetics often tired due to a lack of energy?
57. Why is it dangerous when the body switches to fats and proteins as an alternate energy source?
58. What is the difference between juvenile diabetes and adult diabetes?

**FRONTIERS OF TECHNOLOGY: ISLET TRANSPLANTS (pg 344)**
59. What are some of the side effects caused by juvenile diabetes?
60. Why is it not easy to transplant islet of Langerhans cells from a healthy donor to the pancreas of a diabetic?

**THYROID GLAND (pg 344-345)**
61. Where is the thyroid gland located?
62. What effect does thyroxine have on the body?

63. How do high levels of thyroxine effect the body?

64. How do low levels of thyroxine effect the body?

65. Explain in detail the steps of the negative feedback loop that controls the production of thyroxine. Begin with a drop in the metabolic rate.

**THYROID DISORDERS (pg 345)**

66. What is the cause of goiter?

67. Explain why the thyroid enlarges when there is a shortage of iodine.

**PROSTAGLANDINS (pg 346)**

68. What are prostaglandins?

69. Do most prostaglandins travel in the bloodstream throughout the body?

70. Name 2 effects that prostaglandins have on the body during times of stress.
Endocrine and Homeostasis Crossword

Across
1 Chemical messenger that affects cells in another part of the body
2 Hormones carried by the blood
3 Area of the brain
4 A hormone that helps regulate metabolism
5 A hormone that stimulates the conversion of amino acids to glucose
6 This type of hormone is composed of amino acids
8 An enlargement of the thyroid gland
9 A hormone produced by the beta cells in the pancreas
11 The master gland
12 A disease characterized by hyperglycemia
14 A gland found anterior to the kidney
16 A hormone that regulates water balance in the kidneys
17 Hormones that have a pronounced effect in a localized area

Down
2 Hormones carried by the blood
3 Area of the brain
4 A hormone that helps regulate metabolism
5 A hormone that stimulates the conversion of amino acids to glucose
7 A regulatory mechanism that controls hormone levels
10 A hormone group made from cholesterol
13 A hormone that converts glycogen to glucose
15 Substance needed by the thyroid gland
### HORMONES OF THE POSTERIOR PITUITARY GLAND

<table>
<thead>
<tr>
<th>HORMONE</th>
<th>ABBR</th>
<th>SOURCE</th>
<th>TARGET(S)</th>
<th>PHYSIOLOGICAL EFFECTS</th>
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<tbody>
<tr>
<td>Antidiuretic hormone</td>
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<tr>
<td>Oxytocin</td>
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</table>

### HORMONES OF THE ANTERIOR PITUITARY GLAND

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<th>HORMONE</th>
<th>ABBR</th>
<th>SOURCE</th>
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<tr>
<td>Thyroid stimulating hormone</td>
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<tr>
<td>Adrenocorticotropic hormone</td>
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<tr>
<td>Prolactin</td>
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<td>Leutinizing hormone</td>
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<tr>
<td>Interstitial cell stimulating hormone</td>
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**HORMONES OF THE THYROID GLAND**

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<th>ABBR</th>
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**HORMONES OF THE ADRENAL GLAND**

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<tbody>
<tr>
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<td>Aldosterone</td>
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<tr>
<td>Epinephrine (adrenalin)</td>
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<tr>
<td>Norepinephrine (noradrenalin)</td>
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### HORMONES OF THE PANCREAS

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<td>Glucagon</td>
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### HORMONES OF THE GONADS

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### OTHER HORMONES OF THE BODY

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<td>Pancreozymin</td>
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HORMONES OF THE HYPOTHALAMUS

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<th>MECHANISM CONTROLLING SECRETION</th>
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<td>Gonadotropin releasing hormone</td>
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<tr>
<td>Leutinizing hormone releasing factor</td>
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ENDOCRINE SYSTEM WORKSHEET

Match the hormones on the left to the correct function on the right.

1. insulin     a. stimulates the thyroid gland
2. oxytocin     b. decreases blood calcium levels
3. estrogen     c. causes lactation of the breasts
4. glucagon     d. stimulates the ovaries and the testes
5. thyroxin     e. regulates the metabolism of the body
6. prolactin    f. maintains the uterine lining after ovulation
7. aldosterone  g. increases the recovery of salt by the kidneys
8. adrenalin    h. increases heart rate and blood pressure and sugar levels
9. calcitonin   i. causes uterus to contract for birth and breasts to lactate
10. testosterone j. stimulates the adrenal cortex of the adrenal glands
11. progesterone k. speeds up the removal of sugar from the blood stream
12. growth hormone l. causes the increased release of glucose into the blood
13. luteinizing hormone m. stimulates the follicle cell to release hormones
14. follicle stimulating hormone n. stimulates the growth of female sex organs
15. thyroid stimulating hormone o. stimulates the growth of male sex organs
16. adrenocorticotropic hormone p. stimulates the kidneys to control the amount of water retained
17. antidiuretic hormone q. increases fatty-acid metabolism and amino acids uptake by body cells
Match the hormones on the left to the TARGET organs on the right.

1. insulin a. testes
2. oxytocin b. breasts
3. estrogen c. uterus
4. glucagon d. all general body cells
5. thyroxin e. thyroid gland
6. prolactin f. ovaries
7. aldosterone g. adrenal gland
8. adrenalin h. heart and nervous system
9. calcitonin i. liver
10. testosterone j. kidneys
11. progesterone k. bones
12. growth hormone
13. luteinizing hormone
14. interstitial stimulating hormone
15. follicle stimulating hormone
16. thyroid stimulating hormone
17. adrenocorticotropic hormone
18. antidiuretic hormone

Match the glands on the left to the correct description on the right.

1. pituitary gland a. slightly below the larynx
2. adrenal gland b. on top of the kidneys
3. thyroid gland c. in the pelvic cavity
4. pancreas d. outside the pelvic cavity
5. testes e. attached to the base of the brain
6. ovaries f. below the stomach near the liver

Use the following information to answer the questions that follow.

A man went to his doctor complaining of having extreme thirst, of passing large volumes of urine, as well as having a general feeling of being tired most of the time. A glucose tolerance test indicated that he had abnormally high levels of glucose in his urine.

1. What disorder is the man most likely suffering from?
2. How would the glucose in the urine explain the tiredness felt by the man?
3. How would glucose in the urine cause the thirst and the production of large volumes of urine?
4. If the patient's urine was tested with Benedict's solution, predict the results.
5. Explain the following statement: Blood sugar "spills over" into the urine if there is an insulin deficiency in the blood.
6. Explain the following statement: The amount of sugar falls rapidly when there is an excess of insulin in the blood.
7. What is the difference between glucagon and glycogen?
8. Explain the following statement: It is wise for a diabetic to have some candy on hand when he gives himself an insulin injection.

9. Explain the difference between diabetes mellitus and diabetes insipidus.

10. Describe in some detail the mechanism by which aldosterone helps maintain blood pressure. Begin your explanation as a response to low blood pressure.

11. Describe in some detail how an increase in thyroxin levels would effect blood glucose levels.

12. You should be able to describe and illustrate negative feedback systems which involve the hypothalamus-pituitary complex and one other endocrine gland of the body. For the hormones listed below, draw the negative feedback loops that help maintain homeostasis.

A. insulin

B. glucagon

C. aldosterone

D. ADH

E. thyroxin

F. adrenalin

G. gastrin

H. TSH

I. PTH

J. ACTH
BIOLOGY 30
ENDOCRINE DISORDER PRESENTATIONS

Through library research and internet research, each group will be asked to inform their peers of a particular endocrine disorder. The oral presentation will require the following information:

1. A one page written summary
   - the hilites of your disorder (this should not be what is read during your oral presentation)
   - each group should have enough copies of this summary for all students in the class (31 copies including the presenting group and teacher)

2. A written report (1-2 pages) that covers most or all of the following topics (not all topics will be applicable for all reports)
   - name of the disorder
   - the gland(s) and hormone(s) involved
   - the cause of the disorder
   - the signs and symptoms of the disorder
   - impact- how many people are said to be inflicted with this disorder
   - treatment
   - prognosis (what will happen if you have this disorder)
   - cite references (books, magazines, internet sites etc….)

3. The oral report should be organized to include:
   - the above report topics
   - 2 audiovisual resources (overheads, collage, posters, diagrams, video etc..)

Be sure that your report is informative and entertaining. It should be 4 to 5 minutes in length.

MARKING SCHEME:

A. **Group Assessment**: all students will evaluate the oral presentations (out of 25 marks) based on content, use of audiovisual material, presentation style, language of the presenter (is the material understandable or simple medical language that no one understands), and overall impression.

B. **Teacher Assessment**: you will be given a mark out of 25 based on the written project that is submitted. This mark will also contain a component based on the oral presentation.

C. **Quiz**: the summary sheets will be used to construct a quiz that will be written once all of the groups have presented. If you wish, you may also include a list of quiz questions when you hand in your written report!
DISORDERS OF THE ENDOCRINE SYSTEM

For each of the following disorders:
   i) name the gland and or hormones involved
   ii) identify the cause of the disorder
   iii) list the symptoms or side-effects of the disorder

1. DIABETES MELLITUS:

2. DIABETES INSIPIDUS:

3. HYPERTHYROIDISM (GRAVE'S DISEASE):

4. HYPOTHYROIDISM (GOITER):

5. DWARFISM:

6. GIGANTISM:

7. CRETINISM (children):

8. MYXODEMA (adults):

8. SADS (SEASONAL AFFECTIVE DISORDER):

9. ACROMEGALY:
1. What is the threshold level for plasma glucose which will trigger insulin secretion?

2. What specific group of cells are responsible for secreting the insulin into the blood plasma?

3. How long does it take for the insulin-secreting cells to maximally respond to a sudden rise in plasma glucose concentration?

4. What effect does a rise in plasma insulin have on plasma glucose levels?

5. What are some of the changes that happen to glucose which are responsible for lowering the plasma level?

6. What effect does prolonged exercise have on the secretion of glucagon?

7. Of what value is this change in glucagon secretion during prolonged exercise?

8. Approximately how long after eating is initiated does it take for plasma insulin to peak?

9. What change in the graph for plasma insulin concentration would you expect if the subject being tested were to skip eating lunch?
What letter indicates the gland that functions in the largest number of negative feedback loops?

10. Which hormone from the gland indicated by the letter R causes an increase in the breakdown of fat stored in adipose tissue?

11. Which 2 hormones from which 2 glands (indicated by letter) are responsible for triggering the formation of glucose from fats and proteins by the liver during such times as fasting?

12. Indicate by letter which gland cannot function properly when insufficient levels of iodine are carried in the blood, and explain why this is true.

13. Indicate by letters which 2 glands produce hormones responsible for proper growth and development.

14. Indicate by letter the gland which will secrete a hormone in response to high levels of calcium.

15. What affect does nursing appear to have on the secretion of oxytocin?

16. Why is this change in the plasma levels of oxytocin important to the activity of nursing by the baby?

17. What other effect does oxytocin have in females?

18. While nursing affects the secretion of oxytocin, what effect does nursing appear to have on the secretion of antidiuretic hormone which comes from the same gland?

19. What effect does increasing the osmolality (the amount of solute per unit of solvent) have on the secretion of ADH?

20. How would consuming large amounts of water change the secretion of ADH?
21. What is the name for secretion Y responsible for raising the blood glucose level after exercise?

22. Explain the function of secretion Y

23. What hormone is responsible for reducing the blood glucose level to normal a short time after the meal.

24. Describe the way in which secretion X lowers the blood sugar after eating a large meal.
CHAPTER 17
THE REPRODUCTIVE SYSTEM

IMPORTANCE OF REPRODUCTION (pg 406-407)

1. What does sexual reproduction involve?
2. On what does species survival depend on?
3. How many eggs do human females have and how many actually mature?
4. How many sex cells can human males produce?
5. Name the male and female gonads and identify what each one produces.
6. Define fertilization.
7. Define zygote.

THE MALE REPRODUCTIVE SYSTEM (pg 407-408)

8. During what month of embryonic development do the gonads become distinguishable?
9. What is the scrotum?
10. Why don't the testes ever re-enter the abdominal cavity?
11. What is a hernia?
12. Why is it important that the scrotum have a lower temperature than the abdominal cavity?
13. What does it mean when a man is said to be sterile?
14. What is the function of the vas deferens?
15. What is a vasectomy?
16. Which structure regulates the flow of sperm into the urethra?
17. Define semen.
18. Which structure regulates the flow of urine from the bladder?
19. Is it possible for both urine and semen to pass through the urethra at the same time?
20. What happens to the penis if it is sexually excited?
21. How is the parasympathetic nerve involved in the formation of an erection?
22. Define impotency.
TESTES AND SPERMATOGENESIS (pg 408-409)

23. How is the sperm cell built for motion?

24. What is the function of Sertoli cells?

25. Where are large numbers of mitochondria found in a sperm cell and why?

26. What is a flagellum?

27. What is the function of the acrosome?

28. What are the testes filled with?

29. How long are the seminiferous tubules?

30. Where are spermatogonia found and what is their function?

31. Define meiosis.

32. Define spermatocyte.

33. How long does it take for a spermatocyte to differentiate into a sperm cell?

34. Where do sperm cells mature and develop the swimming motion of their flagella?

SEMINAL FLUID (pg 410)

35. What 3 glands secrete fluid along the vas deferens and urethra?

36. Approximately how many sperm are in every 3 to 4 mL of ejaculate?

37. What do the seminal vesicles contribute to seminal fluid?

38. What is the function of protaglandins?

39. What does the prostate gland secrete into seminal fluid?

40. How is the Cowper's gland involved in the formation of semen?

41. Compare the life span of sperm cells when they are in the epididymis and once they are mixed with the other fluids contained in semen.

HORMONAL CONTROL OF THE MALE REPRODUCTIVE SYSTEM (p410-411)

42. Where in the body is testosterone produced?

43. Where are interstitial cells found?

44. List a few of the effects that testosterone has on the male body.
45. How is testosterone related to anabolic steroids?

46. Which organ controls the production of sperm and testosterone in men?

47. What effect does FSH have in men?

48. What effect does LH have in men?

49. Explain what happens at puberty to young males.

50. How are testosterone levels kept in check?

51. Know figure 17.5 on page 411 of your text, if necessary draw it into your notes.

THE FEMALE REPRODUCTIVE SYSTEM (pg 412-413)

52. How are the sexual lives of men and women different after puberty?

53. Define menopause.

54. Where are the ovaries located?

55. What are the 2 main functions of the ovaries?

56. What is the function of the oviduct or Fallopian tubes?

57. Name the open end of a Fallopian tube.

58. What happens to an ovum (egg) if it is not fertilized within 48 hours of entering the oviduct?

59. Define uterus (womb).

60. Approximately how long does it take for the ovum to travel the oviduct and reach the uterus?

61. Define embryo.

62. Name and describe the 2 types of tissue that make up the uterus.

63. Define menstruation.

64. What is an ectopic pregnancy?

65. How is the uterus connected to the outside environment?

66. Why is the vagina strongly acidic?

67. What is the function of the cervix?

68. Why is it important for women to have regular pap tests?
69. What are follicles?

70. Name and describe the 2 types of cells that make up follicles.

71. What happens to the female ovary after puberty?

72. Approximately how many eggs will the average woman have mature in her lifetime?

73. Explain why birth defects seem to rise as the age of the mother rises.

74. What 2 things are a result of menopause?

75. How is a secondary oocyte formed?

76. What is a polar body?

77. Define ovulation.

78. How is the corpus luteum formed and what is its function?

79. What happens to the corpus luteum if pregnancy does not occur?

80. Where does the secondary oocyte undergo meiosis II and what are the products of meiosis II?

### MENSTRUAL CYCLE  (pg 415-416)

81. How long is the average menstrual cycle?

82. Name the 4 phases of the menstrual cycle.

83. Describe the main event of the flow phase and state how long it takes to complete the flow phase.

84. What is the main event of the follicular phase?

85. Which hormone is involved in the follicular phase and what effect does it have on the endometrium?

86. What days of the menstrual cycle does the follicular phase occur between?

87. What are the 2 main events that occur in the ovulatory phase?

88. What event marks the beginning of the luteal phase?

89. As the oocyte leaves the ovary, estrogen levels decline. How are estrogen levels restored?

90. What is the function of progesterone (3 things)?

91. Explain how a birth control pill acts as a contraceptive.

92. Which days of the menstrual cycle does the luteal phase occur on?
93. What happens to the uterus if it does not receive a fertilized ovum?

94. Know and understand table 17.1 and figure 17.8 on page 416 of your textbook.

**HORMONE CONTROL OF THE FEMALE REPRODUCTIVE SYSTEM (p417-418)**

95. How is the production of estrogen and progesterone controlled in females?

96. What does the hypothalamus release at puberty and what are its effects?

97. During what phase of the menstrual cycle is FSH released and what are its effects?

98. As estrogen levels rise during the follicular phase, what happens to FSH?

99. What effect does high levels of estrogen have on LH?

100. What effect does LH have on the developing follicle (list 2)?

101. What effect does increased levels of estrogen and progesterone have on FSH and LH during the ovulatory phase?

102. Know and understand figure 17.9 on page 117 of your textbook.

103. How are males and females similar?

104. How can cancerous tumors in the male prostate gland be slowed down?

105. Know table 17.2 on page 418 of your textbook.

**FERTILIZATION AND PREGNANCY (pg 420-421)**

106. Out of the 300 million sperm released into the uterus with each ejaculation, how many actually reach the oviducts?

107. Define zygote.

108. Define blastocyst.

109. What is implantation?

110. Which hormone must remain at high concentration levels in order to sustain the corpus luteum and maintain the pregnancy?

111. What happens to the implanted egg if estrogen and progesterone levels fall?

112. What does HCG stand for and what is its function?

113. How do home pregnancy tests determine that a woman is pregnant, that is, what hormone do they test for and why does this hormone indicate that the woman is indeed pregnant?
114. How is the placenta formed?

115. What is the function of the placenta?

116. Why can't a woman become pregnant again if she is still carrying a fertilized egg?

**PRENATAL DEVELOPMENT** (pg 421-423)

117. What 2 layers eventually form from the outer layer of the blastocyst?

118. Describe the chorion and amnion layers.

119. What forms below the embryo by the fourth week of pregnancy?

120. What is the function of the chorionic villi?

121. Describe the allantois layer.

122. What is the function of the umbilical cord?

123. Which portion of the pregnancy is referred to as the first trimester?

124. Name the 3 germ layers that develop by the second week of development?

125. At what point are the heart and brain visible?

126. When is the fertilized egg first referred to as a fetus?

127. Describe the fetus during the second trimester.

128. Describe the main event of the third trimester.

**BIRTH** (pg 423-424)

129. Approximately how long after implantation does it take for labor to begin?

130. What causes a woman's "water to break"?

131. What 2 things help the baby move through the birth canal?

132. What is the function of relaxin and where is it released from?

133. What is believed to trigger the onset of labor?

134. How is the hormone oxytocin involved in the birthing process?

**LACTATION** (pg 424-425)

135. How is breast development stimulated at puberty?

136. What is the function of the hormone prolactin?
137. What is colostrum?

138. After the birthing process has been completed, what event can trigger the release of oxytocin from the pituitary gland?

139. What 2 things does oxytocin help the body achieve?

140. Why do women in some countries breast feed until their children are 4 or 5 years old?

141. Approximately how much milk can be produced each day?

142. Why is it hard for a woman to produce large quantities of milk for long periods of time?

143. Name another important substance found in breast milk besides the food nutrients.

FRONTIERS OF TECHNOLOGY: INVITRO FERTILIZATION (pg 425)

144. Approximately how many Canadian couples are unable to conceive a child?

145. Identify a few reasons why some Canadian couples have a difficult time conceiving a child.

146. Define invitro fertilization.

147. Why is it inaccurate to use the term "test tube baby"?

148. What is a laparoscope?

Label the identified numbers below
Reproduction Crossword

Across
2 Female gonads
4 The womb
6 A fertilized egg
8 Male sex hormone
12 Male gonads
15 Stores sperm cells
16 Outer membrane of an embryo
18 A hormone produced at ovulation
19 Holds the developing embryo in place
20 An early stage of embryo development

Down
1 Uniting of sperm and egg
3 A male gland that produces semen
5 Male sex cells
7 Marks the end of a female's reproductive years
9 Tubules containing immature sperm cells
10 Membrane surrounding the embryo
11 Where mother and fetus exchange nutrients and waste
13 Protective fluid supplies energy for sperm cells
14 Hormone associated with milk production
17 Site of fertilization
THE MALE REPRODUCTIVE SYSTEM

1. The organ of the male that produces sperm is called: __________.
2. The sac-like out-pocketing of the body wall that holds the testes is called the: ______.
3. Sperm learn to swim and mature in the area known as the __________.
4. The tube that carries sperm from the testes to the urethra is the ___________.
5. The seminal vesicles, cowper's gland, and the prostate all produce and secrete a viscous nutritional fluid that carries the sperm. This fluid is called _______.
6. The sperm producing process that occurs in the male is called ________________.
7. Within the testes, spermatogonial cells that line the seminiferous tubules undergo meiosis to produce _____________.
8. Spermatogonial cells contain _______ chromosomes and can be called 2n.
9. Spermatids contain ________ chromosomes and can be called n.
10. The emission and expulsion of sperm by the male is called _____________.
11. Before sperm is released into the environment it is stored in the _____________.
12. Semen contains fluids that are produced from 3 different glands: the prostate secretes a ________, the cowper's gland secretes a ________, and the seminal vesicles secrete a _____________.
13. The urethra has two functions, one is to transport __________ from the urinary bladder, and the second is to transport __________ from the epididymis.
14. Erections are caused by the __________ nervous system and are the result of vasodilation of an __________ leading into the penis, and the constriction of a _______ that is leaving the penis.
15. The ejaculation of sperm is caused by the contraction of _______________ in the penis.
16. The pituitary gland releases _______ that causes the formation of sperm cells in the _____________ of the testes. It also releases _______ that stimulates the _______ cells of the testes to produce the male sex hormone called _______.

17. How is variation in offspring characteristics achieved in sexual reproduction but not in asexual reproduction (ex: budding, fission, cloning, regeneration)?
18. How does variation in a species allow for increased chances of survival of a species?
19. Suggest a reason why the urethra does not get closed off when the corpus cavernosum fills with blood and becomes rigid.
20. What is meant by the term hermaphrodite?
21. Why are the testes moved from within the abdominal cavity out into the scrotum?
22. What hormone is produced by the testes and what are its effects on the male body?
23. Trace the path of the sperm from the seminiferous tubules to the outside of the body.
24. What function do the sertoli cells serve in the seminiferous tubules?
25. Label the following diagram of a sperm cell.
26. Fill in the missing information in the flow chart below (1 through 7).

27. Describe the process of spermatogenesis in some detail. Include where and what is happening from the beginning of the process until the sperm cells begin their journey through the vas deferens on their way to the ejaculatory duct.

Match the descriptions on the right with the correct term on the left.

1. epididymis  a. a substance in the anterior tip of the sperm which is needed for the sperm to penetrate the egg
2. Cowper's gland  b. form protective barriers around maturing sperm as well as nourish the developing sperm cells
3. prostate gland  c. the male sex hormone produced by the cells located between the seminiferous tubules
4. ejaculation  d. the site of sperm production in the testes
5. vas deferens  e. site where sperm are stored and learn to swim
6. seminal vesicles  f. the process by which sperm pass from the epididymis along with glandular secretions to the outside
7. urethra  g. produces an alkaline fluid which provides protection to the sperm
8. seminiferous tubules  h. contains the testes and keeps the sperm cooler
9. testosterone  i. a tail-like structure which propels the sperm
10. scrotum  j. the duct in the penis through which urine and semen pass through
11. sertoli cells  k. produces a lubricating fluid to aid the sperm
12. flagellum  l. produce a solution containing sugar to nourish the sperm
13. enzyme  m. a duct through which the sperm pass in their journey from the epididymis to the prostate
THE FEMALE REPRODUCTIVE SYSTEM

1. The _________ is the canal that connects the uterus to the body's exterior.
2. The _________ is the primary female organ that produces the reproductive cell, the egg, and the female sex hormones.
3. The _________ tubes connect the ovaries to the uterus.
4. The _________ is the open end of the fallopian tubes through which the egg enters.
5. The uterus contains 2 main layers: the _________ which is primarily made of muscle and will contract during child birth, and the _________ which will provide nourishment for the developing embryo.
6. A muscular ring of tissue that separates the vagina and the uterus is known as the _________.
7. The visible portion of the female reproductive system is called the ________ and includes the labia minor, labia major, and the clitoris.
8. _________ is the process of egg (ovum) formation.
9. Within the ovary there are groups of cells called ________ that will help develop the ovum.
10. Each follicle contains _________ which will undergo meiosis to form cells that contain only _______ chromosomes, and granulosa cells that will provide _________ for the developing oocyte cells.
11. Women only produce 400 eggs throughout their reproductive lives, which is halted at about the age of 50 when ________ occurs.
12. After meiosis I, the primary oocyte has been transformed into a _________ that contains only 23 chromosomes, and a _________ that will eventually die as it contains very little cytoplasm.
13. As the follicle continues to develop, one cell will become dominant and eventually burst out of the ovary during a process known as _________. This dominant cell will enter the _________ where it will undergo meiosis II to form a mature ovum.
14. The follicle cells that remain in the ovary continue to grow and eventually form the _________ which secretes the hormones _________ and _________.
15. If _________ does not occur, the corpus luteum will degenerate.

16. Where are the ovaries found?

17. What might be two advantages of internal fertilization over external fertilization?

18. Which hormone stimulates the development of the ovum in the follicles of the ovary?

19. Which hormone initiates the ovulation of the egg from the follicle and stimulates the formation of the corpus luteum?

20. Describe the process of oogenesis in some detail. Include where and what is happening from the release of FSH from the pituitary until the mature ovum has been formed in the oviduct.

21. Fill in the missing information in the diagram below (letters A - G).
3. The __________ phase is the visible part of the cycle, and is marked by the shedding of the ________________. This phase is triggered by low levels of the hormones _____________ and _____________.

4. The __________ phase occurs because of high levels of the hormone ______ released from the pituitary gland. This part of the phase includes the development of the follicle and __________ lining of the uterus which then secretes estrogen. This portion of the cycle characteristically has high levels of the hormones _____________ and _____________.

5. Estrogen promotes ______________ sex characteristics in females, such as _____________ and _______________.

6. The third phase of the menstrual cycle is the _____________ phase and is usually around day ______ of the cycle. This phase is triggered by elevations in the hormone ______ released by the pituitary, and is followed by a decline in the hormone _____________.

7. The final phase of the menstrual cycle lasts approximately ____________ days and is known as the ___________ phase. High levels of the hormone __________ trigger the follicle cells to form the corpus luteum, which in turn will release the hormone _________________. Progesterone stimulates continued growth of the endometrium lining of the _______________.

8. The first half of the menstrual cycle is dominated by the hormones __________ and __________, while the second half of the cycle is controlled more by the hormones __________ and _________________.

9. What is the purpose of the endometrium?

10. Draw a negative feedback loop showing how FSH secretion is controlled.

11. Draw a negative feedback loop showing how LH secretion is controlled.

12. What happens if the ovum is not fertilized? Explain how this leads to a drop of estrogen and progesterone levels, and to the menstrual phase.

13. Identify the hormones and phases indicated by the letters in the following diagram. (A. through K.)
1. The combining of the egg and a sperm is a process known as _____________.
2. Fertilization of the egg occurs in the structures called _____________.
3. The sperm releases an enzyme called _____________ in order to gain access to the egg.
4. A fertilized egg is called a ____________.
5. After approximately 6-7 days the fertilized egg has multiplied many times and is now a hollow mass of cells known as a ________________.
6. This mass of cells will attach itself to the inner wall of the ____________, which is now a thickened lining that will nourish the developing zygote. This thickened lining of the uterus is known as the ________________.
7. In order for the pregnancy to continue, the hormone ____________ must continue to be released by the pituitary as it will continue to sustain the corpus luteum.
8. The outer layer of the developing embryo is called the ________ and produces the hormone ________________, which will maintain the corpus luteum for 3 months.
9. The functioning corpus luteum is of extreme importance as it produces the hormones ___________ and ____________, which help maintain the endometrium where the embryo is growing.
10. The __________ is formed from cells of the embryo and the endometrium, and will act as a connection between the newly forming fetus and the mother.
11. At approximately 4 months, the corpus luteum deteriorates and the __________ begins to produce the hormones estrogen and progesterone, which will prevent the shedding of the ______________.
12. A second layer in the embryo, the ____________, evolves into a fluid filled-sac called the ________________, which will insulate and protect the developing fetus.
13. During the second week of pregnancy the embryo is referred to as a ____________, and 3 germ layers begin to form: the _____________ which forms skin and hair, the ____________ which forms muscles and blood vessels, and the _____________ which forms the inner organs.
14. During week 5 part of the endoderm called the ____________ will extend out and join to the placenta to form the ________________ which will connect the embryo and the placenta.
15. The human ____________ period is about 267 days in length, and consists of 3 different parts: the ____________ is when the heart and limbs become visible, the ________________ is when organs are forming, and the ____________ is when the baby undergoes a major growth period.
16. During the first trimester, at about the 8th week, the embryo is referred to as a ____________.
17. The process of giving birth is also known as ____________ or going into ____________.
18. Birth is signaled by the dilation of the ____________, the bursting of the ________________, and contractions of the ____________.
19. The onset of labor is thought to be triggered by a decrease in the hormone ____________.
20. The placenta releases a hormone called _____________ that helps the cervix loosen to ease the passage of the baby.
21. The posterior pituitary releases the hormone ________________ to trigger uterine contractions.
22. ________________, triggered by oxytocin, also cause uterine contractions.
23. Breast milk production before birth is stimulated by the hormone ____________, but is continued by the hormone ________________ after parturition.
24. ____________ fertilization is when an egg is removed from the ovary, fertilized, and transferred into the uterus.
Match the following:

**What each process is:**

1. ovulation  a. the emission of seminal fluid
2. ejaculation  b. the release of the ovum from the ovaries
3. fertilization  c. the union of the male and female gametes
4. menopause  d. the period of time when menstruation stops
5. implantation  e. the periodic discharge of blood from the uterus
6. menstruation  f. the attachment of the embryo to the endometrium

**Where each process occurs:**

1. ovulation  a. penis  b. uterus
2. fertilization  c. ovaries  d. vagina
3. implantation  e. cervix  f. oviducts
4. spermatogenesis  g. seminiferous tubules

**What each of the following is:**

1. fetus  a. a fertilized ovum
2. ovum  b. male (haploid) gamete cell
3. sperm  c. female (haploid) gamete cell
4. zygote  d. an organism is the early stages of development before birth
5. embryo  e. a fluid-filled tissue of the ovary in which the egg develops
6. follicle cells  f. follicles that remain in the ovary, secrete progesterone
7. corpus luteum  g. an organism after about eight weeks of development

**Name the hormones responsible for the following functions:**

1. stimulates ovulation
2. causes the cervix to dilate
3. stimulates the production of estrogen
4. inhibits the anterior pituitary from making FSH
5. maintains the endometrium
6. stimulates follicle cells to develop into a mature ovum
7. stimulates the muscles of the uterine wall to contract
8. stimulates the corpus luteum to produce progesterone
9. its presence in the blood is used as a positive pregnancy test
10. stimulates the glands of the uterine wall to produce prostaglandins
11. stimulates the development of male secondary sex characteristics
12. stimulates the development of female secondary sex characteristics

**Name the organ or group of cells which produce the following hormones:**

1. FSH  8. HCG
3. Inhibin  10. Estrogen prior to fertilization
4. Oxytocin  11. Estrogen & progesterone early in pregnancy
5. Testosterone  12. Estrogen & progesterone late in pregnancy
6. ICSH  13. Progesterone prior to fertilization
7. LH  14. Prolactin
1. Name the areas labeled F and G

2. List the products indicated by numbers I, II, III, and IV respectively

3. What effect would an increase in the secretion of product III have on the secretion of product I?

4. What effect does product II have on the activity of its target tissue?
5. Which of the two subjects would appear to not have ovulated?

6. What hormone is responsible for the change in body around Day 14 for subject X?

7. Describe 2 useful applications that can be made from the data for subject X?

8. What is the relationship between menstruation and body temperature as shown for subject Y?

9. Which hormone is responsible for the increase in the size of the follicle and maturation of the egg?

10. Which hormone is responsible for the increased secretion of leutenizing hormone between day 10 and day 16?

11. What kind of feedback is responsible for the change in the question above?

12. Peak secretion of what hormone is responsible for the escape of the egg from the follicle and the ovarian surface?

13. A change in blood concentration of which hormone is responsible for the increase in body temperature?

14. What hormone is mostly responsible for the rapid division of endometrial cells and increased blood vessel development (vascularization) between day 4 and day 14 of the menstrual cycle?

15. What 2 hormones are responsible for maintaining the thick vascularized lining of the uterus between days 14 to 28?

16. A decline in which hormone is responsible for the contraction of the uterus during the menstrual flow phase of the menstrual cycle?

17. Low levels of what hormone is responsible for increasing the secretions of FSH which initiates the development of a new follicle in the next menstrual cycle?

18. Which 2 hormones are suppressed by birth control pills, thereby preventing ovulation?
19. Several different cells are shown in various stages of what specific process?

20. What is the role in the process mentioned in number 20 played by the cell identified by number 4 in the diagram (bottom right corner)?

21. What number represents cells that possess lysosome containing enzymes that help in penetrating the protective layers of an unfertilized ovum?

22. What pituitary hormone is responsible for much of the processes illustrated?

23. Indicate by letter those two structures that produce substances which activate the metabolism of sperm.

24. What function does the structure indicated Q have?

25. How would severing the structure indicated by the letter Q affect the production of sperm cells?

26. Describe the effect on reproduction of complete blockage of both structures labeled 1.

27. The sexually transmitted disease, gonorrhea, may cause an infection in the structure labeled 4. Why might such an infection result in sterility?

28. What number indicates the structure responsible for producing a hormone that inhibits uterine in the early stages of pregnancy.

29. What number indicates a structure with a pH between 4 and 5? Why is the pH of this structure important?
30. Across the thin barrier indicated as the chorion which separates the fetal material from maternal blood, soluble food substances pass from the maternal blood space into the blood vessels of the chorionic villus. What structure and process in the human body is similar in function to the function described here for the placenta?

31. Nitrogenous wastes such as urea pass from the blood vessels derived from the umbilical arteries, through the chorionic villus and into maternal blood space. What structure in the human body is similar to the function of the placenta described here?

32. What part of the placenta has a function similar to an alveolus in the lung?

33. What blood vessel would you predict to contain blood with high concentrations of carbon dioxide?

34. What changes would account for the change in testosterone levels for males between the ages of 13 to 18?

35. How would you predict this graph to change if it were showing a population of males using anabolic steroids for prolonged periods of time?
36. This diagram shows the concentration of chorionic gonadotrophin, estrogen and progesterone excreted in the urine during pregnancy. Why is there a sharp decline in chorionic gonadotrophin at the third month?

37. What hypothesis can you provide for the fact that many miscarriages occur in the third month of pregnancy?

38. How do you account for the continuous rise in estrogen and progesterone to the ninth month of pregnancy?

39. Which hormone from the menstrual cycle is represented here?

40. What affect would the increase in this hormone between days 15 to 20 have on the secretion of the gonadotrophic hormone, LH? Why?

41. Which graph illustrates the most likely interaction of hormones during the later stages of pregnancy?

42. What effect does the hormone relaxin have on the body during pregnancy?

43. Which one of these three hormones would be useful in inducing labor? Why?

41. What 2 structures are represented by the letters W and X respectively?
CHAPTER 18
ASEXUAL REPRODUCTION

IMPORTANCE OF CELL DIVISION  (pg 430-431)

1. How many red blood cells divide in the human body every second?
2. What would happen to you if your cells could not divide?

PRINCIPLES OF MITOSIS  (pg 431-432)

3. Identify the 2 main points of the cell theory.
4. Define binary fission.
5. Differentiate between mother and daughter cells.
6. Describe the 2 stages of cell division.
7. Define mitosis.
8. How many chromosomes are found in a human cell?
9. List 2 things that are ensured by the duplication of complementary strands of genetic information in human cells.
10. What does every single cell in the human body have in common?

STAGES OF CELL DIVISION  (pg 432-435)

11. Do cells spend a lot of time in interphase or do they spend very little time in interphase?
12. Describe what happens to a cell during interphase.
13. What happens to the single-stranded chromosomes during interphase?
14. Define the following terms as they related to prophase: centriole, aster, spindle fiber.
15. What are chromosomes made of?
16. What is the function of the centromere?
17. What happens to the nuclear membrane during prophase?
18. Name the second phase of cell division.
19. Where do the chromosomes move to or travel toward?
20. Name the third phase of cell division.
21. Describe the main event that takes place during anaphase.

22. Name the fourth and final phase of cell division.

23. Describe what happens to the cell during telophase.

24. Define chromatin.

25. Define cytokinesis.

26. What is the purpose or function served by the process of cytokinesis?

27. How does the process of cytokinesis differ in plant and animal cells?

**CLONING (pg 437-439)**


29. Why is cloning referred to as a form of asexual reproduction?

30. What are "buds" and "runners", and how do they give clones an advantage over alternate methods of reproduction?

31. If all cells are identical to their parent cells, how do some cells specialize into leaf cells while others become root cells?

32. Define enucleated.

33. Define totipotent.

34. Why did Briggs and King fail to clone a frog when they used cells from a gastrula, but succeed when they used frog cells from a blastula?

35. What type of cells must be used in order to clone humans, that is, what type of human cells are still totipotent?

**IDENTICAL TWINS: NATURE'S CLONES (pg 440)**

36. Explain how identical twins are formed.

37. How are fraternal twins formed?

**CELL DEATH AND THE AGING PROCESS (pg 440-442)**

38. How did scientists discover that immature heart cells have a biological clock that controls how often they divide?

39. What types of cells in the human body have the ability to reproduce? ....Which type of cells don't have the ability to reproduce?

40. Name 2 types of cells in the human body that do not age.
41. What is leukemia?

42. As a cell becomes more specialized how is its ability to undergo mitosis and its life span affected?

43. In a perfect world or environment, what is the maximum age that a person could live for?

44. Does inactivity reduce the speed with which cells age?

ABNORMAL CELL DIVISION: CANCER  (pg 442-443)

45. What is cancer?

46. What balance is needed for the human body to be healthy?

47. Can normal cells divide when they are isolated from one another?

48. Is the reproduction of cancer cells regulated by the healthy cells that surround it?

49. Define metastasis.

50. Why is the fact that cancer cells do not mature or specialize so dangerous for humans who suffer from cancer?
Mitosis

- Prophase
- Metaphase
- Anaphase
- Telophase

Two daughter cells
CHAPTER 19
SEXUAL CELL REPRODUCTION

IMPORTANCE OF MEIOSIS  (pg 448-449)
1. What is meiosis?
2. How are sex cells formed from meiosis different that the daughter cells formed by mitosis?
3. What is another name for sex cells?
4. How many chromosomes are in a human cell after it has undergone meiosis?
5. Differentiate between diploid and haploid cells.
6. How does sexual reproduction create a greater range of characteristics within a species?
7. What are homologous chromosomes?
8. How is your appearance determined by the chromosomes you receive from your mom and dad?

STAGES OF MEIOSIS  (pg 449-451)
9. How many steps occur in meiosis and what is the product?
10. What is another name for meiosis II?
11. How many chromosomes are in the 2 cells that are produced as a result of meiosis I?
12. Define tetrad.
13. Define synapsis and crossing-over.
14. During what stage of meiosis I does segregation occur?
15. How are the cells formed at the end of telophase I different than the cells formed by regular telophase?
16. What happens to the 2 haploid cells during meiosis II?
17. Name the 4 stages of meiosis II and give a brief description of what happens in each stage.

DEVELOPMENT OF MALE & FEMALE GAMETES  (pg 452-453)
18. Define gametogenesis.
19. Differentiate between an ootid and polar body.
20. How is meiosis different in the formation of eggs and sperm?
21. Why don't sperm cells contain a lot of cytoplasm?
22. How are males and females different in regards to their production of sex cells?

23. Differentiate between sex chromosomes and autosomes.

24. How are X and Y chromosomes related to whether an individual is male or female?

**ABNORMAL MEIOSIS: NONDISJUNCTION (pg 454-455)**

25. Define nondisjunction.

26. How many chromosomes are found in the 2 gametes formed during nondisjunction?

27. Define trisomy.


**NONDISJUNCTION DISORDERS (pg 455-456)**

29. What is the cause of Down Syndrome?

30. Define karyotype.

31. Identify some of the characteristics of people who suffer from Down Syndrome.

32. How is the age of the mother related to the chance of her baby having Down Syndrome?

33. What is the cause of Turner Syndrome?

34. Identify some of the characteristics of a female who is suffering from Turner Syndrome.

35. How often are Turner Syndrome babies born?

36. What is the cause of Klinefelter Syndrome?

37. Describe an individual who suffers from Klinefelter Syndrome.

38. How often are babies born with Klinefelter Syndrome?

**FRONTIERS OF TECHNOLOGY: AMNIOCENTESIS (pg 458)**

39. What is an amniocentesis and what is it used for?

40. What does a chromosome count of 47 indicate to a doctor?

41. Explain how chorionic villus sampling (CVS) is done and how it is different from an amniocentesis.

42. Do you think these recent technologies should be used to warn parents of disorders in their babies so that they may choose to abort the pregnancy?
THE MYTH OF CRIMINAL CHROMOSOMES (pg 460)

43. What were XYY males often referred to as?

44. Identify some of the characteristics of an XYY male.

45. Do scientists today accept the hypothesis that XYY males are prone to criminal behavior more than the normal XY males?

FRONTIERS OF TECHNOLOGY: REPRODUCTIVE TECHNOLOGY (pg 461)

46. Define artificial involution.

47. How do scientists get high-grade cows to produce more eggs than normal?

48. What is in vitro fertilization?

49. What is a surrogate?

REDEFINING MOTHERHOOD (pg 462)

50. Can a woman without ovaries give birth to a child?
Asexual Cell Reproduction Crossword

Across
1 Making an identical organism
3 A single strand of a chromosome that remains joined by a centromere
7 Asexual cell division
9 Mitosis phase in which daughter cells reorganize
10 Chromosomes line up along the equatorial plate during this phase
12 Early stage of development
13 Disease characterized by uncontrolled cell division
14 These fibers guide chromosomes

Down
1 Holds chromosome together
2 Reproduces by budding
3 Structure anchors spindle fibers in animal cells
4 Describes a nucleus that can bring a cell from egg to adult
5 A phase in which chromosomes move to opposite poles
6 Single-stranded chromosomes become double-stranded
8 A cancer cell moves
11 First true phase of mitosis
MEIOSIS

The following list represents a series of events that occur during the division of the cell nucleus during the process of meiosis. Arrange the events in their proper sequence by establishing a new sequence of numbers to the left of those listed. Also, classify each event according to the phase it belongs by placing the letter I (interphase), P (prophase), M (metaphase), A (anaphase), and T (telophase) in the blank to the right of each event.

MEIOSIS I

____ 1. The spindle forms
____ 2. The spindle separates the pairs of homologous chromatids with one pair going to each pole
____ 3. The chromosomes disappear
____ 4. Cytoplasm divides by cytokinesis
____ 5. Tetrads become aligned along the equator of the spindle
____ 6. The nuclear membrane forms
____ 7. The chromosomes become visible
____ 8. The nuclear membrane disappears
____ 9. The homologous chromosomes, each made of two chromatids attached at the centromere, align themselves next to each other to make up a tetrad by a process called synopsis
____ 10. DNA material is replicated or doubled

MEIOSIS II

____ 1. Two daughter chromosomes are pulled to each pole
____ 2. The chromosomes disappear
____ 3. Cytokinesis completes the second division
____ 4. The nuclear membrane forms
____ 5. The chromosomes appear
____ 6. Dyads become aligned at the equator
____ 7. The nuclear membrane disappears
____ 8. The centromeres divide

2. Explain the difference between the terms haploid and diploid, and identify which phases of meiosis these terms apply to.

3. What process is responsible for restoring the diploid chromosome number in the human life cycle?

4. How does the chromosome arrangement of metaphase I differ from metaphase in mitosis?

5. Why do we refer to chromatids as sister chromatids?
### Sexual Cell Reproduction Crossword

<table>
<thead>
<tr>
<th>Across</th>
<th>Down</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 Another name for sex cells</td>
<td>2 The formation of gametes</td>
</tr>
<tr>
<td>4 Full complement of chromosomes</td>
<td>3 Pictures of chromosomes</td>
</tr>
<tr>
<td>6 Chromosomes number found in sex cells</td>
<td>arranged in homologous pairs</td>
</tr>
<tr>
<td>7 Chromosomes that do not determine sex</td>
<td>5 The presence of three</td>
</tr>
<tr>
<td>9 The exchange of genetic information by</td>
<td>homologous chromosomes in</td>
</tr>
<tr>
<td>chromosomes</td>
<td>every cell</td>
</tr>
<tr>
<td>11 The separation of paired chromosomes</td>
<td>6 ________ chromosomes are</td>
</tr>
<tr>
<td>during meiosis</td>
<td>similar in size and shape</td>
</tr>
<tr>
<td>12 A technique used to identify genetic</td>
<td>8 Contains four chromosomes</td>
</tr>
<tr>
<td>defects in a fetus</td>
<td></td>
</tr>
<tr>
<td>13 The presence of a single chromosome in</td>
<td>10 Unfertilized egg cells</td>
</tr>
<tr>
<td>place of a homologous pair</td>
<td></td>
</tr>
</tbody>
</table>

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*Across:* 1 Another name for sex cells, 4 Full complement of chromosomes, 6 Chromosomes number found in sex cells, 7 Chromosomes that do not determine sex, 9 The exchange of genetic information by chromosomes, 11 The separation of paired chromosomes during meiosis, 12 A technique used to identify genetic defects in a fetus, 13 The presence of a single chromosome in place of a homologous pair

*Down:* 2 The formation of gametes, 3 Pictures of chromosomes arranged in homologous pairs, 5 The presence of three homologous chromosomes in every cell, 6 ________ chromosomes are similar in size and shape, 8 Contains four chromosomes, 10 Unfertilized egg cells
MITOSIS AND MEIOSIS REVIEW

1. Explain the differences in DNA content between:
   a) mitosis early interphase and mitosis prophase
   b) mitosis prophase and mitosis late telophase
   c) meiosis anaphase I and meiosis metaphase II
   d) meiosis metaphase II and meiosis late telophase II

2. In what type of cells does mitosis occur? ……What type of cells does meiosis occur?

3. In what phase of the cell cycle does a cell spend most of its time, and explain why this phase takes the largest portion of time.

4. List two structures that are built during the early stages of mitosis.

5. Explain the difference between chromatin and chromatids. Which phase of mitosis do we see chromatin and in which phase do the chromatids become visible?

6. In what ways is mitosis different from meiosis?

7. In what ways is mitosis similar to meiosis?

8. How does the interphase between division I and division II in meiosis differ from the interphase before division I?

9. Explain the importance of crossing-over in relation to the survival of the species.

10. In what phase of meiosis does crossing-over occur?

11. In what organs of the male and female body do meiosis occur?

12. How do daughter cells formed by meiosis compare to the parent cells from which they came from?

13. Which meiotic cell division is most like mitotic cell division?

14. What implication would oogenesis which resulted in forming only oocytes in place of polar bodies have for conception?

15. What two processes affecting chromosomes results in most of the genetic variation in sexual reproduction?

16. How many daughter cells occur in spermatogenesis as a result of meiosis?

17. What is the process called when homologous chromosomes, each made up of two chromatids, come together as pairs into a structure called a bivalent or tetrad?
CHAPTER 22
DNA: THE MOLECULE OF LIFE

IMPORTANCE OF DNA (pg 516-517)

1. What does the nucleus of every cell in your body contain?
2. DNA is the only molecule that can duplicate itself. What does this allow cells to do?
3. What is the role of DNA in your cells?
4. Define genes.
5. Is it possible for another human to have the same genetic code (DNA) as you?
6. Identify the 2 ways that ensure your descendents will be unique, that is, have a different genetic code than you.
7. Define mutation.
8. What are proteins?

SEARCHING FOR THE CHEMICAL OF HEREDITY (pg 517)

10. What 2 things make up chromosomes?
11. How many different amino acids make up the infinite variety of proteins that exist?
12. What are nucleic acids made up of?
13. What 3 molecules combine to form nucleotides?

HISTORICAL PROFILE: JAMES WATSON AND FRANCIS CRICK (pg 520-521)

14. Which 2 scientists are credited with discovering the structure of DNA?
15. DNA is made up of sugar (deoxyribose), phosphate, and 4 different nitrogen bases. Identify the 4 types of nitrogen bases found in DNA.
16. What do scientists know about the proportion of nitrogen bases within a given species?

STRUCTURE OF DNA (pg 521-522)

17. DNA is often described as being a double helix. Describe a double helix.
18. Which molecules form the backbone of the double helix? …Which form the rungs?
19. What type of chemical bond holds the nitrogen base from one back bone to the nitrogen base from the other back bone?

21. DNA is made up of many units, each composed of a deoxyribose sugar, a phosphate, and a nitrogen base. What is the name used to describe these structural units that make up DNA?

22. Why are the nucleotides referred to as "complementary nucleotides"?

REPLICATION OF DNA  (pg 523)

23. Define replication.

24. During replication, what happens to the hydrogen bonds that hold the base pairs together?


26. After replication has been completed the new DNA is really only "half-new". Explain.

27. Which nitrogen bases are complementary with one another?

28. What are polymerases and what is their function during the replication process?

29. Explain how the steak you eat for dinner provides you with nucleotides to synthesize more DNA.

30. Why don't you look like the food that you eat even though your body uses the nucleotides from those organisms?

31. Name 2 environmental factors that increase the risk of genetic mistakes such as un-complementary nitrogen bases becoming paired to one another.

32. How does the cell reduce or prevent permanent damage due to genetic mistakes from occurring?

FRONTIERS OF TECHNOLOGY:  DNA FINGERPRINTING  (pg 526)

33. Who developed the DNA fingerprinting test?

34. On what premise or foundation is the entire DNA fingerprinting test based on?

GENE RECOMBINATIONS IN THE LABORATORY  (pg 527-528)

35. What are endonucleases?

36. Define restriction enzyme.

37. What is a ligase enzyme capable of?

38. How are restriction and ligase enzymes used in gene splicing?

39. What did Herbert Boyer and Stanley Cohen accomplish?

40. Define recombinant DNA.
41. Does the new DNA that is spliced into an organism affect that organism or does it become useless DNA that is ignored?

42. How did scientists use gene splicing with E. coli bacteria for human benefit?

43. Why is insulin created by E. coli bacteria better than cow or pig insulin?

**DNA AND INDUSTRY  (pg 528-529)**

44. What is biotechnology?

45. Identify a few materials that bacteria have produced as a result of biotechnology.

46. Approximately how much money will biotechnology inject into the Canadian economy in the year 2000?

**NEW, IMPROVED MOUSE  (pg 529)**

47. How have mice been used in cancer research due to recombinant DNA technology?

48. Identify 3 concerns over the practice of creating and patenting genetically engineered animals.
DNA Crossword

Across
2. The acid of DNA
5. One of the scientists who discovered the shape of DNA
7. Occur when DNA is altered
8. Duplication process of DNA
10. A nitrogen base found in DNA and RNA
12. _____ enzyme acts like scissors

Down
1. Physicist who discovered the structure of DNA
3. Functional units of DNA
4. Long threads of genetic information found in the nucleus
6. Nitorgen base in DNA only
9. Enzymes that join nucleotides together
11. An enzyme that works like a molecular glue
1. What chemicals make up chromosomes?

2. What are nucleotides?

3. Compare the amount of DNA found inside one of your muscle cells with the DNA found in one of your brain cells.

4. Why are organ transplants more successful between identical twins than between other individuals?

5. What is the significance of DNA replication for your body?

6. Why are the opposing sides of the DNA molecule never identical, but always complementary?

7. Briefly describe the events of DNA replication.

8. A drug holds the complementary nitrogen bases with such strength that the DNA molecule is permanently fused in the shape of a double helix. Predict whether or not this drug might prove harmful. Provide your reasons.

9. Provide the base sequence for the complementary strand of DNA that would match the DNA strand shown below:

   TAGTCTAAGCCGTAATCA

10. Where do the nitrogen bases, sugars, and phosphates come from to make the complementary strand?

11. Differentiate between DNA polymerase and DNA ligase enzymes.

12. Differentiate between ligase enzymes and restriction enzymes.

13. Explain how ligase and restriction enzymes can be used in gene splicing.

14. What is the function of the enzyme gyrase during DNA replication.

15. Differentiate between the following terms: chromosomes, DNA, genes, nucleotides.

16. Explain how your cells reduce the chances of mutations occurring during DNA replication.

17. What is recombinant DNA, how is it created, and what can it be used for?
CHAPTER 23
PROTEIN SYNTHESIS

IMPORTANCE OF PROTEINS  (pg 532-533)
1. What are the structural components of cells?
2. What are all proteins made up of?
3. Identify a few examples of what proteins are responsible for in our cells.
4. What controls the production of each protein in a cell?
5. How is the sequencing of amino acids regulated within a cell?
6. Why are some organ transplants rejected by the recipient of the new organ?

ONE GENE, ONE PROTEIN  (pg 533-534)
7. What are enzymes?
9. What is the "one gene, one protein" hypothesis?

THE ROLE OF DNA IN PROTEIN SYNTHESIS  (pg 534-535)
10. Does the DNA in all organisms have the same basic structure: deoxyribose sugar, phosphate, and 4 nitrogen bases?
11. How is the DNA of various organisms different from one another?
12. Explain how only 4 nitrogen bases can provide the code to build 20 different amino acids.
14. What is the function of messenger RNA (mRNA) in protein synthesis?
15. How is RNA different than DNA?
16. What are terminator codons and initiator codons?

PROTEIN SYNTHESIS: TRANSCRIPTION  (pg 535)
17. What is the first step of protein synthesis?
18. Which mRNA base pairs with the DNA base cytosine? …. With DNA adenine? …with DNA thymine?
19. Define transcription.
20. Once a strand of mRNA has been created, where does it go?

21. Why is it good that the DNA remains in the nucleus throughout the entire process of protein synthesis?

**PROTEIN SYNTHESIS: TRANSLATION (pg 536-537)**

22. How is the protein synthesis mechanism turned "on" at the ribosome?

23. What is the function of transfer RNA (tRNA)?

24. Define anticodon.

25. Explain how the mRNA codon and tRNA anticodon work together to place amino acids in the correct sequence.

26. How does the ribosome know that protein synthesis is complete and that the process can be turned off?

27. Define translation.

**DNA AND MUTATIONS (pg 539-540)**

28. Structurally, what is a mutation?

29. What are mutagenic agents?

30. Explain why the altering of one nitrogen base in the DNA of a cell is so dangerous.

31. Is it possible for a genetic mutation to be favorable and actually improve the cell?

32. How does the chemical mutagen hydroxylamine affect the DNA of cells?

33. If the backbone of the DNA ladder is broken, cells can re-glue it back in to place. Does this guarantee that no damage has been done to the genetic code?

34. Why is it more dangerous when a mutation happens in a fertilized egg or young fetus, rather than an adult?

35. Describe the condition sickle-cell anemia.

**ONCOGENES: GENE REGULATION AND CANCER (pg 544-546)**

36. What is a general characteristic of cancer?

37. Identify 2 reasons why scientists believe that cancer is due to changes in the genetic code.

38. Define oncogene.

39. Explain why normal cells are not affected by cancer genes in their DNA.
40. Differentiate between structural genes and regulator genes.

41. Explain how the "ras" oncogene causes an over-production of cells.

**FRONTIERS OF TECHNOLOGY: THE AMES TEST (pg 546-547)**

42. Identify some mutagens and carcinogens in your environment.

43. What is the Ames test used for?

**BIOLOGICAL WARFARE (pg 547-549)**

44. How did American soldiers use biological warfare in the 1800's?

45. Why is the HIV virus not suitable for use in biological warfare?

46. Why is combining genes for weaponry a frightening prospect?
Protein Synthesis Crossword

Across
5 _____ genes turn off structural genes
6 _____ acids are the building blocks of proteins
7 It may be a cancer-causing agent
8 Protein that speeds chemical reactions in cells
9 Three-base code for an amino acid found on mRNA
11 Information encoded on RNA is used to build proteins

Down
1 A rapidly growing industry based on genetics
2 _____ genes code for proteins
3 Made from amino acids
4 The genetic code from DNA is written into mRNA
6 Three-base codes found in tRNA
10 A cancer-causing gene
DNA, RNA, AND PROTEIN SYNTHESIS

Match the terms on the left with the correct descriptions on the right.

1. uracil  a. the sugar found in RNA
2. tRNA  b. made of proteins
3. deoxyribose  c. copying of the DNA code by mRNA
4. mRNA  d. the forming of a protein from the code found on mRNA
5. double helix  e. a 3 base code for an amino acid
6. enzymes  f. a base found in RNA only
7. transcription  g. the sugar found in DNA
8. anticodon  h. duplication of the DNA code
9. nucleotide  i. made of sugar, phosphate, and a base
10. adenine  j. carries information out into the cytoplasm
11. codon  k. bonds with thymine
12. replication  l. shape of the DNA molecule
13. translation  m. brings amino acids to the ribosome to form a protein
14. ribose  n. the 3 base code found on tRNA

Read the following 11 events that describe protein synthesis. Place these events in the order in which they occur, from step 1 to step 11. The first step is labeled for you.

1. The ribosome moves along the mRNA attaching the proper tRNA anticodon to the mRNA.
2. When the message is stopped, the polypeptide chain breaks away and is ready to be used by the cell.
3. When the mRNA molecule is complete, it breaks away from the DNA strand.
4. Specific amino acids combine with tRNA and are taken to the mRNA at the ribosome.
5. The DNA molecule in the nucleus unwinds.
6. Messenger RNA nucleotides attach themselves to the exposed DNA bases.
7. The amino acids of the tRNA are joined releasing the tRNA so that it can go get more amino acids.
8. The mRNA leaves the nucleus and becomes associated with the ribosomes.
9. At the end of the mRNA strand is one of 3 codons that stops the chain formation. These codons do not code for any amino acids. The formation of the protein chain is terminated.
10. The DNA molecule "unzips" to expose its' base nucleotides.
11. The DNA strand rejoins and coils.

Using the following list of nucleic acids, place the correct number of the nucleic acid(s) that best match the description given below.

1. DNA
2. DNA, mRNA
3. mRNA
4. tRNA
5. mRNA, tRNA
6. DNA, mRNA, tRNA
a. found in nucleus of cell  
  i. composed of only three nucleotides  
b. contains the sugar ribose  
  j. only found in cytoplasm  
c. contains the sugar deoxyribose  
  k. found in both nucleus and cytoplasm  
d. contains the base uracil  
  l. a single strand  
e. contains the base thymine  
  m. a double strand  
f. contains the base adenine  
  n. involved in replication  
g. contains the base cytosine  
  o. transports amino acids (translation)  
h. contains the base guanine  
  p. contains the code for proteins  
  (transcription)  

Answer the following questions.
1. Who first proposed the shape of the DNA molecule?
2. What three things are a nucleotide made of?
3. The DNA molecule "unzips" at what location?
4. Name the base found in DNA that is not found in RNA.
5. At what cell structure does protein synthesis take place?
6. What are long chain polypeptides made up of?
7. How many bases are needed to pick up an amino acid?
8. An anticodon is found on what type of nucleic acid?
9. What type of bonds hold the nitrogenous bases together?
10. Some codons do not code for an amino acid, they are known as ________ codons. Other codons that start the synthesis of proteins are called ________ codons, while codons that signal the end of protein synthesis are called ________ codons.
11. Differentiate between the processes of transcription and translation.
12. Differentiate between RNA polymerase, DNA polymerase, Gyrase, Ligase, and restriction enzymes.
13. Fill in the following table based on the original DNA codons provided.

<table>
<thead>
<tr>
<th>DNA codon</th>
<th>Complementary DNA strand</th>
<th>Complementary mRNA codon</th>
</tr>
</thead>
<tbody>
<tr>
<td>AAG</td>
<td></td>
<td></td>
</tr>
<tr>
<td>GAG</td>
<td></td>
<td></td>
</tr>
<tr>
<td>TCT</td>
<td></td>
<td></td>
</tr>
<tr>
<td>TAA</td>
<td></td>
<td></td>
</tr>
<tr>
<td>GGA</td>
<td></td>
<td></td>
</tr>
<tr>
<td>CCA</td>
<td></td>
<td></td>
</tr>
<tr>
<td>CGC</td>
<td></td>
<td></td>
</tr>
<tr>
<td>AAA</td>
<td></td>
<td></td>
</tr>
<tr>
<td>TGG</td>
<td></td>
<td></td>
</tr>
<tr>
<td>ATT</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
14. Using the mRNA chart for amino acids, match the following mRNA codons with their appropriate amino acids.

<table>
<thead>
<tr>
<th>Codon</th>
<th>Amino Acid</th>
</tr>
</thead>
<tbody>
<tr>
<td>CUU</td>
<td>1. Stop</td>
</tr>
<tr>
<td>UAG</td>
<td>2. Gln</td>
</tr>
<tr>
<td>ACA</td>
<td>3. Leu</td>
</tr>
<tr>
<td>UGG</td>
<td>4. Ile</td>
</tr>
<tr>
<td>AGC</td>
<td>5. Trp</td>
</tr>
<tr>
<td>AUG</td>
<td>6. Ser</td>
</tr>
<tr>
<td>GAG</td>
<td>7. Start</td>
</tr>
<tr>
<td>AAU</td>
<td>8. Asn</td>
</tr>
<tr>
<td>AUA</td>
<td>9. Thr</td>
</tr>
<tr>
<td>CAG</td>
<td>10. Glu</td>
</tr>
</tbody>
</table>

15. Using the mRNA chart for amino acids, match the following DNA codons with their appropriate amino acids.

<table>
<thead>
<tr>
<th>Codon</th>
<th>Amino Acid</th>
</tr>
</thead>
<tbody>
<tr>
<td>AAA</td>
<td>1. Ile</td>
</tr>
<tr>
<td>GAA</td>
<td>2. Lys</td>
</tr>
<tr>
<td>TAA</td>
<td>3. Ser</td>
</tr>
<tr>
<td>CAC</td>
<td>4. Stop</td>
</tr>
<tr>
<td>AGC</td>
<td>5. Phe</td>
</tr>
<tr>
<td>CGT</td>
<td>6. Start</td>
</tr>
<tr>
<td>TAC</td>
<td>7. Val</td>
</tr>
<tr>
<td>TTA</td>
<td>8. Asn</td>
</tr>
<tr>
<td>TTC</td>
<td>9. Ala</td>
</tr>
<tr>
<td>ACT</td>
<td>10. Leu</td>
</tr>
</tbody>
</table>

Answer the following questions using the mRNA codon chart as needed. Be sure to show all conversions that will help you get your answer.

16. The second codon in the double helix is TAT. What is the amino acid coded by this triplet?

17. Read the following DNA code beginning at the left and provide the names, in order, of the amino acids coded in the DNA.


18. If a DNA codon is CAG and the tRNA anti-codon loop reads CAG, what codon is carried by the mRNA?

19. To code for insulin, a protein, you need an amino acid sequence of -alanine-lysine-proline-theorine-. Which sequence of nitrogen bases in DNA listed below, encodes the information to create insulin?

   A) -CGA-TTT-GGT-TGA-
   B) -CGT-AAA-GGT-ACT-
   C) -GCU-AAA-CCA-ACU-
   D) -GCG-AAG-CCA-ACG

20. Using the DNA sequence TCAGGA, what is the dipeptide formed?
Fill in the following table.

<table>
<thead>
<tr>
<th>English Language</th>
<th>Genetic Language</th>
</tr>
</thead>
<tbody>
<tr>
<td>Letters</td>
<td></td>
</tr>
<tr>
<td>Words</td>
<td></td>
</tr>
<tr>
<td>Sentences</td>
<td></td>
</tr>
<tr>
<td>Book</td>
<td></td>
</tr>
</tbody>
</table>

21. What nitrogenous base can join with the following complementary bases?
   a) adenine base of tRNA with ________ base of mRNA
   b) uracil base of tRNA with ________ base of mRNA
   c) guanine base of tRNA with ________ base of mRNA
   d) guanine base of DNA with ________ base of mRNA
   e) thymine base of DNA with ________ base of mRNA
   f) adenine base of DNA with ________ base of mRNA

22. Which amino acids connect to the tRNA molecules that have the anti-codon sequences:
   a) AGC    b) CUU    c) ACU    d) AUA

23. Explain why DNA strands are coded using triplet codons and not just the 4 nitrogenous bases alone.

24. True or False: Some of the amino acids have more than one codon, but each codon can only have one particular amino acid.

25. Explain how an infinite variety of proteins can be created from only 20 amino acids.

26. Explain the difference between somatic mutations (DNA mutations in body cells) and gametic mutations (DNA mutations in gametes).

27. Complete the following table using check marks.

<table>
<thead>
<tr>
<th></th>
<th>mRNA</th>
<th>tRNA</th>
</tr>
</thead>
<tbody>
<tr>
<td>Deoxyribose present</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Ribose present</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Phosphoric acid present</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Adenine present</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Thymine present</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Uracil present</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Guanine present</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Cytosine present</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Carries an amino acid to a ribosome</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Found in the nucleus</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

28. Using the DNA codons provided, identify the complementary mRNA codons, the tRNA codons, and the amino acids that would be bonded together to form a protein.

<table>
<thead>
<tr>
<th>Original DNA codon</th>
<th>mRNA codons</th>
<th>tRNA codons</th>
<th>Amino acids</th>
</tr>
</thead>
<tbody>
<tr>
<td>AAT</td>
<td>GGG</td>
<td>ATA</td>
<td>AAA</td>
</tr>
</tbody>
</table>
29. What in an oncogene?

30. Differentiate between a mutation caused by a base pair substitution and a frameshift mutation. (Which mutation is more dangerous to the cell?)

31. What is the difference between an intron, exon, cistron, and transposon?

32. What is a carcinogen and give an example of a carcinogen?

33. What is a mutagen?
# Messenger RNA Codons and Their Corresponding Amino Acids

<table>
<thead>
<tr>
<th>First Base</th>
<th>UUU phenylalanine</th>
<th>UUC phenylalanine</th>
<th>UUA leucine</th>
<th>UUG leucine</th>
<th>C</th>
<th>CU leucine</th>
<th>CUC leucine</th>
<th>CUA leucine</th>
<th>CUG leucine</th>
<th>A</th>
<th>AU isoleucine</th>
<th>AUC isoleucine</th>
<th>AUA isoleucine</th>
<th>AUG methionine*</th>
<th>G</th>
<th>GU valine</th>
<th>GUC valine</th>
<th>GUA valine</th>
<th>GUG valine</th>
</tr>
</thead>
<tbody>
<tr>
<td>U</td>
<td>UCU serine</td>
<td>UCC serine</td>
<td>UCA serine</td>
<td>UCG serine</td>
<td>C</td>
<td>CCU proline</td>
<td>CCC proline</td>
<td>CCA proline</td>
<td>CCG proline</td>
<td>A</td>
<td>ACU threonine</td>
<td>ACC threonine</td>
<td>ACA threonine</td>
<td>ACG threonine*</td>
<td>G</td>
<td>GCU alanine</td>
<td>GCC alanine</td>
<td>GCA alanine</td>
<td>GCG alanine</td>
</tr>
<tr>
<td></td>
<td>UAU tyrosine</td>
<td>UAC tyrosine</td>
<td>UAA stop **</td>
<td>UAG stop **</td>
<td></td>
<td>CAU histidine</td>
<td>CAC histidine</td>
<td>CAA glutamine</td>
<td>CAG glutamine</td>
<td></td>
<td>AAU asparagine</td>
<td>AAC asparagine</td>
<td>AAA lysine</td>
<td>AAG lysine</td>
<td></td>
<td>GAU aspartate</td>
<td>GAC aspartate</td>
<td>GAA glutamate</td>
<td>GAG glutamate</td>
</tr>
<tr>
<td></td>
<td>UGU cysteine</td>
<td>UGC cysteine</td>
<td>UGA stop **</td>
<td>UGG tryptophan</td>
<td></td>
<td>CGU arginine</td>
<td>CGC arginine</td>
<td>CGA arginine</td>
<td>CGG arginine</td>
<td></td>
<td>AGU serine</td>
<td>AGC serine</td>
<td>AGA arginine</td>
<td>AGG arginine</td>
<td></td>
<td>GGU glycine</td>
<td>GGC glycine</td>
<td>GGA glycine</td>
<td>GGG glycine</td>
</tr>
</tbody>
</table>

*Note: AUG is an initiator codon and also codes for the amino acid methionine.

**Note: UAA, UAG, and UGA are terminator codons.

## Information About Nitrogen Bases

<table>
<thead>
<tr>
<th>Nitrogen Base</th>
<th>Classification</th>
<th>Abbreviation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Adenine</td>
<td>Purine</td>
<td>A</td>
</tr>
<tr>
<td>Guanine</td>
<td>Purine</td>
<td>G</td>
</tr>
<tr>
<td>Cytosine</td>
<td>Pyrimidine</td>
<td>C</td>
</tr>
<tr>
<td>Thymine</td>
<td>Pyrimidine</td>
<td>T</td>
</tr>
<tr>
<td>Uracil</td>
<td>Pyrimidine</td>
<td>U</td>
</tr>
</tbody>
</table>
CHAPTER 20
GENES AND HEREDITY

IMPORTANCE OF GENETICS  (pg 468-469)
1. What is the study of genetics?
2. Define heredity.
3. What controls your biological traits?
4. Explain how your traits are determined by the genes in your cells.

EARLY BELIEFS  (pg 469)
5. Define hybrid.
6. What was infanticide?

PIONEER OF GENETICS: GREGOR MENDEL  (pg 469-470)
7. With what organisms did Mendel do most of his experiments and studies?
8. Why did Mendel choose to study garden peas?
9. Explain the difference between self-fertilizing and cross-fertilizing.
10. Name the male and female parts of the flowers on a pea plant.
11. What is pollination?
12. How did Mendel ensure that his pea plants were being cross-fertilized and not self-fertilized?

MENDEL'S EXPERIMENTS  (pg 471)
13. What did Mendel discover when he crossed plants that produced round seeds with plants that produced wrinkled seeds?
14. After Mendel had repeated his experiments using other traits besides round versus wrinkled seeds, what conclusion did he make?
15. Differentiate between dominant and recessive genes.

MENDEL'S LAWS OF HEREDITY  (pg 471-472)
16. Explain Mendel's laws of heredity with regards to: inherited characteristics, the principle of dominance, and segregation.
17. Mendel continued his experiments using hybrid plants. What is a hybrid plant?
18. What is the filial 1 generation or F1 generation?

19. Explain the difference between "R" genes and "r" genes.

20. Compare the appearance of the F1 generation with the appearance of the F2 generation.

21. What is the expected ratio of the F2 generation?

GENETIC TERMS (pg 472-473)

22. Define genotype.

23. Why must a short pea plant have a "tt" genotype?

24. Define phenotype.

25. Differentiate between the terms homozygous and heterozygous.

26. Define alleles.

27. How many alleles does a pea plant have for one particular trait, such as height?

SINGLE-TRAIT INHERITANCE (pg 473-474)

28. What is a monohybrid cross?

29. What is a punnett square used for?

30. What would the genotype be for a plant that is heterozygous and produces round seeds?

31. What would the genotype be for a plant that produces wrinkled seeds?

32. What do you write along the top and side of a punnett square?

33. Looking at figure 20.10 on page 474, what would be the probability of the following offspring:
   a) phenotype- round seeds
   b) genotype- homozygous dominant
   c) phenotype- wrinkled seeds
   d) genotype- heterozygous dominant
   e) genotype- homozygous recessive

TEST CROSS (PG 475)

34. Why are black sheep seen as undesirable by sheep farmers?

35. What is the function of a test cross?

36. With what genotype is the unknown genotype always crossed with in a test cross?

37. What does it mean if the F1 generation of the test cross are all identical? … If they are a 50% split of 2 different traits?
MULTIPLE ALLELES (pg 475-476)

38. Is it possible to have more than 2 alleles for one trait?

39. How many genes can an organism, such as a fruit fly, have for a particular trait?

40. How are multiple alleles represented in a punnett square since we can no longer use a capital and lower case letter?

INCOMPLETE DOMINANCE (pg 476-478)

41. Define incomplete dominance.

42. What is intermediate inheritance?

43. In a trait that has incomplete dominance, what is the percentage ratio of the F2 generation?

44. What is codominance?

45. Describe a roan calf and how it is created.

SCIENCE AND POLITICS: LYSENKO AND VAVILOV (pg 480)

46. What did Lysenko propose during the 1940's?

DIHYBRID CROSSES (pg 480-481)

47. What type of offspring are always created by pure-breeding plants?

48. Do the laws of genetics apply to dihybrid crosses as they did to monohybrid crosses?

49. What is the genotype of the offspring that are produced when a pure-breeding dominant plant is crossed with a pure-breeding recessive plant? …..what is the phenotype of the offspring?

50. What type of gametes are formed from the genotype YYRR? …from yyrr?

51. Describe the law of independent assortment.

52. What type of gametes are formed from the genotype YYrr? …..from yyRR?

53. If the F1 generation (YyRr) plant is allowed to self-fertilize, what are the possible gametes formed?

54. What is the ratio of the offspring formed when the F1 generation is allowed to self-fertilize?

PROBABILITY (pg 482-483)

55. What is the study of probability?

56. Write the formula that is used to predict the probability of an event.
57. Describe the rule of independent events and the product rule.

58. What is the probability of flipping a coin and getting heads 4 times in a row?

59. If I had already flipped a coin 4 times and got 4 tails in a row, what is the probability that I could flip a tail on the next toss?

60. What are the ratios of the offspring when 2 heterozygous parents (EeWw x EeWw) are crossed?

61. If a tall female pea plant (Tt) is crossed with a tall male pea plant (Tt), what is the probability of the following events:
   a) tall phenotype  e) a tt genotype
   b) short phenotype  f) being a male tt genotype
   c) a TT genotype  g) being a female TT genotype
   d) a Tt genotype

SELECTIVE BREEDING  (pg 485)

62. Define selective breeding.

63. What is inbreeding?

64. What is hybridization and what are its' goals?

GENE INTERACTION  (pg 487-488)

65. What are polygenic traits?

66. What is an epistatic gene?

67. Describe the condition called complementary interaction.

68. Name 2 things that enzymes are capable of doing in cells.

69. Is it possible for two white clover plants that are unable to produce cyanide to have offspring that have the ability to produce cyanide?

ONE GENE, MANY EFFECTS  (pg 488-489)

70. What are pleiotropic genes?

71. What is the function of hemoglobin in red blood cells?

72. People who suffer from sickle-cell anemia have trouble carrying oxygen in their blood. What is another problem with these malfunctioning red blood cells?

73. Describe Marfan's syndrome.

EFFECTS OF ENVIRONMENT ON PHENOTYPE  (pg 490)

74. What do all genes have in common?

75. What 2 things affect the phenotype of an organism?
Genes and Heredity Crossword

Across
1. The breeding stock is drawn from a limited number of individuals
2. YyRr (x) YYRR is an example of a ______
3. Units of instruction located on chromosomes
4. Refers to the genes that an organism contains
5. The passing of traits from parents to offspring
6. Offspring that differ from their parents in one or more traits
7. What the organism looks like
8. Genotypes with different alleles
9. ______ genes affect many characteristics
10. Genotypes with identical gene pairs
11. Genes that determine the expression of a genetic trait in offspring
12. ______ dominance occurs when the offspring appear to be a blend

Down
2. YyRr (x) YYRR is an example of a ______
3. Units of instruction located on chromosomes
4. Refers to the genes that an organism contains
5. The passing of traits from parents to offspring
6. Offspring that differ from their parents in one or more traits
7. What the organism looks like
8. Genotypes with different alleles
9. Many genes affect one trait
10. ______ genes affect many characteristics
11. Genes that determine the expression of a genetic trait in offspring
HEREDITY: CLASSICAL GENETICS

1. Match the terms on the left with the correct description on the right.

1. genotype a. a different form of a gene
2. allele b. the plants first studied for inheritance of characteristics
3. monohybrid c. how gene pairs are assorted
4. homozygous d. when both alleles are the same
5. Mendel e. the gene that is expressed only when homozygous
6. peas f. the genes present in an organisms cells
7. phenotype g. stamen & pistel are on different flowers
8. independently h. the appearance of an organism
9. cross pollination i. a cross involving only one pair of traits
10. dominant j. discovered the principles of heredity
11. recessive k. the stamen & pistel are on the same flower
12. self fertilization l. the gene that masks the effects of other genes

2. True or False.

1. Two alleles of Gg are G and g.
2. Yy is a heterozygous genotype.
3. rr is homozygous dominant.
4. Gametes contain 2 alleles of each gene.
5. The phenotype Tt is heterozygous.
6. UU is a homozygous dominant genotype.
7. The genes T and t both code for the same trait of the individual.
8. The phenotype is the appearance of the individual.
9. Dominant genes are only expressed when in a homozygous individual.
10. r is dominant over R.

3. Circle the symbols which represent a recessive trait:

N t R B y a S K b

4. Invent appropriate symbols for the following pairs of dominant and recessive traits. Assume the trait listed first is the dominant trait.
   a. yellow and white flowers
   b. brown and silver fur
   c. spotted and solid coat
   d. brown and blue eyes

5. Which of the following examples describe genotype and phenotype?
   a. curly hair
   b. Rr
   c. A person with blue eyes
   d. A person with an allele for blue eyes and one for brown.
   e. A person who is homozygous for green eyes.
6. From the parents genotypes, list all the possible gametes which could be produced through meiosis. Remember, the parents are 2n and the gametes are only n.

<table>
<thead>
<tr>
<th>Parents</th>
<th>Gametes</th>
</tr>
</thead>
<tbody>
<tr>
<td>a. KK</td>
<td>_______</td>
</tr>
<tr>
<td>b. Ee</td>
<td>_______</td>
</tr>
<tr>
<td>c. Tt</td>
<td>_______</td>
</tr>
<tr>
<td>d. XY</td>
<td>_______</td>
</tr>
<tr>
<td>e. Bb</td>
<td>_______</td>
</tr>
</tbody>
</table>

7. State the genotypes of the following organisms.
   a. Homozygous green pod pea plant (green is dominant).
   b. Homozygous short-haired hamster (short is recessive).
   c. Homozygous six-fingered man (5 fingers is dominant).
   d. Heterozygous striped tiger (no stripes is recessive).
   e. Homozygous sickled blood cells (normal cells are dominant).

8. Complete the following chart using the information provided.

In the pea plant: Green seeds are dominant over yellow seeds
Round seeds are dominant over wrinkled seeds
Constricted pod shape is recessive to inflated pod shape
Tall stem length is dominant over short stem length

<table>
<thead>
<tr>
<th>Parent Genotype</th>
<th>Phenotype</th>
<th>Possible gametes</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pure green</td>
<td>GG</td>
<td>Green</td>
</tr>
<tr>
<td>Pure yellow</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Homozygous tall stem</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Homozygous wrinkled</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Hybrid inflated</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Homozygous tall</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Pure round</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Homozygous constricted</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Hybrid green</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

9. If red hair is dominant in horses to black hair, what are the possible genotypes and phenotypes is we cross a homozygous red horse and a homozygous black horse.

10. In summer squash, white fruit color is dominant over yellow.
   a) If a squash plant homozygous for white is crossed with one homozygous for yellow, what will be the genotypes and phenotypes of the F1 offspring?

   b) Use a punnett square to diagram a cross between two F1 individuals. What are the genotypic and phenotypic ratios for the offspring?
c) Use a punnett square and give genotypic and phenotypic ratios for a cross of an F1 individual with its yellow parent.

11. You have been asked to cross a homozygous blond parent with a heterozygous blond parent. In this question you have not been told which gene is dominant over the other.
   a) How can you tell which gene is dominant?

   b) Give the possible genotypic and phenotypic ratios of the cross above.

12. Do we have to use the term homozygous when a trait is recessive? Why or why not.

13. What are the possible genotypes and phenotypes if we cross 2 heterozygous tall pea plants?

14. Why is it impossible to have a recessive short plant if one parent is short and the other is homozygous tall?

15. If two pea plants are crossed and the F1 offspring includes one homozygous tall pea plant, what are:
   a) the phenotypes of the parents
   b) the possible genotypes of the parents

16. If a white rabbit is dominant to a jack rabbit, what are the possible genotypes and phenotypes if we cross a heterozygous white rabbit to a jack rabbit.

17. If both parents are homozygous tall, what percentage of their offspring could be short?

18. If blue eyes are dominant to brown eyes what would be the possible F2 genotypes and phenotypes of the offspring if the parents are homozygous blue eyes and brown eyes and the F1 offspring mated with a heterozygous blue eyed person?

19. If blue eyes are dominant to brown eyes what would be the F2 possible genotypes and phenotypes of the offspring if the parents are homozygous blue eyes and heterozygous blue eyes and the F1 offspring mated with a heterozygous blue eyed person?

20. The following problems are based on Wyandotte poultry in which rose comb is dependent upon a dominant gene, and single comb upon its recessive allele. To be included in the Wyandotte flock, a bird must have a rose comb.
   a) What would be the genotypic and phenotypic ratios for F1 offspring of a cross between the two heterozygous birds?
b) The Wyandotte poultry are required to have a rose comb. In certain strains of Wyandotte, however, single-combed birds occasionally appear. Why is this so?

c) The Wyandotte breeders never use a single-combed bird for mating. When a single-combed bird is born it is immediately discarded from breeding. Will this be sufficient to eliminate the gene for single-comb from the flock? Explain

d) A rose-combed male is mated with two rose-combed females. Female A produces 14 chicks, all of which are rose-combed. Female B produces 9 chicks, seven of which are rose-combed and two which are single-combed. What are the genotypes of the three parent birds?

21. The gene for tallness in peas is dominant over the gene for dwarfism. A cross between a tall pea plant and a dwarf produced 123 tall plants and 119 dwarf plants. What are the genotypes of the parents?

22. Albinism is a failure to produce the enzyme needed to make melanin. It is recessive to normal pigmentation. An albino woman (no color in skin, hair, iris) whose father is albino and mother normal, marries a normal man, one of whose parents is normal and the other albino. He has an albino sister. The couple have a normal daughter.
   a) What are the genotypes of the mother and father of the albino woman?
   b) What are the genotypes of the parents of the albino woman's husband?
   c) What is the albino woman's genotype?
   d) What is the albino woman's phenotype?
   e) What is the genotype of the albino woman's husband?
   f) What is the new child's (daughter) genotype?

23. In rabbits, grey fur is dominant to white fur. In order to determine the genotype of a grey rabbit a test cross is done and the results are 50% grey and 50% white offspring.
   a) What is a test cross?
   b) What is the genotype of the original grey rabbit?
INCOMPLETE DOMINANCE

1. What is meant by incomplete dominance?

2. When doing questions involving incomplete dominance, why is it best to use two capital letters or two lower case letters and subscripts, rather than the standard method of representing recessive genes with small letters and dominant genes with capital letters?

3. In snap dragons, yellow flower color is not completely dominant over white. The heterozygous condition produces pale-yellow flowers.
   a) What will be the result of a cross between two pale-yellow flowered plants?
   b) What will be the result of a cross between a pale-yellow flower and a white flowered plant?

4. Coat colors of the shorthorn breed of cattle represent a classical example of codominant alleles. Red is governed by the genotype C’C’, white by C’Cw, and roan by C’Cw.
   a) When roan shorthorns are crossed among themselves, what genotypic ratio is expected among their progeny?
   b) When roan shorthorns are crossed among themselves, what phenotypic ratio is expected among their progeny?

5. When chickens with white feathers are crossed with black-feathered birds, their offspring are all blue (Blue Andalusian). When blue Andalusians are crossed among themselves they produce white, blue and black offspring in a 1:2:1 ratio respectively.
   a) When blue Andalusians are crossed with black-feathered birds, what would you expect the phenotypic ratio to be?
   b) When blue Andalusians are crossed with black-feathered birds, what would you expect the phenotypic ratio to be in the F2 generation?

6. Yellow coat color in guinea pigs is produced by the homozygous genotype C’yC’y, cream color by the heterozygous genotype C’yC’w, and white by the homozygous genotype C’wC’w.
   a) What genotypic ratio are matings between cream-colored individuals likely to produce?
   b) What phenotypic ratio are matings between cream-colored individuals likely to produce?

7. A mating of an albino (white) guinea pig and a black one gave 6 white, 3 black, and 3 brown offspring in the F2 generation.
   a) What were the genotypes for the albino (Cw) and the black (Cb) parent guinea pigs respectively?
   b) What kinds of offspring, and in what proportions, would result from the mating of the black parent above with another animal of the same genotype?

8. How does the genotypic ratio expressed in incomplete dominance differ from the ratio expressed in complete dominance?
9. In the four o'clock, a flower rather like a petunia, the allele for red flower color is incompletely dominant over the allele for white flower color. When a red flower is crossed with a white one, an intermediate pink flower is produced.
   a) Show the genotypes of the parents and the F1 generation of a cross between a red and a white four o'clock flower.

   b) What would be the anticipated offspring if the F1 plant from above were crossed back with the red parent? ....... With the white parent?

10. Lethal alleles have such a detrimental effect on an organism that the organism cannot survive. Some lethal dominant alleles exhibit incomplete dominance, in which only the homozygous individual succumbs to the allele and dies. An example is the creeper chicken who has a heterozygous (Cc) who is damaged, a normal chicken is (cc), and death occurs in the genotype (CC).
   a) A creeper chicken (Cc), heterozygous for a lethal allele, mated with a normal chicken (cc). What is the expected genotypic ratio of the F1 generation?

   b) Why didn't the lethal allele (C) cause death in any of the embryos of this cross?

11. When two Mexican Hairless dogs are crossed about a third of the pups have hair, two-thirds are hairless, and some are born dead.
   a) The Mexican Hairless dog is not a recessive trait. How do you know that?
   b) In the first part of the question which dog is true breeding?
   c) Why is the symbol Hh a good representation of the trait for Mexican Hairless dogs?
   d) What would happen if two Mexican Hairless dogs were crossed?

   e) The hh genotype represents the puppies born dead. Why?
   f) What would be the phenotype of the HH genotype?
1. What are multiple alleles?

2. How many alleles for 1 trait can a single cell (2n) have?

3. What are the four phenotypes for blood type in humans?

4. How many genotypes are there for type A blood? Type B? Type AB? Type O?

5. What are the three alleles for blood type in humans?

6. $I^A$ and $I^B$ are considered to be codominant while $I^O$ is recessive to both $I^A$ and $I^B$. Can you explain what this means?

7. Diagram a cross between a male with blood type AB and a female with type AB blood. Give the genotypic and phenotypic ratios for the offspring.

8. A parent has type O blood. Which blood type could not be found in any of the children in this family?

9. What genotypes may be present in parents if a child has blood type O?

10. The children of a man with type A blood and a woman with type B blood were tested for blood type. Of the four children, one had type A, one had type B, and one had type O blood. What were the genotypes of the parents?

11. A man of blood type O marries a woman of blood type B (homozygous). What are the possible blood types they could expect in their children?

12. What are the possible genotypes of children born to a mother having the genotype $I^AmI^B$ and a father with type AB?

13. A woman with blood type B has a child with blood type O. What are the genotypes of the mother and child? Which genotypes could the father not have?

14. Two babies get mixed up in a hospital. Baby 1 has type AB blood and baby 2 has type A blood. Mr. Jones has type A blood and Mrs. Jones has type O blood. Mr. Smith has type AB blood and Mrs. Smith has type B blood. Which baby belongs to the Jones and which baby belongs to the Smiths?

15. Multiple Alleles control the intensity of pigment in mice. The gene $D_1$ designates full color, $D_2$ designates dilute color and $D_3$ is deadly when homozygous. The order of dominance is $D_1>D_2>D_3$. When a full-color male is mated to a dilute color female, the offspring are produced in the following ratio: two full color to one dilute to one dead. What are the genotypes of the parents?
16. Plumage color in mallard ducks is dependent upon a set of three alleles: $M^R$ for restricted mallard pattern, $M$ for mallard, and $m$ for dusky mallard. The dominance hierarchy is $M^R > M > m$.

a) What genotypic ratio is expected in the F1 generation when crossing $M^R M^R$ with $M^R m$?

b) What phenotypic ratio is expected in the F1 generation when crossing $M^R M^R$ with $M^R m$?

c) What percentage of the F1 generation are expected to be restricted mallard pattern when crossing $M^R M$ with $M^R m$?

17. A couple believes that they have brought home the wrong baby from the hospital. The wife is blood type O, and her husband is blood type B. The baby is blood type O. Could the baby be theirs?

18. Suppose that two newborn babies were accidentally mixed up in the hospital, and there was a question of which baby belonged to which parents. From the following blood types, which baby most likely belongs to which parents?

<table>
<thead>
<tr>
<th>Baby 1</th>
<th>Baby 2</th>
</tr>
</thead>
<tbody>
<tr>
<td>Type O</td>
<td>Type A</td>
</tr>
<tr>
<td>Mr. Brown</td>
<td>Mrs. Brown</td>
</tr>
<tr>
<td>Type B</td>
<td>Type AB</td>
</tr>
<tr>
<td>Mr. Smith</td>
<td>Mrs. Smith</td>
</tr>
<tr>
<td>Type B</td>
<td>Type B</td>
</tr>
</tbody>
</table>

19. A man of blood type B is being sued by a woman of blood type A for paternity. The woman's child is blood type O. Can this man be the father of her child?

20. Martha has type A blood. Her baby has type O blood. Jim has type A blood, but both of his parents had type AB blood. Can Jim be the father of Martha's child?
1. From the parents genotypes, list all of the possible gametes which could be produced through meiosis.
   a) RRAA
   b) RRVv
   c) KkIi
   d) liAA
   e) MMDD

2. In mice, a dominant gene (K) produces a kinked tail, while the recessive allele (k) results in a normal tail. At an independently assorting locus, a homozygous recessive genotype (ff) results in a fat mouse. The dominant allele (F) produces normal growth. Two dihybrid (heterozygous for both genes) mice are mated. What proportion of the offspring are expected to be of genotype kkFf?

3. Short hair (L) is dominant over long hair (l) in rabbits. In addition, the gene for spotted coat color (S) is dominant over the allele for solid color (s). Two dihybrid rabbits are mated. What phenotypes are expected, and in what ratios, among the bunnies produced?

4. In Martians, one gene is responsible for antennae. Martians who are homozygous recessive (aa) have no antennae, whereas those carrying the dominant allele (A) have antennae. A separate gene is responsible for the size of their eyes. The dominant allele (B) results in bulging eyes, while the homozygous recessive genotype (bb) results in normal-sized eyes. A homozygous bulging-eyed Martian with antennae is mated to a Martian with normal eyes and no antennae.
   a) In the F1 generation, what is the chance of a baby Martian having bulging eyes and antennae?
   b) In the F2 generation, what is the chance of getting a Martian with bulging eyes and antennae?

5. In the garden pea plant, round seed shape (R) is dominant over wrinkled (r), and yellow seed color (Y) is dominant over green (y).
   a) What phenotypes would be expected, and in what ratios, in the F2 from the cross of a homozygous wrinkled, yellow plant to a round, green one?
b) In the F2, what is the ratio of round to wrinkled? What is the ratio of yellow to green?

6. In watermelons, the genes for green color and for short shape are dominant over their alleles for striped color and for long shape. Suppose a plant with long striped fruit is crossed with a plant that is heterozygous for green color and homozygous for short shape. What are the phenotypes and their respective ratios?

7. A pea plant with a long stem, axial flower positions and a heterozygous genotype for the two traits is peacefully growing in your garden. What phenotype ratio would occur in the offspring if you mate this plant with a short pea plant with terminal flowers?

8. Some dogs bark while others are silent when trailing. The barking characteristics (B) is dominant. Erect ears (E) are dominant to drooping ears. List the genotypes, genotypic ratio, phenotypes and phenotypic ratio expected in pups when a heterozygous erect-eared barker crosses with a droopy-eared, silent-trailer.

9. If one individual is homozygous for two dominant traits and another is homozygous for two recessive traits, and if the two individuals are crossed, what proportion of the F1 offspring from this cross will resemble each parent in appearance? The F2 offspring?
1. Assuming a 1:1 sex ratio, what is the probability what a family of six children will consist of:
   a) a boy, a girl, a boy, a girl, a boy, a girl?
   b) all girls?
   c) All the same sex?

2. The probability that, if a family has five children, all will be girls is ______.

3. What is the probability of drawing an ace from a standard deck of 52 cards?

4. What is the probability of drawing an ace, king or queen in pulling a card from a standard deck?

5. What is the probability of tossing five heads of a coin in a row?

6. What is the probability of tossing a coin and getting heads three times in a row?

7. Having tossed a coin five times and getting tails five times, what is the chance that the next toss of the coin will be heads?

8. How often would you expect a die to stop with the six-side up?

9. Of the 148,462 deaths in New York in 1935, 4196 were of diabetes and 7436 were of tuberculosis. Based on this data:
   a) What is the probability that the next person to die would die of diabetes?
   b) What is the probability that the next person to die would die of tuberculosis?

10. What is the chance of drawing a spade in a single draw from a deck of cards?

11. What is the chance of rolling two dice, both rolling six-face up?

12. What is the probability of getting three heads when tossing three coins at a time?

13. What is the chance that in rolling a die it will come up either 6 or a number other than 6?
PUNNETT SQUARE REVIEW

1. In a certain animal black fur (B) is dominant to white fur (b). Determine the expected genotypic and phenotypic ratios resulting from a cross between two heterozygous blacks.

2. In fruit flies, long wing (L) is dominant to short wing (l). Two long wing flies produced 49 short wing and 148 long wing offspring. What are the probable genotypes of the parents? What proportion of the long wing offspring should be heterozygous?

3. If a brown-eyed man marries a blue-eyed woman and they have ten children who all have brown eyes, what would be the likely genotype of the father? Can you be certain of the man's genotype?

4. If three of the children had blue eyes in the above question, what would be the genotypes of the father? Can you be certain of the man's genotype?

5. In Andalusian fowl, B is the gene for black plumage. Small b is the gene for white plumage. The genes show incomplete dominance. The heterozygous condition results in blue plumage. List the genotypic and phenotypic ratios expected from the crosses:
   a) black x blue
   b) blue x blue
   c) blue x white

6. In cattle, black coat color is dominant to white coat color. A farmer has a black male of undetermined genotype. How can the farmer determine the genotype of the male?

7. In guinea pigs black coat color (B) is dominant to white and short hair (S) is dominant to long. Show a cross between a homozygous black, short-haired, guinea pig with a white, long-haired, guinea pig.

8. King Henry the VIII married his brother's widow, Catherine of Aragon. The only children that lived was a daughter who later became Queen Mary I. If Henry's blood type was AB and Catherine of Aragon's blood type was OO, what were the possible blood phenotypes and genotypes of Queen Mary I?
9. Henry the VIII wanted a son so he got his marriage to Catherine of Aragon annulled and married one of the ladies of the court named Anne Boleyn in 1533. The only child of this marriage was a daughter who later became Queen Elizabeth I. If both parent's blood types were AB, what were the possible blood phenotypes and genotypes of Queen Elizabeth I?

10. In humans, brown eyes (B) are dominant to blue, and black hair (L) is dominant to blond hair. Show the results of the children from the marriage of two parents, both of whom are heterozygous for brown eyes and black hair.

11. In Andelusian fowl, feather color is incompletely dominant. Blue feather color is found in an animal heterozygous for white (W1) and black (W2) feathers. Also, normal (N) size is dominant to bantam (small) size. Show the results of a cross between a white bantam Andelusian and a black Andelusian heterozygous for normal size. Give both genotypic and phenotypic ratios of the F1 generation.

12. About 70% of Canadians get a bitter taste from a drug, phenyl thiocarbimide (PTC), the others do not. The ability to taste this drug results from a dominant allele. Taste-blindness is recessive. A normal-pigmented woman (N) who is taste-blind has a father who is an albino-taster. She marries an albino who is a taster but has a mother who is taste-blind. (normal pigment is dominant)
   a) Show the genotypes of the female and male.
   b) Give the expected genotypic and phenotypic ratios of the children the couple may have.

13. Define and give an example of a lethal allele.

14. White Leghorn chickens are homozygous for an allele for color (C). Another independent allele (I) acts as a color inhibitor if present in the dominant form of the allele. White Wyandotte chickens are homozygous recessive for both the color allele and the inhibitor allele. Predict the F2 phenotypes and expected phenotypic ratio if a White Leghorn chicken (IICC) is crossed with a White Wyandotte (iicc).
15. Suppose that in outer space there exists creatures whose traits are inherited by Mendel's laws. You find that purple eyes (P) are dominant to yellow eyes (p). Two purple eyed creatures mate and produce six offspring, four of them have purple eyes and two have yellow eyes.

a) What are the genotypes of the parents?

b) The phenotypes?

c) What are the genotypes of the offspring?

16. If a child is born with type O blood, what blood type will one of the parents never be? Explain your answer.

17. A type of rodent demonstrates codominance. Black and white phenotypes are homozygous whereas gray fur indicates the heterozygous condition. A black male is crossed with a gray female. What are the genotypic and phenotypic ratios of the offspring?

18. Although the terms codominance and incomplete dominance are often used together to mean the same thing, they are actually separate terms. Explain the difference between codominance and incomplete dominance.
CHAPTER 21
THE SOURCE OF HEREDITY

IMPORTANT OF THE CHROMOSOMAL THEORY (pg 494-495)
1. Where in the body did early scientists believe that hereditary traits were located?
2. Which technology allowed genetic investigations to progress and improve?

CYTOLOGY AND GENETICS (pg 495)
3. What did Aristotle believe about heredity over 2000 years ago?
4. What is cytology?
5. Who discovered and coined the term "mitosis"?

DEVELOPMENT OF THE CHROMOSOMAL THEORY (pg 495-496)
6. What did Sutton and Boveri both notice about chromosomes?
7. How did Sutton explain the fact that thousands of traits are controlled by only 46 chromosomes?

CHROMOSOMAL THEORY (pg 496)
8. Outline the 4 key components of chromosomal theory.
9. Differentiate between a somatic cell and a gamete.

MORGAN'S EXPERIMENTS (pg 496-498)
10. Why was the fruit fly ideal for Morgan's genetic experiments?
11. What did Morgan determine about the location of the genes for eye color in fruit flies?
12. What are sex-linked traits?
13. Provide the phenotypes for: \( X^R X^R, X^Y, X^R X^T, X^R Y \)
14. Which chromosome does the father always supply to a male offspring?
15. Is it possible for males to be heterozygous for a sex-linked trait?

SEX DETERMINATION (pg 498-500)
16. Name a trait that is sex-linked in humans.
17. Why are more males color blind than females?
18. What is a Barr body?
19. What did Mary Lyon propose a Barr body was made of?
20. Are all female somatic cells identical?
21. Why are male calico cats so rare compared to the number of female calico cats?
22. Describe the chromosomal arrangement in females. …in males.
23. Approximately how many genetic traits are carried on the X chromosome?
24. What type of information is carried on the Y chromosome?
25. What is TDF?
26. When does a male fetus begin to differ from a female fetus?
27. What happens to the developing fetus if the TDF gene is activated?

GENDER VERIFICATION AT THE OLYMPICS (pg 501)
28. Are all of the genes that code for sex (male and female) located on the sex chromosomes?
29. Do men only carry genes that code for male traits, such as the male sex hormones?
30. What is believed to compose a Barr body?
31. Why would a woman with Turner syndrome not contain Barr bodies?
32. Describe a person who has testicular feminization syndrome.

GENE LINKAGE AND CROSSING-OVER (pg 503-504)
33. What did Morgan notice when he crossed fruit flies with the AABB and aabb genotypes?
34. Where are the genes for eye color found in fruit flies?
35. If genes are found on nonhomologous chromosomes, do they segregate independently?
36. If genes are found on the same chromosome, will they segregate independently?
37. Define linked genes.
38. What is crossing-over and when does it occur?
39. How can the frequency of crossing-over be calculated?

MAPPING CHROMOSOMES (pg 504-505)
40. Define gene marker.
41. If genes on the same chromosome are extremely close together will they be affected by crossing-over more often than genes that are further apart but still on the same chromosome?

42. Which genes are closer to one another, A and B with a crossover value of 3%, or C and D with a value of 8%?

43. Define map distance.

44. Which genes would be most affected by crossing-over, A and B that are 9 map units apart or C and D that are 2 map units apart?

**GENE RECOMBINATIONS IN NATURE (pg 507-508)**

45. What controversial theory did Barbara McClintock propose in the 1940's?

46. Define transposons.

47. What are plasmids?

48. Define conjugation.

**GENE SPICING TECHNIQUES AND GENE MAPPING (pg 508-509)**

49. What is an RFLP?

50. How can RFLP's be used to identify individual people?

51. What 2 other technologies are used along with RFLP's to map chromosomes?

52. Describe the process of gel electrophoresis.

53. Define genome.

54. How many genes do we have on our chromosomes and how many of these have been mapped?

**FRONTIERS OF TECHNOLOGY: GENE THERAPY (pg 511-512)**

55. How many genetic diseases have been identified and give three examples?

56. Define gene therapy.

57. Describe the process of gene insertion.

58. Describe the processes of gene modification and gene surgery.

59. As of today, what type of cells are scientists using gene therapy on?

60. What ethical or moral questions may result from the science of gene therapy?
Heredity Crossword

Across
2 _____ traits are controlled by genes on the sex chromosomes
5 The complete set of instructions contained within your DNA
6 _____ bodies are small dark spots of chromatin
7 A form of sexual reproduction
8 Locating gene position along chromosomes
9 Gene _____ are usually recessive traits that identify other genes

Down
1 Small rings of genetic material found in bacteria
2 All cells except sex cells
3 An insect used in the study of genetics
4 Segments of DNA that move along chromosomes
GENETICS REVIEW

1. The law of dominance states that one form of a hereditary trait, known as the ________ trait, prevents the expression of the other trait, known as the ________ trait.
2. Two sex-linked traits in humans are ___________ and ________________.
3. ___________ occurs when one gene is not completely dominant over the other gene and a new phenotype is created.
4. ___________ occurs when two genes are expressed at the same time, in a sense both genes are dominant and are expressed.
5. The law of independent assortment states that segregation of alleles occurs ___________ of the segregation of other alleles.
6. Each gamete contains ______ allele for each trait.
7. Alleles are carried on one of the 22 chromosomes known as ___________.
8. Genes may also be carried on the _____ chromosome, but never on the _____ chromosome. These traits are known as ________________ traits.
9. The chromosomal theory of heredity states that _______ are located on chromosomes.
10. Variety in offspring is created by the process of ____________ which occurs during meiosis and the formation of the gametes.
11. In humans, sex is determined by the ________.
12. Genes located on the same chromosome are said to be ___________.
13. A couple that already has 3 sons wishes to have a fourth child. The probability that the fourth child will be a boy is _______.
14. Linked genes may be separated by _____________________.
15. A trait is made up of _____ alleles, one from your mom and one from your dad.
16. The combination of alleles which an organism has is called its _____________.
17. A description of a trait that an organism is expressing is called its _____________.
18. An organism that has two alleles that are the same for a trait is said to be _________.
19. When an organism has two different alleles for the same trait it is said to be _________________.
20. When traits are governed by more than two alleles they are termed _______________.
21. Dormant X chromosomes in females are called _____________ and can be used in gender verification.
22. The male and female fetus is the same until the ___________ week of pregnancy when the _______________ gene is activated, which subsequently triggers the release of the male sex hormones.
23. Genes on the same chromosome that are close together have a ___________ chance of being separated by crossing over than do genes that are further apart.
24. The law of segregation states that each gamete will receive one ________ for each trait.
25. A ____________ is used to show the genetic history of a family.
1. In foxes, silver-black coat color is governed by a recessive allele, r, and red coat color by its dominant allele R. Determine the genotypic and phenotypic ratios expected from the following matings.
   a) homozygous red x heterozygous red

   b) heterozygous red x silver-black

   c) homozygous red x silver-black

2. Over the summer holidays Rudolph the Red Nose Reindeer travels to Africa and ends up marrying a zebra. The coat color for tawny (T) is dominant to stripes (t) and black nose (B) is dominant to red nose (b). If Rudolph's genotype is Ttbb and the zebra's genotype is ttBb, what are the possible phenotypes of their offspring and in what ratios?

3. In turkeys, B is the gene for black plumage and b is the gene for white plumage. The genes show incomplete dominance. The heterozygous condition results in blue plumage. List the genotypic and phenotypic results from the crosses between:
   a) black x blue

   b) blue x blue

   c) blue x white

4. Jack with type AB blood and Jill with type B blood go up the hill and get married. What is the probability of their having a child with type AB blood? Type A blood? Type O blood?

5. Hemophilia is a sex-linked disorder. Miss Piggy is a carrier of hemophilia. What are the chances of her giving birth to a normal son if she marries Kermit who is normal?
6. Fozzy Bear with type O blood is accused of fathering the child of Miss Piggy with type AB blood. The child has type AB blood. Is Fozzy Bear guilty?

7. In cats which are XX (female) and XY (male), the X-linked allele (B) determines black coat color when homozygous, yellow when homozygous recessive (b), and tortoise shell (calico), a mixture of black and yellow, when heterozygous. The Y chromosome lacks the gene for hair color.
   a) A yellow mother has a litter consisting of two yellows and three calico offspring. What is the genotype of the father?

   b) A calico mother has a litter of six: one yellow male, two black males, one yellow female and two calico females. What is the genotype of the father?

   c) A calico mother has a litter of three black females. If the father was black, how often would you expect the same results to happen?

8. Nystagmus is a condition in men characterized by involuntary rolling of the eyeballs. The gene for this condition is recessive and X-linked. Three phenotypes are possible: normal, slightly rolling, and severe rolling. A woman who exhibits slight nystagmus and a normal man are considering marriage, and so they ask a geneticist what the chance is that their children will be affected. What will the geneticist tell them is she knows her genetics?

9. Human color blindness is a sex-linked trait due to a recessive gene.
   a) What is the probability that a woman with normal vision (but a carrier) whose husband is color blind will have a color blind son?

   b) What is the probability that a woman with normal color vision whose father was color blind, and whose husband has normal vision will have a color blind daughter?

10. An X-linked gene (c) produces red-green color blindness. A normal woman whose father was color blind marries a color blind man.
    a) What are the chances that the first child will be a color blind boy?

    b) Of all the phenotypes produced from this marriage, what percent of the girls are expected to be color blind?

    c) Of all the children, sex unspecified, from this marriage, what proportion are expected to be normal?
11. If a trait is always transmitted directly from a father to all his sons and from these sons to all their sons, etc…. what chromosome would the gene for the trait be likely to be on?

12. In cats the genotype BB is black. Bb is tortoise shell and bb is yellow. The gene is on the X chromosome. A tortoise shell female is crossed with a black male.

   a) What offspring would be expected?

   b) Would you expect to find any tortoise shell males?

13. In men color blindness is due to a sex-linked recessive allele while blue eyes are due to an autosomal recessive allele. Two brown-eyed persons with normal vision produced a blue-eyed color blind son. What are the genotypes of the parents?

14. A blue-eyed woman whose father was color blind marries a brown-eyed man whose mother was blue-eyed. What proportion of the sons would be blue-eyed and color blind?

15. Color blindness is inherited as a sex-linked recessive allele. Write as far as possible the genotypes of each person in the following pedigree. Black circles indicate color blind persons.

16. A man who is color blind has an XO daughter who has normal vision. What does this tell you about the place where non-disjunction occurred?

17. In mice there is a coat color gene called Tabby (T) located on the X chromosome. What genotypes would be expected among the progeny of a Tabby (TO) female mated with a normal gray colored (t) male? (at least one X chromosome is needed for the embryo to survive)

18. Hemophilia is a sex-linked recessive disorder in humans. Show the only two crosses that can result in the birth of a hemophiliac girl.

19. Show the results of a cross between a man with type O blood and a woman with type AB blood.
20. A man has two parents who appear normal. He marries a woman who also has two parents that appear normal. They have a son who is color blind. Show how this could have happened.

21. A certain woman was a carrier of hemophilia. What are the chances of her giving birth to a normal son if she marries a normal man?

22. In fruit flies, white eye color is a recessive sex-linked characteristic. A red-eyed male fly was mated with a white-eyed female fly. Show the results of such a cross (both genotypic and phenotypic ratios).

23. A red-eyed female fly was mated to a red-eyed male fly. They produced 96 offspring, 24 of which were male with white eyes. Show how this was possible. Also give the probability of the birth of a red-eyed male.
1. The data below show the rates at which crossovers occur for certain genes in Drosophila. Use this information to determine a gene order for the chromosome on which these genes are located.

<table>
<thead>
<tr>
<th>Genes</th>
<th>Crossover Rate</th>
</tr>
</thead>
<tbody>
<tr>
<td>Curved wings/vestigial wings</td>
<td>8.5</td>
</tr>
<tr>
<td>Curved wings/reduced bristles</td>
<td>24.5</td>
</tr>
<tr>
<td>Reduced bristles/purple eyes</td>
<td>3.5</td>
</tr>
<tr>
<td>Black body/lobe eyes</td>
<td>23.5</td>
</tr>
<tr>
<td>lobe eyes/reduced bristles</td>
<td>21</td>
</tr>
<tr>
<td>vestigial wings/purple eyes</td>
<td>12.5</td>
</tr>
<tr>
<td>vestigial wings/black body</td>
<td>18.5</td>
</tr>
<tr>
<td>purple eyes/curved wings</td>
<td>21</td>
</tr>
</tbody>
</table>

Hint: Of these genes, curved wings is closest to the end of the chromosome.

2. Map the chromosome based on the information below (crossover frequency).

<table>
<thead>
<tr>
<th>Genes</th>
<th>Crossover Frequency</th>
</tr>
</thead>
<tbody>
<tr>
<td>Blue eyes to short fingers</td>
<td>6%</td>
</tr>
<tr>
<td>Short fingers to widows peak</td>
<td>12%</td>
</tr>
<tr>
<td>Blue eyes to green eyes</td>
<td>13%</td>
</tr>
<tr>
<td>Short fingers to roman nose</td>
<td>15%</td>
</tr>
<tr>
<td>Blue eyes to roman nose</td>
<td>21%</td>
</tr>
<tr>
<td>Green eyes to roman nose</td>
<td>8%</td>
</tr>
<tr>
<td>Blue eyes to widows peak</td>
<td>18%</td>
</tr>
<tr>
<td>Widows peak to roman nose</td>
<td>3%</td>
</tr>
<tr>
<td>Green eyes to widows peak</td>
<td>5%</td>
</tr>
<tr>
<td>Short fingers to green eyes</td>
<td>7%</td>
</tr>
</tbody>
</table>

Hint: Of these genes, blue eyes is closest to the end of the chromosome.
1. Kinky hair (k) is a recessive trait in humans. A kinky hair woman marries a normal haired man and they have four children. One kinky and one normal haired boy, one kinky and one normal haired girl. Draw the pedigree to show this description and indicate P1 and F1 genotypes.

2. Color blindness is a recessive sex-linked trait in humans. A normal man married a carrier female and they have 3 children. One normal girl, a color blind boy and a normal boy. Draw the pedigree to show this description and indicate P1 and F1 genotypes.

3. Look at the following pedigree for the trait that has the dominant form A and recessive form a. State the genotypes of the individuals and state whether this trait is dominant-recessive (autosomal inheritance) or sex-linked inheritance.
CHAPTER 24
POPULATION GENETICS

IMPORTANCE OF VARIATION  (pg 556-557)

1. Besides physical appearance, how can variation in organisms exist?

2. What is the source of genetic variation among individuals?

3. What advantage can mutations give to a population of organisms?

4. How do some genes increase in frequency within a population while others disappear?

5. What is earth's most valuable resource?

GENES IN HUMAN POPULATIONS  (pg 557)

6. Identify 3 problems that exist when one tries to study the genetics of humans.

7. Define population sampling.

8. Approximately how many people can roll their tongues because they have the dominant gene for tongue rolling?

9. Which blood type is most common in humans? ….. which is the rarest?

10. Approximately what percentage of Canadians have blood that is Rh negative?


POPULATION EQUILIBRIUM  (pg 560-561)

12. What 2 things are populations characterized by?

13. What is the Hardy-Weinberg principle?


15. Write the mathematical equation that expresses the Hardy-Weinberg principle.

16. The equation works on populations of organisms that are not evolving. Identify 5 conditions that cause a gene pool to not change.

17. What is the cause of evolution/change in the genetic composition of a population?

18. Write the punnet square on page 560 of the text into your notes. Realize that these gametes (A and a) represent an entire population, not just one male and one female.
19. If allele B has a frequency of 0.7, and allele b has a frequency of 0.3, predict the frequencies of the 3 genotypes in the next generation by using the Hardy-Weinberg equation.

20. Predict the genotypic frequencies of the next generation for a population that has a frequency of 0.6 for the C allele and 0.4 for the c allele.

21. Explain how the Hardy-Weinberg principle can be beneficial when looking at the frequency of recessive genetic disorders.

22. Define carrier.

23. In addition to being able to predict the percentage of carriers in a population, what is a second way of using the Hardy-Weinberg formula?

**EVOLUTIONARY CHANGE (pg 562-563)**

24. Are gene pools stable or unstable?

25. Identify the 3 main ways in which a gene pool is changed or forced to evolve.

26. What is a mutation?

27. Differentiate between chromosome mutations and gene mutations.

28. What is the original source of variation in populations that leads to evolutionary change?

29. How is it possible for a mutation to remain hidden within a population for a long period of time?

30. What is genetic drift?

31. What is gene flow?

32. Define immigration and emigration.

**CHI-SQUARE TEST (pg 563-566)**

33. What is a "chance" event?

34. What can probability predict?

35. How does sample size affect the chances of achieving expected results?
36. Use table 24.1 to predict the odds of throwing an "8" with two di.

**FRONTIERS OF TECH: MITOCHONDRIAL DNA & EVOLUTION (pg 570-571)**

37. What is the function of the mitochondria in our cells?

38. How is mitochondrial DNA different than the DNA found in the nucleus?

39. Describe the endosymbiotic hypothesis that attempts to explain why DNA is found in mitochondria.

**SPECIATION (pg 571-573)**

40. Define speciation.

41. Is it possible for a species to change and evolve but not become a new or different species?

42. What makes one species different than another species? That is, one species of moth different than another species of moth that looks very similar.

43. What are the 2 ways in which a new species may be created from an existing species?

44. Define selection pressure.

45. Explain how geographic isolation may lead to the formation of a new species.

46. What is reproductive isolation?

47. Give a few reasons as to why members of a population may become reproductively isolated from one another.

48. Generally, is speciation a sudden or lengthy process?

49. Define polyploidy.

**KEY POINT: HARDY-WEINBERG THEORY**

The proportions of alternate forms of a gene (alleles) in a large population will not change from generation to generation, unless mutation, selection, emigration or immigration of individuals from other populations influences them. If these conditions have no effect and if mating is random, the properties of genotypes in the population will also remain the same after one generation.

As long as no influences are brought to bear against a population, the population will remain stable.

The Hardy-Weinberg equation shows a picture of the make-up of a given gene pool. It will show the percent of two genes for a specific trait in a given population.

50. The five conditions of the Hardy-Weinberg principle are rarely met in nature. Yet the theory is still useful for studying "real" populations. How can you account for this apparent contradiction? Give three ways that the principle can be used.
Population Genetics Crossword

Across
2 A group of similar organisms located in a defined area
4 What lions and tigers will bear
5 Mathematical relationship based on probability
7 Sites of cytoplasmic DNA
8 Formation of a new species
9 The movement of organisms from one locale to another

Down
1 A law based on equilibrium of genotypes in populations
2 Condition in which organisms have more than two sets of chromosomes
3 A chart used to trace genetic characteristics
6 A theory used to explain the origin of mtDNA
HARDY-WEINBERG PROBLEMS

1. In a given population of organisms, the dominant allele has a frequency of 0.7, and the recessive allele has a frequency of 0.3. Use the Hardy-Weinberg formula to determine the genotype frequencies within the population.

2. Suppose a recessive disorder occurs in 9% of the population. What percentage of the population is heterozygous?

3. What would be the frequency of the genotypes if the genes have a frequency of exactly half and half?

4. In Tanzania, 4% (0.04) of the population are homozygous sickle-cell anemics (ss) and 32% (0.32) are heterozygous (Ss). From these data, calculate the proportion of alleles that are s and S.

5. In a moth population, 40% are dark colored and the white color (W) is dominant. Determine the frequency of the homozygous white moth.

6. A particular recessive trait was found in 300 out of 1200 people observed.
   a. What are the allele frequencies for the recessive and dominant alleles?

   b. What percentage of the students would be carriers of the allele for the recessive trait?

   c. How many of the 1200 students have the homozygous dominant genotype?

7. The recessive frequency for attached earlobes is 25% in a group of 2200 people.
   a. What are the allele frequencies for the dominant and recessive alleles?

   b. What are the genotypic frequencies?
c. How many people in the group have (unattached) earlobes?

8. Only four percent of the population studied could wiggle their ears (a recessive trait).
   a. What are the frequencies for the recessive and dominant alleles?

9. In a group of 200 dudes at Eddy's party last Saturday night, 162 individuals were tongue rollers (dominant) and 38 people could not roll their tongues (recessive). What is the gene and genotypic frequencies for this select population?

10. In the town of High River, 245 individuals had dimples in their cheeks (recessive) while 255 did not have dimples (dominant). What is the frequency of the genes in this population?

11. White wool is dependent upon a dominant allele B and black wool is dependent on the recessive allele b. Suppose that a sample of 900 sheep in Manitoba gave the following data: 891 white and 9 black. What is the frequency of the genes in this population?

12. The recessive trait of widow's peak was found in 250 out of 2200 people observed.
   a. What are the allele frequencies for the recessive and dominant alleles?
   
   b. What percentage of the students would be carriers of the allele for the recessive trait?

   c. How many of the 2200 students have the homozygous dominant genotype?

13. The recessive allele frequency for attached earlobes is 25% in a group of 3200 people.
   a. What are the allele frequencies?

   b. What are the genotype frequencies?

   c. How many people in the group have free (unattached) earlobes?

14. In a population of 200 pigs, there are 72 who have the recessive trait.
   a. Determine the frequencies of the dominant and recessive alleles.
b. Determine the number of heterozygotes in the population.

c. If natural selection removed all of the individuals with the recessive trait, then what would be the genotypic frequencies in the next generation?

15. In a given population of organisms, the dominant allele has a frequency of 0.70. Find all other frequencies.

16. In peppered moths, the white allele is dominant to the black allele. In October of 1994, an ecologist observed the peppered moths in Baker's Wood:
   
   White moths: 1025
   Black moths: 125

Determine the percentage of the homozygous recessive, homozygous dominant, and heterozygous genotypes.

17. A survey of 50 teachers at John Diefenbaker found that 32 had hair on their knuckles (dominant H) while 18 had no hair (recessive h). What is the frequency of the genes in this population and of the three possible genotypes?

18. In a given population of 610 individuals, the gene frequencies of the L and l alleles were found to be 0.62 and 0.38 respectively. Calculate the number of individuals with the L, Ll, and l genotypes.

19. How can you determine whether or not a given population is in genetic equilibrium?

20. A group of students were invited to taste phenylthiocarbamide (PTC). The ability to taste PTC is inherited by a single pair of genes and tasting (T) is dominant to non-tasting (t). Among 798 students, 60.4% were tasters.
   a. Calculate the allele frequencies for T and t.

   b. How many of the students were TT, Tt, and tt?
21. If a recessive allele occurs in 65% of the population, find each of the genotypic frequencies for this characteristic.

22. In 1000 tobacco seeds you will find a 3:1 ratio of green to albino plants. Find the allele and genotypic frequencies for this characteristic.

23. If the individuals in the pedigree below represent a distinct population, how many could be expected to be heterozygous for PKU? How many would be homozygous dominant for this trait?
CHAPTER 25
POPULATIONS & COMMUNITIES

IMPORTANCE OF POPULATIONS & COMMUNITIES (pg 576-577)

1. Define population.

2. What are a few factors that are associated with changes in a population?

3. Define community.

4. Differentiate between interspecific and intraspecific competition.

HABITATS, GEOGRAP. RANGE, AND THE ECOLOGICAL NICHE (pg577-578)

5. Differentiate between the terms geographic range and habitat.

6. List a few factors that might limit where an organism may live.

7. Define ecological niche.

DISTRIBUTION OF POPULATIONS (pg 578-579)

8. Identify the 3 population patterns that ecologists use when studying the distribution of an organism.

9. Describe a clumped distribution.

10. What determines where a population of organisms will clump together versus where they will not live?

11. Describe a random distribution of organisms.

12. Describe a uniform distribution of organisms.

CHAOS THEORY AND BIOLOGICAL SYSTEMS (pg 579-580)

13. Classically, how have scientists approached the study of an entire system?

14. How would a scientist who believes in Chaos Theory look at entire system?

SIZE AND DENSITY OF POPULATIONS (pg 580-581)

15. What three things are needed in order to accurately describe a population?


17. Define population density.

18. Write the formula used to calculate population density and label the 3 variables.
19. Does the population density by itself give an accurate description or representation of the population of organisms being studied?

DETERMINING CHANGES IN POPULATION DENSITY  (pg 581)

20. Define rate of change and write the symbol for it.

21. What is the formula used to calculate rate of density change?

22. What does it mean if the rate of density change is a negative number? …if it is a positive number?

POPULATION GROWTH PATTERNS  (pg 582-587)

23. Define the following terms:
   a) Natality
   b) Mortality
   c) Immigration
   d) Emigration

24. Write the formula used to calculate population growth.

25. Do the populations in ecosystems tend to change or remain the same?

26. Define dynamic equilibrium.

27. Differentiate between the terms open population and closed population.

28. What is a growth curve?

29. On a growth curve graph, which variable is the manipulated variable? Which is the responding variable?

30. What is the general shape of the growth curve for a closed population?

31. Define lag phase.

32. What occurs during the growth phase of the growth curve?

33. What formula is used to calculate the expected population at a given time (I)?

34. What is the stationary phase and what environmental conditions cause it to happen?

35. Define death phase.

36. What shape of graph occurs when some limiting factor is introduced? Draw an example of this type of graph.

37. Define carrying capacity.

38. What is a gestation period?
39. Define biotic potential.

40. Identify the 4 factors that affect an organism's biotic potential.

41. Define environmental resistance.

42. Which formula is used to calculate population increase when depending on biotic potential and carrying capacity?

43. Describe a J-shaped curve.

44. Which type of organisms tend to have J-shaped growth curves?

45. What is the most important limiting factor in regards to animal populations?

46. What is one way that animals may make adjustments in order to maintain a balance at their carrying capacity level?

47. Explain what happened at the Kaibob Plateau in Arizona.

LIMITING FACTORS IN POPULATIONS (pg 588-589)

48. On what does the survival of organisms depend on?

49. What is the law of minimum?

50. Define Shelford's law of tolerance.

51. Describe 2 adaptations that organisms may use to help them survive the extremes that may occur in their abiotic environment.

52. What is a density independent factor?

53. What are density dependent factors? Give a few examples.

r AND K POPULATION STRATEGIES (pg 589)

54. Where are K-selected populations found?

55. Describe a K-selected population, that is, give a few characteristics that are typical of a K-selected species.

56. Where are r-selected populations found?

57. Describe a r-selected population, that is, give a few characteristics that are typical of a r-selected species.

LIFE HISTORY PATTERNS (pg 590)

58. What is a population cycle?
59. Describe the growth curve for many rodents.

60. What often causes the sharp decline in a population during its' population cycle?

61. What is the relationship between the snowshoe hare and lynx population cycles?

62. Is the relationship between the hares and the lynx as simple as it seems? That is, do the lynx help control the hare populations?

63. What did studies on the hare-lynx relationship on arctic islands reveal?

**POPULATION HISTOGRAMS** (pg 592-594)

64. What information does a population histogram give you that a population growth curve does not?

65. Which graph, a population histogram or population curve, is best for predicting whether or not a population is growing, declining, or stabilized?

66. What 2 factors are not represented on a population histogram that may alter any predictions you may make?

67. Define zero population growth.

68. What event caused the first significant change in human population growth?

69. Identify 3 factors that have led to a dramatic increase in human population during the nineteenth century?

**INTRASPECIES AND INTERSPECIES COMPETITION** (pg 594-595)

70. State Gause's principle.

71. Differentiate between interspecific and intraspecific competition.

**PREDATION** (pg 595-596)

72. What is predation?

73. Define camouflage.

74. Define mimicry.

75. In predator-prey relationships does one organism influence or pressure the other organism or do they both influence one another?

76. Define coevolution.

**SYMBIOTIC RELATIONSHIPS** (pg 596-598)

77. Define symbiosis.
78. Differentiate between the terms parasitism, commensalism, and mutualism.

79. Define the terms parasite and host.

**SUCCESSION IN COMMUNITIES  (pg 600-603)**

80. Define succession.

81. What is a climax community?

82. What type of factors influence the succession of a community?

83. Describe the process of primary succession.

84. Describe the process of secondary succession.

85. Define pioneer community and give a few examples of the types of organisms found in a pioneer community.

86. What is a microclimate and explain how they are created?

87. As plant communities change and experience succession, what happens to the animal community?

88. Define the term seral stages.

89. Do the various stages of succession overlap at all?

90. Briefly describe the 4 stages of succession as depicted in figure 25.31.

91. Briefly describe the 4 generalizations about succession.
**Populations and Communities Crossword**

**Across**
1. Both organisms benefit in this relationship
2. Developing a similar color pattern
4. Conditions in a small part of a habitat
6. A protective strategy
7. A graph used to express how populations change over time
9. _____ capacity establishes the number of organisms in an area
10. A population with a short life span and high birth rate
13. One organism benefits and the other is unaffected
15. The physical area in which a species lives
16. _____ isolation
17. Is made from the populations of all organisms in an area
18. A group of individuals of the same species

**Down**
1. Environmental _____ includes factors that reduce populations
3. The number of organisms found in a defined area
5. A theory used to explain disorder
8. Living off another organism
11. _____ community is the final stage of succession
12. Organism that carries a parasite
14. _____ potential is the maximum number of offspring
Match the following terms to the list of descriptions given below.

<table>
<thead>
<tr>
<th>Term</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Alleles</td>
<td>describes the proportions of alleles in a population where no evolution is taking place</td>
</tr>
<tr>
<td>Biotic potential</td>
<td>describes the number of a particular species living in a set area</td>
</tr>
<tr>
<td>Carrying capacity</td>
<td>the birth rate</td>
</tr>
<tr>
<td>Closed population</td>
<td>alternate forms of the same gene</td>
</tr>
<tr>
<td>Commensalism</td>
<td>the growth of a population at a rate equal to the number of offspring to exponent of the number of generations</td>
</tr>
<tr>
<td>Environmental resistance</td>
<td>the death rate</td>
</tr>
<tr>
<td>Exponential growth</td>
<td>the maximum population that an area can sustain</td>
</tr>
<tr>
<td>Hardy-Weinberg principle</td>
<td>a relationship in which one organism benefits and the other organism is neither harmed nor helped</td>
</tr>
<tr>
<td>Heterozygous</td>
<td>describes two alleles that are different</td>
</tr>
<tr>
<td>Immigration</td>
<td>the movement of an individual out of a population</td>
</tr>
<tr>
<td>K-selected populations</td>
<td>a population that is only affected by mortality and natality</td>
</tr>
<tr>
<td>Intraspecific competition</td>
<td>describes two alleles that are the same</td>
</tr>
<tr>
<td>Locus</td>
<td>the movement of an individual into a population</td>
</tr>
<tr>
<td>Mortality</td>
<td>a relationship in which both organisms benefit from interacting with one another</td>
</tr>
<tr>
<td>Natural selection</td>
<td>the process of building a community after it has been disturbed by a fire, flood, etc</td>
</tr>
<tr>
<td>Interspecific competition</td>
<td>the position of a gene in a chromosome</td>
</tr>
<tr>
<td>Lichens</td>
<td>the first species to survive in a bare rock succession (e.g., lichen)</td>
</tr>
<tr>
<td>mimicry</td>
<td>a relationship in which one organism benefits at the expense of another organism</td>
</tr>
<tr>
<td>natality</td>
<td>the process of building a community from scratch or from where none existed before</td>
</tr>
<tr>
<td>Parasitism</td>
<td>a portion of a chromosome that determines a hereditary trait of the offspring</td>
</tr>
<tr>
<td>pioneer community</td>
<td>the species most suited to an area that settles into an area as its final community until nature or man removes them</td>
</tr>
<tr>
<td>Predator-prey</td>
<td>a relationship between organisms of the same species in which both or all are vying for the same space, water, light, food</td>
</tr>
<tr>
<td>primary succession</td>
<td>is the process in which a sequence of communities replace one another through time until the one most suited to the area settles in to stay</td>
</tr>
<tr>
<td>Population density</td>
<td>a population that is affected by natality, mortality, immigration, and emigration</td>
</tr>
<tr>
<td>interspecific competition</td>
<td>occurs when a harmless species has the color patterns that closely resemble those of a poisonous species thus protecting the prey from the predator</td>
</tr>
<tr>
<td>Parasitism</td>
<td>a relationship between organisms of different species in which they are vying for the same space, light, food, water</td>
</tr>
<tr>
<td>Symbiosis</td>
<td>a relationship in which members of one species hunt and kill the other species for food</td>
</tr>
<tr>
<td>Secondary succession</td>
<td>a close, long-term relationship between two individuals of different species</td>
</tr>
</tbody>
</table>
29. a stable population with a long life-span and low birth rate
30. the maximum number of offspring produced under ideal conditions
31. all of the factors that tend to reduce population numbers
32. an unstable population with a short life-span and high birth rate
33. Explain how the terms biotic potential, limiting factors, and environmental resistance are related.

34. Explain how population size and population density are different.

35. How is carrying capacity related to space and populations?

36. How does environmental resistance affect the growth rate curve?

37. What is the difference between a population that demonstrates a J-shaped curve and one that demonstrates an S-shaped curve?

38. What type of population is able to overshoot its carrying capacity?

39. Explain how the carrying capacity of a population could change.

40. A biologist studied a population of box turtles in an Ontario woodlot for a period of 10 years. He determined that the natality averaged 40 per year, the mortality 30 per year, immigration 3 per year, and emigration 8 per year.
   a) Was the population increasing or decreasing?
   b) Was the area supplying box turtles to other places or vice versa?
   c) What was the annual average change due to immigration and emigration?
   d) If the initial population was 15 turtles, what must the population have been at the end of 10 years?

41. Explain the difference between the terms density-dependent and density-independent factors as applied to a population.

42. Label the following statements as being either commensalism, mutualism, parasitism, or predation.
   a) A bird builds its nest in the branches of a tree.
   b) A remora attaches itself to a shark without harming the shark and feeds on the scraps of food that the shark eats.
   c) A shrimp cleans the external parasites, debris, and ectocommensals off the skin of a large fish.
   d) An anaerobic bacterium infects a cut, grows, and reproduces, causing lockjaw in a human.
   e) A wolf hunts and kills a deer.
   f) Certain algae and fungi live together as lichens.

43. If 400 hare live in an area that is 50 hectares in size, what is the population density of the hare?

44. If the population density of arctic fox were 27 per hectare in 1991, and then 38 per hectare in 2001, calculate the rate of density change.

45. Calculate the density of a field mouse population if 82 animals were observed in a 20 hectare area.

46. If a herd of deer had a population of 250 deer experienced 45 births and 60 deaths, and no immigration or emigration, what is the per capita growth rate of the deer population?
47. If a pod of whales had an original population of 75 whales experienced 12 births and 8 deaths, 5 whales emigrated and 8 immigrated, calculate the per capita growth rate of the whale population.

48. Explain the difference between Shelford's Law of Tolerance and Gause's principle.

49. If a population of 4500 Pacific Clams occupied a rectangular territory 5.0 meters by 5.0 meters, calculate the average density of this clam population.

50. If Grizzly Bears are determined to have a population density of 0.3 bears per 100 square kilometers, calculate the size of the Grizzly Bear population in an area 7000 square kilometers in size.

51. Draw a population growth curve and label the following areas of the graph: carrying capacity, lag phase, stationary phase, death phase, growth phase, environmental resistance.
   a) for a r-selected species
   b) for a k-selected species
**Abbreviations for Some Hormones**

<table>
<thead>
<tr>
<th>Hormone</th>
<th>Abbreviation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Adrenocorticotropic hormone</td>
<td>ACTH</td>
</tr>
<tr>
<td>Antidiuretic hormone</td>
<td>ADH</td>
</tr>
<tr>
<td>Follicle stimulating hormone</td>
<td>FSH</td>
</tr>
<tr>
<td>Human chorionic gonadotropin</td>
<td>HCG</td>
</tr>
<tr>
<td>Luteinizing hormone</td>
<td>LH (formerly ICSH in males)</td>
</tr>
<tr>
<td>Parathyroid hormone</td>
<td>PTH</td>
</tr>
<tr>
<td>Prolactin</td>
<td>PRL</td>
</tr>
<tr>
<td>Somatotropin (human growth hormone or growth hormone)</td>
<td>STH (HGH or GH)</td>
</tr>
<tr>
<td>Thyroid stimulating hormone</td>
<td>TSH</td>
</tr>
</tbody>
</table>

**Pedigree Symbols**

- Male
- Female
- Mating
- Mating between close relatives
- Roman numerals symbolize generations
- Arabic numbers symbolize individuals within a given generation
- Birth order, within each group of offspring, is drawn left to right, oldest to youngest
- Identical twins
- Non-identical twins
- Affected individuals
- Known heterozygotes for autosomal recessive
- Known carrier of X-linked recessive
- Deceased individuals
- Sex unknown
### Symbols

<table>
<thead>
<tr>
<th>Symbol</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>$D_p$</td>
<td>population density</td>
</tr>
<tr>
<td>$N$</td>
<td>numbers of individuals in a population</td>
</tr>
<tr>
<td>$A$</td>
<td>area, space, or volume occupied by a population</td>
</tr>
<tr>
<td>$t$</td>
<td>time</td>
</tr>
<tr>
<td>$\Delta$</td>
<td>change</td>
</tr>
<tr>
<td>$r$</td>
<td>biotic potential OR maximum per capita population growth rate</td>
</tr>
<tr>
<td>$K$</td>
<td>carrying capacity</td>
</tr>
<tr>
<td>$\frac{\Delta N}{\Delta t}$</td>
<td>a change in population size during time interval</td>
</tr>
<tr>
<td>$&gt;$</td>
<td>greater than, dominant over</td>
</tr>
<tr>
<td>$&lt;$</td>
<td>less than, recessive to</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Symbol</th>
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</tr>
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<tbody>
<tr>
<td>$\sigma$</td>
<td>male</td>
</tr>
<tr>
<td>$\varphi$</td>
<td>female</td>
</tr>
<tr>
<td>$n$</td>
<td>chromosome number</td>
</tr>
<tr>
<td>$B, b$</td>
<td>alleles; upper case is dominant, lower case is recessive</td>
</tr>
<tr>
<td>$I^A, I^B, i$</td>
<td>alleles, human blood type (ABO)</td>
</tr>
<tr>
<td>$P$</td>
<td>parent generation</td>
</tr>
<tr>
<td>$F_1, F_2$</td>
<td>first, second filial (generation)</td>
</tr>
<tr>
<td>$p$</td>
<td>frequency of dominant allele</td>
</tr>
<tr>
<td>$q$</td>
<td>frequency of recessive allele</td>
</tr>
</tbody>
</table>

### Equations

<table>
<thead>
<tr>
<th>Subject</th>
<th>Equation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hardy–Weinberg principle</td>
<td>$p^2 + 2pq + q^2 = 1$</td>
</tr>
<tr>
<td>Population density</td>
<td>$D_p = \frac{N}{A}$</td>
</tr>
<tr>
<td>Change in population size</td>
<td>$\Delta N = (\text{factors that increase pop.}) - (\text{factors that decrease pop.})$</td>
</tr>
<tr>
<td>Per capita growth rate</td>
<td>$cgr = \frac{\Delta N}{N}$</td>
</tr>
<tr>
<td>(time will be determined by the question)</td>
<td></td>
</tr>
<tr>
<td>Growth rate</td>
<td>$\frac{\Delta N}{\Delta t} = rN$</td>
</tr>
<tr>
<td></td>
<td>$\frac{\Delta N}{\Delta t} = rN \frac{(K - N)}{K}$</td>
</tr>
</tbody>
</table>
NERVOUS SYSTEM REVIEW

Know all of the following terms by either defining them, describing them, drawing them, etc…. are all of the above. Just know them and everything about them and how they all relate to one another!

1. nervous system, endocrine system, homeostasis
2. hormone, chemical messages, electrical messages
3. central nervous system, peripheral nervous system
4. somatic nervous system, autonomic nervous system
5. glial cells
6. neurons
7. motor neurons, sensory neurons, interneurons
8. dendrites, cell body, axon
9. schwann cells
10. myelin sheath
11. nodes of Ranvier
12. saltatorial conduction
13. myelinated, unmyelinated
14. neurilemma
15. white matter, gray matter
16. reflex arc
17. stimulus, response, effector
18. action potential
19. resting neuron, excited neuron, electrochemical gradient
20. -70 mV, +40 mV
21. potassium ions, sodium ions
22. resting potential
23. polarized, depolarization, repolarization
24. refractory period
25. threshold level
26. sodium gates, potassium gates
27. all or none response
28. synapse
29. presynaptic neuron, postsynaptic neuron
30. neurotransmitter
31. acetylcholine
32. acetylcholinesterase
33. presynaptic knobs
34. hyperpolarization
35. summation
36. excitatory and inhibitory neurotransmitters
37. enzymes
38. sympathetic and parasympathetic nervous systems
39. dura matter, arachnoid, pia matter
40. CSF
41. Spinal tap
42. Dorsal nerve, ventral nerve
43. Forebrain, hindbrain, midbrain
44. Olfactory lobes
45. Cerebrum
46. Cerebral cortex
47. Corpus callosum
48. Frontal, parietal, temporal, occipital lobes
49. Thalamus, hypothalamus
50. Cerebellum, pons, medulla oblongata
51. Strokes
52. Taste buds
53. Olfactory cells
54. Sclera, choroid layer, retina
55. Cornea
56. Aqueous humor, vitreous humor
57. Iris, pupil
58. Lens, ciliary muscles
59. Rods and cones
60. Optic nerve
61. Optic chiasma
62. Fovea centralis, blind spot
63. Accommodation
64. Pupil dilation and constriction
65. Rhodopsin
66. Proteins, vitamin A
67. Color blindness, night blindness
68. Glaucoma
69. Cataract
70. Astigmatism
71. Nearsightedness, farsightedness
72. Concave lens, convex lens
73. Inner ear, middle ear, outer ear
74. Pinna, auditory canal
75. Ear hairs, ear wax
76. Tympanic membrane
77. Ossicles
78. Maleus, incus, stapes
79. Oval window
80. Eustachian tube
81. Amplification
82. Vestibule
83. Semicircular canals, cochlea
84. Static equilibrium, dynamic equilibrium
85. Organ of corti, otoliths, utricle, saccule
ENDOCRINE REVIEW

Know, love, and respect all of the following:

1. What is a hormone?
2. Endocrine versus exocrine hormones.
4. Target tissue or organ.
5. The relationship between the nervous and endocrine systems (short and long term homeostasis).
6. Hypothalamus
7. Pituitary gland
8. Hormone receptor sites
9. Steroid hormones versus protein hormones
10. Negative feedback and positive feedback
11. Posterior pituitary versus anterior pituitary
12. Human growth hormone
13. Gigantism and dwarfism, acromegaly
14. Adrenal glands
15. Adrenal medulla, adrenal cortex
16. Epinephrine, norepinephrine, adrenalin, noradrenalin
17. Sympathetic nerves
18. Cortisol, aldosterone
19. Pancreas, islets of Langerhans
20. Insulin, glucagon
21. Liver and glycogen
22. ADH (anti-diuretic hormone)
23. Diabetes mellitus versus diabetes insipidus
24. Hyperglycemia versus hypoglycemia
25. Thyroid gland
26. Thyroxine
27. Goiter, iodine, hyperthyroidism (grave's disease), myxodema, cretinism
28. Prostaglandins
29. Oxytocin
30. FSH
31. LH
32. ICSH
33. GH
34. TSH
35. ACTH
36. Prolactin
37. Calcitonin
38. PTH
39. Testosterone, estrogen, progesterone
40. Releasing factors of the hypothalamus
41. Testes, ovaries, kidneys, bones, uterus,
1. sexual reproduction vs. asexual reproduction
2. gonads, testes, ovaries
3. scrotum, temperature, penis
4. epididymis, vas deferens, urethra
5. seminal vesicle, prostate gland, cowpers gland
6. seminiferous tubules, spermatogenesis, spermatids, sperm, semen,
7. flagellum, acrosome, mitochondria, enzymes,
8. meiosis, 2n vs. n, haploid vs. diploid
9. 23 chromosomes, 46 chromosomes
10. ejaculation
11. interstitial cells, testosterone, sertoli cells
12. FSH, LH (ICSH)
13. Ovaries, fallopian tubes, fimbria
14. Endometrium, myometrium
15. Vagina, cervix, uterus, vulva, acidity
16. Oogenesis, egg, ovum, oocytes, granulosa cell, polar body,
17. 400 eggs, menopause
18. follicles, ovulation, oviducts, corpus luteum
19. FSH, LH, progesterone, estrogen
20. Menstrual cycle, 28 days
21. flow phase, follicle phase, ovulatory phase, luteal phase
22. fertilization, implantation, oviducts, blastocyst, zygote, womb
23. chorion layer, HCG, placenta, amnion layer, amniotic sac
24. ectoderm, mesoderm, endoderm, allatosis, umbilical cord
25. three trimesters, gestation period,
26. parturition, fetus, labor
27. relaxin, oxytocin, prolactin
28. invitro fertilization, vasectomy, sterile
29. amniocentesis, ultra-sound
30. breast-feeding, hormones etc…, lactation
MITOSIS, MEIOSIS, MOLECULAR GENETICS REVIEW
(know and love all of the following)

1. meiosis, mitosis
2. cytokinesis, spindle fibers
3. haploid, diploid, gametes
4. 2n, n, 23 chromosomes, 46 chromosomes
5. homologous chromosomes,
6. chromatids, centomeres
7. genes
8. tetrad, crossing over, synapsis
9. prophase, metaphase, anaphase, telophase (I and II)
10. gametogenesis, eggs and sperm, ootid and polar body,
11. sex chromosomes and autosomes
12. nondisjunction, trisomy, monosomy
13. down's syndrome, turner syndrome, klinefelter syndrome
14. karyotype
15. karyotyping, amniocentesis, chorionic villus sampling (CVS)
16. supermales
17. surrogate mother, in vitro fertilization, artificial semination
18. DNA, heredity, chromosome, gene
19. Nucleotides
20. Nitrogen bases, phosphates, sugar molecules
21. double helix, Watson and Crick, backbone and ladder rungs
22. complementary base pairs, hydrogen bonds
23. semi-conservative DNA replication
24. polymerases, ligases, restriction enzymes, gyrase
25. recombinant DNA, biotechnology, oncogenes, gene splicing
26. mutations
27. DNA fingerprinting, electrophoresis
28. proteins, amino acids, enzymes
29. one gene - one protein hypothesis
30. triplet codons, 64 codons
31. DNA vs RNA, messenger RNA, protein synthesis, ribosome
32. terminator codons, initiator codons
33. transcription
34. tRNA, anticodon
35. translation
36. somatic mutations, gametic mutations, base-pair substitution, frame-shift mutation
37. mutagen, carcinogen
38. be able to use your mRNA chart in both directions using DNA, mRNA, and tRNA
1. genetics, heredity, traits
2. hybrid
3. pollination, fertilization
4. self-fertilizing, cross-fertilizing
5. dominant genes, recessive genes
6. Mendel's: inherited characteristics, principle of dominance, law of segregation
7. filial generation (F1 and F2), offspring
8. genotype, phenotype, ratios
9. homozygous and heterozygous
10. alleles
11. monohybrid cross, punnett squares, dihybrid cross
12. test cross
13. multiple alleles, superscript letters
14. incomplete dominance and codominance
15. law of independent assortment
16. probability
17. rule of independent events, product rule
18. selective breeding, inbreeding
19. polygenic traits, epistatic genes, pleiotropic genes
20. pedigrees, carriers,
21. chromosomal theory
22. Morgan's experiments with fruit flies
23. sex-linked traits, X and Y chromosomes
24. color blindness, hemophilia
25. Barr body
26. somatic cells and gametic cells
27. linked genes
28. crossing over and frequency of crossing over
29. gene markers
30. map distance, crossover value
31. gene therapy, gene insertion
32. map chromosomes
1. genetic diversity, genetic variation
2. gene pool, gene frequencies
3. population,
4. Hardy-Weinberg principle
5. genetic equilibrium
6. \( p^2 + 2pq + q^2 = 1, \quad p + q = 1 \)
7. allele frequency calculations, genotypic frequency calculations
8. 5 conditions needed to meet the Hardy-Weinberg principle
9. evolution, genetic change
10. carrier,
11. How is the Hardy-Weinberg useful to us?
12. mutations, genetic drift, migration
13. chromosome mutations and gene mutations
14. selection pressure, speciation, geographic isolation, reproductive isolation
15. populations vs. community
16. habitat, niche
17. clumped, random, and uniform distribution
18. abiotic factors and biotic factors
19. population size, population density (formula)
20. natality and mortality
21. emigration and immigration
22. population growth (formula)
23. open populations and closed populations
24. growth curves, J shaped and S shaped, exponential growth
25. lag phase, growth phase, stationary phase, death phase
26. carrying capacity
27. environmental resistance, limiting factors
28. biotic potential
29. K-selected and r-selected species
30. Shelford's law of tolerance
31. density dependent and density independent factors
32. populations cycles
33. Gause's principle
34. interspecific and intraspecific competition
35. predator and prey
36. mimicry and camouflage
37. symbiosis
38. parasitism, commensalism, mutualism
39. parasite and host
40. primary succession and secondary succession
41. pioneer community, pioneer species, climax community