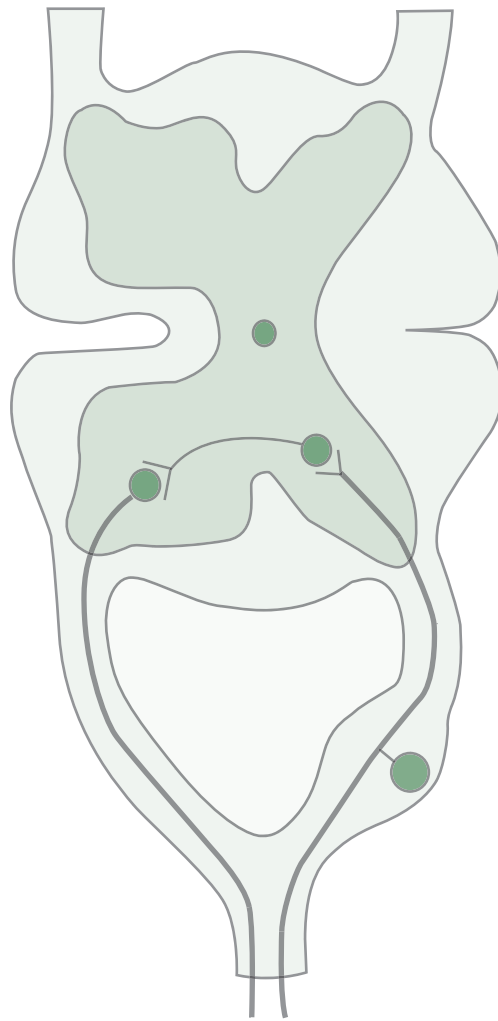


MAINTAINING DYNAMIC EQUILIBRIUM

UNIT 1



NEURON TYPE AND FUNCTION NEURONS, TRANSMISSION AND SYNAPSE

LESSON 1

INTRODUCTION TO NEURONS

The human body contains billions of cells. Like other systems in the body, the nervous system is composed of specialized cells. *Neuron* cells are specialized and designed to conduct nerve impulses. Neurons carry messages using electrochemical communication. There are many kinds of neurons. They differ in size, structure and function.

The nervous system also contains *glial cells* or *glial*. They have a variety of functions, such as support and insulation. The *Schwann cell* is a type of glial cell. It surrounds extensions of neurons called *axons*.

FACT

The human brain contains about 100 billion neurons.

TARGET CELLS

Cells stimulated by nerve cells are called *target cells*. Examples of target cells include:

1. *muscle cells* - they may respond by contracting or relaxing
2. *glands* - they may respond by secreting various substances
3. *other neurons* - they may respond by generating their own impulses

TYPES OF NEURONS

1. *Sensory neurons* - these neurons receive information from the environment
2. *Interneurons* - these neurons pass information between sensory neurons and motor neurons
3. *Motor neurons* - these neurons carry information to a target cell

STRUCTURE OF A NEURON

Like all cells, neurons contain a plasma membrane, *cytoplasm* (containing organelles) and a nucleus. Neurons differ from other cells. They contain unique structures called *axons* and *dendrites*. These are extensions of the cytoplasm. Axons carry information away from the neuron. Dendrites carry information toward the neuron.

ASSIGNED READINGS:

1. Read the pages indicated for your text.
Living Systems: pages 700-709.
Nelson Biology: pages 241-243, and 246-254.

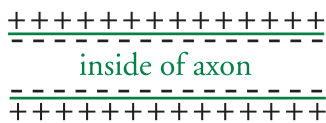
The reading will reinforce your awareness of the structure, function and location of the following parts of a neuron: axon, dendrite, cell body, myelin, Schwann cell, node, and axon terminal.

THE NERVE IMPULSE

A nerve impulse is an electrochemical response to a stimulus. When a nerve cell is stimulated, it sends an impulse along the neuron and the impulse is passed to another neuron until it reaches its destination. This electrochemical response is caused by a reversal in charge between the inside of a neuron and the outside of a neuron.

These differences in charges are caused by the distribution of *ions* on each side of the membrane. Normally, there is a greater distribution of positive ions outside the membrane because sodium ions are positively charged. Inside the membrane there are negative protein ions and positive potassium ions. When the inside is more negative and the outside is more positive, the neuron is at its *resting potential*. It is polarized. It has a charge of -70 mV.

Fig 1-1



When a neuron is stimulated, sodium and potassium ions pass across the membrane. This causes the neuron to become depolarized, making the inside positive relative to the outside. In order to pass through the plasma membrane, ions must enter through openings created by protein molecules. There are three types of protein “gates” in the membrane of a neuron:

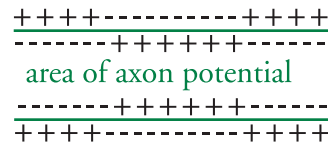
1. *gated channels* - are like gates which open or close to specific types of ions
2. *leak channels* - are like gates that are partially open, allowing ions to leak through slowly
3. *sodium-potassium pumps* - these protein gates use cellular energy to pump ions in and out of the membrane. For every two potassium ions that enter this gate, three sodium ions are ejected.

When a neuron is at rest, the sodium gates are closed. This means sodium cannot enter the cell. Potassium leak channels are open permitting some potassium to leak out.

When the neuron becomes depolarized, some

sodium gates open. At first, only a few sodium ions enter the cell. However, when the voltage reaches about -50 mV, the neuron is said to reach its *threshold* - the minimum voltage required for a neuron to “fire” or send an impulse. Once it reaches its threshold, all the sodium gates open and sodium pours into the cell. This causes the inside of the cell to become positive relative to the outside. The cell reaches its *action potential*, which is about +50 mV.

Fig 1-2



Once this happens, there is a brief rest period (called the *refractory period*) of about one millisecond. Then the potassium gates open. Potassium leaves the cell, causing the inside of the cell to become more negative again relative to the outside. The cell becomes repolarized. However, the distribution of ions is not the same as it was during the resting potential. To restore the proper distribution of ions, the sodium-potassium pump kicks in, sending out three sodium ions for every two potassium ions that enter. This restores the neuron to its resting potential.

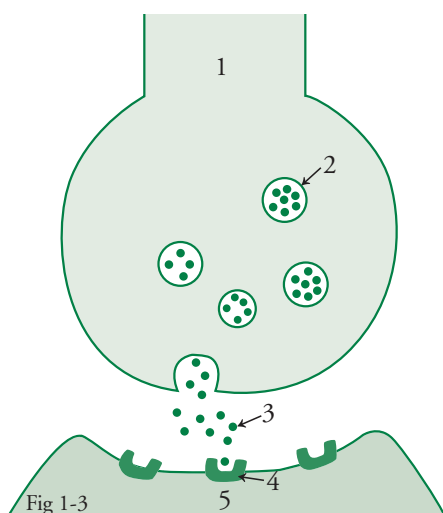
This rapid depolarization and repolarization of the neuron causes the nerve impulse to travel rapidly along the neuron. Nerve impulses travel in one direction only. They are “all-or-none” reactions, once the neuron fires, it fires completely.

THE SYNAPSE

A *synapse* is the space between two cells where a stimulus passes from an axon across a membrane to a target cell. When a nerve impulse passes along an axon and reaches the *axon terminal buttons*, the neuron must pass the impulse along to a target cell.

Tiny sacs called *vesicles* are present in the axon terminal buttons. When the impulse reaches the axon terminal buttons, the vesicles are stimulated to release a chemical called a *neurotransmitter*.

There are many kinds of neurotransmitters. Acetylcholine is one of the common neurotransmitters. The neurotransmitter leaves the vesicle, passes through the plasma membrane, and enters the synapse. It then binds to special protein molecules (receptors) on the target. The neurotransmitter and receptor fit together to stimulate the target cell.



1. Presynaptic neuron
2. Vesicle
3. Neurotransmitter
4. Receptor
5. Postsynaptic neuron or muscle

LESSON EXERCISE

PART 1

Are the following statements true or false? Check your answers in the answer key.

1. Cells that are unmyelinated conduct impulses faster than cells that are myelinated.
2. The myelin sheath is produced by Schwann cells.
3. Sensory neurons carry information to target cells.
4. A muscle cell is an example of a target cell.
5. Neurons do not contain a nucleus.
6. Axons are shorter than dendrites.
7. The space between two Schwann cells is called a node.
8. Interneurons pass information between sensory neurons and motor neurons.
9. Dendrites carry information away from the neuron.
10. An example of a glial cell is a Schwann cell.

PART 2

Indicate whether each statement is describing the resting potential or the action potential of a neuron.

1. The inside of the neuron has more sodium ions.
2. The inside of the neuron has a negative charge.
3. The sodium gates are open.
4. The outside of the neuron contains more sodium ions.
5. The inside of the neuron has a positive charge.

PART 3

Match the terms below to the descriptions provided.

TERMS

- _____ synapse
- _____ neurotransmitter
- _____ vesicle
- _____ postsynaptic neuron
- _____ presynaptic neuron
- _____ receptor
- _____ acetylcholine

DESCRIPTION

- a) the tiny sac that stores and releases neurotransmitters
- b) an example of a neurotransmitter
- c) the neuron that receives the neurotransmitter
- d) the gap or space between two neurons
- e) the chemical released into the synapse
- f) the neuron that releases the neurotransmitter
- g) the protein to which the neurotransmitter attaches once it crosses the synapse

SOMETHING TO THINK ABOUT:

What happens to your body when you are faced with a stressful situation (danger, fright, fear, etc.)? How long does it usually take for your body to return to normal?

DO AND SEND 1

- 1. State three ways that neurons are similar to other cells in the body, and state three ways they differ.
- 2. State three differences between axons and

dendrites.

- 3. What is the relationship between Schwann cells and myelin?
- 4. Imagine two neurons. One is wrapped with a myelin sheath and has a large diameter. The second neuron has no myelin sheath and a narrow diameter. Which of these neurons conducts a nerve impulse more rapidly? Explain.
- 5. Draw and label a diagram of a neuron. Label the axon, dendrite, node, myelin, and cell body.
- 6. Write a 100-word paragraph to explain the psychological effect of either chocolate (a substance) or acupuncture (a procedure) on the nervous system.
- 7. Copy the letter of the question and the correct word that completes each sentence.
 - a) A neuron at rest has a negatively charged (membrane/mitochondria).
 - b) Sodium is an ion of salt that has a (positive/negative) charge.
 - c) Resting neurons have a high concentration of potassium (inside/outside) the cell.
 - d) Potassium is an ion that has a (positive/negative) charge.
 - e) The inside of the cell has a high concentration of negatively charged (chlorine/protein) ions.
 - f) In a resting cell, potassium gates are open and potassium ions leak (inside/outside) cell.
 - g) The resting cell maintains a negatively-

- charged inside membrane by ejecting (protein/sodium/potassium) with an active transport pump.
- h) When a cell has a slightly negative charge inside it is called the (resting/ action) potential.
 - i) When the neuron is stimulated the gates that hold the sodium outside the cell swing (open/closed).
 - j) When the gates open, (sodium/ potassium) rushes (in/out) of the cell.
 - k) When the cell reaches its action potential, the inside of the membrane becomes (positive/negative).
 - l) When the inside of the cell becomes positively charged, this is called (repolarization, depolarization).
 - m) The sodium gates close immediately after they let sodium flood in and the (potassium/chlorine) gates open so that potassium rushes (out/in) of the cell in an attempt to make the inside of the cell less (positive/negative).
 - n) Once potassium has rushed (into/out of) the cell, the inside become more (negative/positive) once again. The process of becoming more (negative/ positive) inside is called (repolarization/ depolarization). However, even though the cell is becoming more (negative/ positive) it is not the same as resting potential because there is too much (sodium/potassium) inside the cell.
 - o) In order to get sodium back (into/out of) the cell and potassium back (into/ out of) the cell, the sodium-potassium pump ejects (three/two) sodium ions each time it admits (three/two) potassium ions into the cell.
 - p) As the sodium-potassium pump works, the cell returns to its normal (resting/ action) potential.
8. Copy the letter for each question and indicate whether the following statements are true or false. If the statement is false, re-write the sentence to make it true.
- a) Nerve cells that can conduct impulses are called Schwann cells.
 - b) Myelinated nerve cells conduct impulses faster than unmyelinated nerve cells.
 - c) Dendrites are short, unbranched extensions of the cell body.
 - d) Axons carry impulses toward the cell body.
 - e) The resting potential of a nerve cell is about -50 mV.
 - f) At rest, the inside of a nerve cell is positive relative to the outside.
 - g) At rest, the inside of the nerve cell contains more negative protein ions and more positive sodium ions that outside.
 - h) Sensory neurons take information from the central nervous system and carry it to muscles and glands.
 - i) Nerve impulses can travel in either direction along the axon.
 - j) A stimulus to a neuron causes movement of sodium ions in and potassium ions out of the cell.
 - k) The sodium-potassium pump restores

the membrane to its resting potential.

- l) An action potential is caused by a change in membrane potential.
9. In this exercise you will use the Internet to access [EBSCO](#) through [lrt.ednet.ns.ca](#).

[EBSCO](#) permits a periodical database search of newspaper and magazine articles.

Using a minimum of six articles, research a mind altering drug (like codeine, caffeine, heroin)

- identify the biological effects, reactions, properties and characteristics
- provide an understanding of its impact on neurotransmitters like serotonin
- assess the associated risks and potential benefits offered by the drug

Your response should be in the form of a 500 word magazine article. Be sure to include all of your sources.

Or

Select a nerve poison to investigate. Research the psychological effect it has on the nervous system, its sources, and the historical and/or current reasons for its use. Your response should be in the form of a 500 word magazine article. Be sure to include all of your sources.

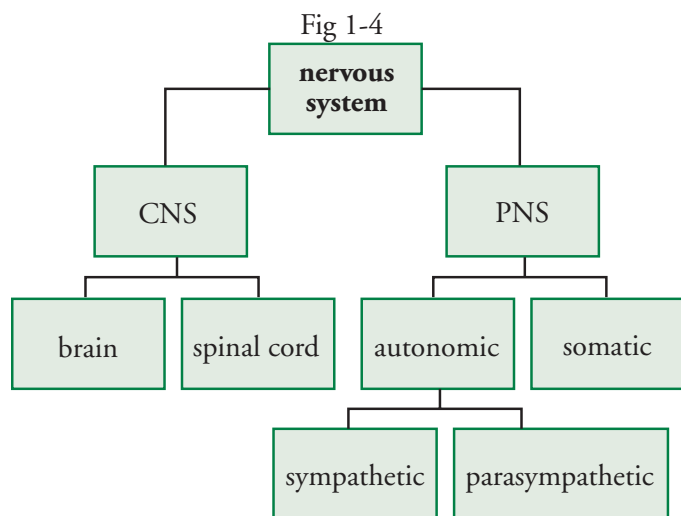
STRUCTURE OF THE NERVOUS SYSTEM

THE CENTRAL NERVOUS SYSTEM

LESSON 2

ORGANIZATION OF THE CENTRAL NERVOUS SYSTEM

The human nervous system is organized into two divisions: the central nervous system and the peripheral nervous system. The *central nervous system* (CNS) is the brain and spinal cord. The *peripheral nervous system* (PNS) is all the nerves outside the CNS. The PNS, in turn, can be subdivided. Examine the diagram below.



ASSIGNED READING

Living Systems: Pages 712-715. Examine Figure 25-20 on page 715 of your textbook. Familiarize yourself with the parts.

Nelson Biology: Pages 257 - 262. Examine Figure 11.18 on page 258. Familiarize yourself with the parts.

THE BRAIN

The human brain is made of soft, gelatinous tissue. It is located inside the skull or cranium in the cranial cavity and it weighs about 1.5 kg.

PROTECTION OF THE BRAIN

1. *Cranium* - The bones of the skull protect the brain from injury.
2. *Meninges* - The brain tissue is covered by a set of three membranes referred to as meninges. These protect and nourish the brain. The three layers are:
 - a) *dura mater* – this is the outermost layer
 - b) *arachnoid* – this is the middle layer
 - c) *pia mater* – this is the innermost layer
3. *Cerebrospinal fluid* - Is found between the layers of the meninges. It is also found in the spinal cord. It helps to cushion the brain against shock.

HEALTH CONNECTION

Meningitis is an infection of the meninges

4. *Blood-Brain Barrier* - This is a filtration system which controls the types of materials entering the brain's cells. It will allow needed materials, like glucose and oxygen, to enter the cells, but prevents harmful materials from entering.

REGIONS

The *forebrain* is the largest part of the brain. It includes the *cerebrum*, the *thalamus* and the *hypothalamus*. The *midbrain* is a relay center. The *hindbrain* includes the *cerebellum*, the *pons* and the *medulla*. Together, the midbrain and the hindbrain are called the *brainstem*.

FOREBRAIN

CEREBRUM

This is the largest part of the human brain. It is divided into two separate halves, the *cerebral hemispheres*. The hemispheres are connected by a cluster of nerve tissue called the *corpus callosum*. The surface of the cerebrum is the *cerebral cortex*. This area of the brain is made up of many folds and fissures. The cerebral cortex contains the cell bodies of thousands of neurons. The neurons are not covered with *myelin*. They are *unmyelinated*. The inner region of the cerebrum is made up of myelinated axons. Myelin makes the axons a whitish colour and is called the brain's white matter. The outer region of the cerebrum is called grey matter.

Humans have the largest cerebrum making us capable of language, reasoning, and personality.

The cerebrum is divided into specific lobes:

- a) *frontal lobe*
 - behind the forehead
 - controls the movement of voluntary muscles (such as walking, speech)
 - the center of intellectual activities (memory, speech) and personality
- b) *parietal lobe*
 - found at the top and sides of the head

- interprets many skin sensations (touch, temperature awareness, taste, pain)
- controls some emotions
- controls some speech

c) *occipital lobe*

- at base of the head
- controls vision

d) *temporal lobe*

- around the temples
- controls hearing, memory, and language

THALAMUS

It sorts and interprets incoming sensory information and acts to filter information and send information to the conscious part of the brain.

HYPOTHALAMUS

This area controls basic functions, such as hunger, thirst, body temperature, aggression, pleasure, blood pressure, and sleep. It also regulates the pituitary gland located slightly below and connected to it.

MIDBRAIN

This area is a relay center. Information going to and coming from the forebrain and hindbrain must pass through here. The midbrain controls some visual and auditory reflexes.

HINDBRAIN

CEREBELLUM

Located at the back of the head. Like the cerebrum, it is divided into folds. It controls posture, balance and muscle tone.

PONS

The name *pons* means bridge. It acts as a bridge between the areas above it and below it to control respiration.

- | | |
|-------------------|----------------------|
| ___ thalamus | G. respiration |
| ___ parietal lobe | H. relay center |
| ___ frontal lobe | I. heat, pain, touch |
| ___ spinal cord | J. reflex center |

MEDULLA OBLONGATA

It is located at the upper part of the neck level with the mouth. It controls vital reflexes like breathing rate, heart rate, diameter of blood vessels, swallowing, digesting, vomiting, coughing, and sneezing.

PART 3:**THE SPINAL CORD**

The spinal cord extends from the medulla oblongata. It is protected by three meninges and the bones of the vertebral column (the vertebrae). It has a fluid-filled center. The spinal cord also consists of white matter on the outside and grey matter on the inside. If you look at the spinal cord in cross-section, the grey matter looks like a butterfly.

LESSON EXERCISE

Match the parts of the brain to one of its functions by indicating the correct letter. When you are finished, check your answers in the answer section.

STRUCTURE

- ___ cerebellum
- ___ medulla
- ___ temporal lobe
- ___ hypothalamus
- ___ pons
- ___ occipital lobe

FUNCTION

- A. hearing
- B. balance and coordination
- C. vision
- D. coughing, swallowing
- E. body temperature
- F. voluntary movements

DO AND SEND 2**NERVOUS CONTROL IN OTHER ORGANISMS:**

Not all organisms have a nervous system as sophisticated and complex as the human nervous system. In this assignment, you will explore the types of nervous systems found in other organisms.

1. Using the Internet, your text or other references, research:
 - Paramecium
 - Hydra
 - Planarian
 - Earthworm
 - a) to describe the type of nervous control found in the organism
 - b) to write a description of the organism
 - c) to contrast the type of nervous control in the planarian and the hydra
2. Is there an advantage to having a brain at the anterior end of the body?

STRUCTURE OF THE NERVOUS SYSTEM

THE REFLEX ARC

LESSON 3

WHAT IS A REFLEX?

A *reflex* is a simple, predictable, involuntary response to a stimulus. Reflexes usually produce the same response to the same stimulus. They occur rapidly and may be protective. If you touch a hot stove, you immediately pull your hand away.

Consider the protection reflex responses in these examples:

1. An object comes close to your eye unexpectedly. You blink. Why?
2. You enter a bright room. Your pupil constricts (gets smaller). Why?

The neurons involved in a reflex are located in the spinal cord. The pathway of the reflex arc:

1. Receptor cells detect a stimulus. Stimuli are sound waves, light waves, heat, odour, etc.
2. The receptor passes information to a sensory neuron. The axon of the sensory neuron enters the dorsal root of the spinal cord.
3. The information is passed from the sensory neuron to an interneuron.
4. The interneuron passes the information to a motor neuron. The axon of the motor neuron exits the ventral root of the spinal cord.
5. The information passes along the motor neuron axon to a target cell, such as a muscle, to cause a response.

If we touch a hot stove, we pull our hand away immediately. This is a primary response. Neurons send information to the brain which allows us to interpret the information as pain. Shaking your hand would be a secondary response.

ASSIGNED READING

Living Systems: Pages 715-718. Examine Figure 25-22 on page 718 of your text. Familiarize yourself with all parts of the diagram.

Nelson Biology: Pages 243-244. Examine Figure 11-15 on page 244 of your text. Familiarize yourself with all parts of the diagram.

LESSON EXERCISE

You are walking barefoot and step on a sharp tack. You automatically pull your foot back in a reflex reaction. The following events occur in your body. Put these events in the correct sequence by numbering them from 1 - 6.

- _____ A motor neuron passes the impulse to the muscles in your foot.
- _____ A receptor in your foot is stimulated.
- _____ The impulse passes to an interneuron.
- _____ A sensory neuron carries the impulse to your spinal cord.
- _____ You pull your foot away.
- _____ The interneuron passes the impulse to a motor neuron.

SOMETHING TO THINK ABOUT:

Select a partner and test each others reflexes (e.g., knee jerk test for reaction time). What can be learned from tests like this?

DO AND SEND 3

The diagram below represents a cross-section of the spinal cord. It shows the pathway of a reflex arc as it enters and leaves the spinal cord. Copy or trace the diagram and, using a straight edge, neatly label the following structures on the diagram below:

- sensory neuron
- spinal nerve
- cell body of sensory neuron
- dorsal root of spinal cord
- interneuron
- motor neuron
- grey matter
- white matter
- ventral root
- ganglion (enlarged area of nerve tissue which contains sensory cell bodies)

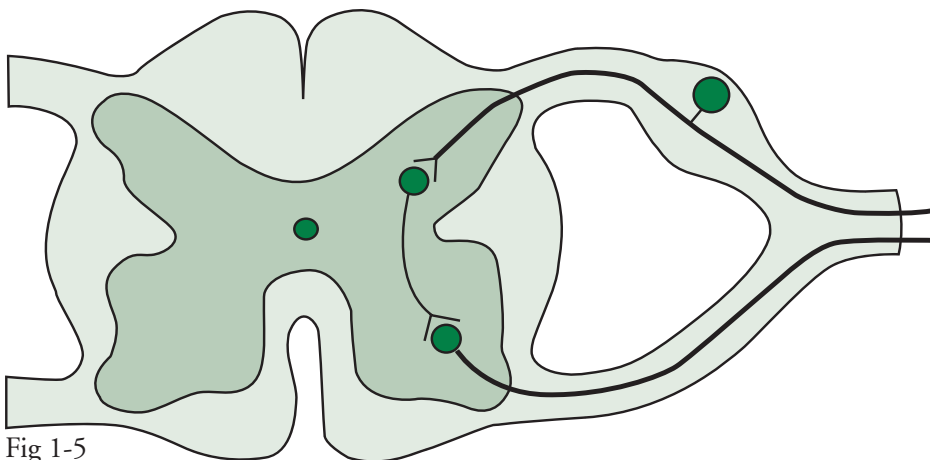


Fig 1-5

STRUCTURE OF THE NERVOUS SYSTEM

THE PERIPHERAL NERVOUS SYSTEM

LESSON 4

PERIPHERAL NERVOUS SYSTEM

The peripheral nervous system consists of all those parts of the nervous system outside the brain and spinal cord. It is primarily made up of sensory and motor neurons.

The PNS can be subdivided into the *somatic nervous system* and the *autonomic nervous system*. The somatic system sends impulses to those muscles that you control voluntarily. E.g., when you use your hand to write, you are using the *somatic nervous system*. The somatic system also controls many of your reflexes.

The *autonomic nervous system*, on the other hand, controls many activities in your body over which you have no conscious control and of which you are usually unaware. These responses are automatic and involuntary. They involve your circulatory and respiratory system, and your digestive tract. The autonomic system includes two kinds of nerves which work together. The *sympathetic nervous system* speeds up certain activities in the body. It is the branch of your nervous system that prepares the body for stress. The *parasympathetic nervous system* slows things down.

ASSIGNED READING

Living Systems: pages 715-719.

Nelson Biology: pages 256-257.

LESSON EXERCISES

For the activity below, decide if the sympathetic nervous system is operating or if the parasympathetic nervous system is operating.

Hint: Ask yourself if the activity listed is required during stress or an emergency. If it is, then the sympathetic nervous system is operating. When you are finished, check your answers in the answer key.

1. heart rate increases
2. pupils of eyes dilate (open up)
3. breathing rate slows down
4. stomach muscles churn during digestion of food
5. blood pressure increases
6. salivary glands produce saliva
7. liver releases more glucose
8. adrenal gland releases adrenaline

SOMETHING TO THINK ABOUT:

Prepare a chart to visually contrast the sympathetic and parasympathetic components of the autonomic nervous system on the various parts of the body (e.g., heart, digestive tract, blood vessels, bladder, bronchi, eye).

DO AND SEND 4

Part 1: Record the number and the letter of the matching definition for the following:

- | | |
|----------------------------|-------------------------------------------------------------------|
| 1. ____ CNS | a) Responsible for most reflex actions |
| 2. ____ PNS | b) Fluid that protects the CNS from shock |
| 3. ____ Thalamus | c) Tough membranes that surround the CNS |
| 4. ____ Hypothalamus | d) Controls blood temperature, thirst and hunger |
| 5. ____ Cerebrum | e) Largest part of brain; controls thought |
| 6. ____ Cerebellum | f) Neurons carrying information to brain |
| 7. ____ Cerebral fluid | g) Neurons carrying information to muscles |
| 8. ____ Spinal cord | h) Part of brain stem that controls heart rate and breathing rate |
| 9. ____ Grey matter | i) Consists of sensory neurons and motor neurons outside the CNS |
| 10. ____ White matter | j) Special nerves that control automatic functions of the body |
| 11. ____ Meninges | k) Consists of the brain and the spinal cord |
| 12. ____ Autonomic NS | l) Relays and sorts sensory and motor information in the brain |
| 13. ____ Motor neurons | m) Neurons that have a myelin sheath |
| 14. ____ Sensory neurons | n) Neurons that have no myelin sheath |
| 15. ____ Medulla oblongata | o) Part of brain responsible for coordination of motor activity |
| 16. ____ Interneurons | p) Neurons that connect sensory and motor neurons |

Part 2: Copy the number for each question and indicate whether each of the following statements is true or false.

1. ____ The cerebellum is the largest part of the brain.
2. ____ The pons is located below the medulla oblongata.
3. ____ The hypothalamus controls urges such as thirst and hunger.
4. ____ The corpus callosum controls most thinking and reasoning processes.
5. ____ Motor neurons will carry an impulse toward the central nervous system.
6. ____ The dorsal root of the spine's vertebrae has sensory neurons passing through.
7. ____ The hypothalamus produces several hormones that are stored in the pituitary gland.
8. ____ A reflex usually involves the peripheral nerves and the spinal cord.
9. ____ The temporal lobe of the brain controls vision.
10. ____ The frontal lobe of the brain controls hearing.
11. ____ The pons controls respiration.
12. ____ The sympathetic nervous system is part of the autonomic nervous system.
13. ____ The midbrain connects the hindbrain with the forebrain.

ORGANISMS' HOMEOSTASIS TO COMBAT DISEASE DISEASES OF THE NERVOUS SYSTEM LESSON 5

HOMEOSTASIS

Homeostasis refers to the ability of an organism to maintain a constant internal operating system despite changes in the environment. A simple example of this is our ability to maintain a constant body temperature despite changes in the external air temperature.

An inability to maintain homeostasis can result in death. All parts of our body work together to maintain this balance.

For each report, include the following:

1. Cause
2. How the disorder affects the nervous system
3. Symptoms
4. Treatment

For each choice, discuss how advances in science and technology influence our ability to explore the human brain (e.g., MRI, CAT scan, EEG, DNA analysis).

The reports should be submitted using the recommended format for research reports included in the appendix of this booklet.

DO AND SEND 5

RESEARCH

Research the impact any two of these four disorders have on the ability of our nervous system to maintain homeostasis.

Using any resources available, including the Internet, write a 100-word report on each of the two disorders you chose.

1. *Encephalitis* - a viral disorder of the nervous system
2. *Pneumococcal meningitis* - a bacterial disorder of the nervous system
3. *Parkinson's disease* - a genetic disorder of the nervous system
4. *Carpal tunnel syndrome* - an environmental disorder of the nervous system

SENSE ORGANS

THE EYE

LESSON 6

LOCATION:

Each eye fits into a socket or opening in the skull called an orbit.

PROTECTION:

The eye is protected in the following ways:

1. bones of skull
2. eyebrows
3. eyelids, partially cover eye; contain glands that produce an oily substance that lubricates the eye
4. eyelashes
5. lacrimal glands, found in the corner of each eye; cleans and moistens the eye
6. conjunctiva, a thin membrane that lines the eyelids and covers part of the eye. It secretes mucus which helps to lubricate the eye

STRUCTURE:

The eye is about one inch in diameter and is made up of three distinct layers. The three layers, and their location and functions are summarized in the table on the next page.

PATHWAY OF VISION:

When light enters the eye, it follows this pathway:

Light waves → cornea → pupil → lens → retina
→ rods and cones → optic nerve → occipital lobe of brain

ASSIGNED READING

Living Systems: pages 722-723.

Examine Figure 25-26.

Nelson Biology: pages 288-290.

Examine Figure 13.5.

LESSON EXERCISE

Match the structures below to the descriptions provided. Check your answers in the answer section.

Terms

- _____ lens
- _____ rods
- _____ cones
- _____ iris
- _____ pupil
- _____ cornea
- _____ sclera
- _____ retina
- _____ aqueous humour
- _____ vitreous humour

Structure

- a) opening in the center of the eye
- b) photoreceptors for colour
- c) transparent covering at the front of the eye
- d) muscles that control the amount of light entering eye
- e) photoreceptors for night vision
- f) outer layer of eye that covers the eye and the eyelid
- g) watery fluid found in front of the lens
- h) jellylike fluid found behind the lens
- i) crystalline structure that changes shape to focus light
- j) inner layer of eye that contains photoreceptors

LAYERS, LOCATION AND FUNCTIONS OF THE EYE

Outer Layer	sclera (white of the eye)	<ul style="list-style-type: none"> - protects eye - maintains shape of eye - muscles used for moving eye are attached to this layer
	cornea (window of eye)	<ul style="list-style-type: none"> - in the center of sclera - transparent (so light rays can pass through it) - slightly curved to direct light rays into pupil - contains touch and pain receptors
Middle Layer	choroid	<ul style="list-style-type: none"> - contains blood vessels to nourish eye
	pupil	<ul style="list-style-type: none"> - circular opening at front of choroid
	iris (colored part of eye)	<ul style="list-style-type: none"> - muscular layer that can open or close to control amount of light entering eye - contains pigments that give eye its color
	lens	<ul style="list-style-type: none"> - spherical crystalline structure - found behind the iris and pupil - held in place by ligaments - bends light rays to direct them toward retina
	aqueous humor	<ul style="list-style-type: none"> - fluid-filled chamber in front of iris - helps to maintain eyeball's shape
	vitreous humor	<ul style="list-style-type: none"> - fluid-filled chamber behind the iris - helps to maintain eyeball's shape
Inner Layer	retina	<ul style="list-style-type: none"> - located at back of eye - contains receptors sensitive to light - rods are sensitive to dim light - cones are sensitive to bright light, and are responsible for color vision
	fovea centralis	<ul style="list-style-type: none"> - tiny depression in the center of the retina - most sensitive area of retina contains only cones
	optic disk	<ul style="list-style-type: none"> - area where optic nerve attaches to retina - produces blind spot - no vision - because it contains no rods or cones

DO AND SEND 6

The human eye is susceptible to disease and malfunction.

1. Using the Internet, the public library, and your textbook, briefly describe each of the following eye disorders: glaucoma, cataracts, conjunctivitis. Include in your answer a definition of the condition, symptoms, and treatment.
2. Explain what causes each of the following vision defects:
 - astigmatism
 - myopia (near-sightedness)
 - hyperopia (farsightedness)
 - macular degeneration
3. Laser surgery is used to treat vision. Briefly explain the effectiveness of this surgery and the methods used to correct vision using laser surgery. Evaluate the procedure by identifying the risks and benefits of this surgery.
4. Speculate about why birds of prey often have much greater visual resolution (ability to distinguish between objects at great distances) than humans. What is it about a bird's eye that gives it this ability?

SENSE ORGANS
THE EAR
LESSON 7

ASSIGNED READING:

Living Systems: pages 720 - 721. Examine Figure 25-24 and familiarize yourself with the parts of the ear.

Nelson Biology: pages 299 - 303. Examine Figures 13.13 and familiarize yourself with the parts of the ear.

PARTS OF THE EAR

The ear has three regions. These regions, the structures they contain, and their functions are summarized below.

Outer Ear	auricle or pinna	funnels sound waves into the auditory canal
	external auditory meatus (auditory canal)	directs sound waves to eardrum; produces wax which protects the ear by trapping foreign particles
	tympanum (eardrum)	thin membrane that vibrates when sound waves hit it
Middle Ear	ossicles (ear bones) <ul style="list-style-type: none"> • malleus (the hammer) • incus (the anvil) • stapes (the stirrup) 	transmit the vibrations from the eardrum to the oval window
	Eustachian tube (auditory tube)	equalizes pressure on both sides of the eardrum
Inner Ear	oval window	receives vibrations from ossicles, which causes fluid in the cochlea to move
	cochlea	tiny hairs lining the cochlea become stimulated by movement of fluid; these hairs respond to different pitches
	semicircular canals	maintain balance; filled with fluid; arranged to perceive any movement of the head
	auditory nerve	receives impulses generated in inner ear and sends them to temporal lobe of brain

PATHWAY OF HEARING:

The path a sound wave travels through the ear is as follows:

Sound waves → pinna → auditory canal → tympanum → ear ossicles (malleus, incus, stapes) → cochlea → auditory nerve → temporal lobe

LESSON EXERCISE

Match the structures on the next page to the descriptions by indicating the correct letter. When you are finished, check your answers in the answer section.

STRUCTURE

- _____ tympanum
- _____ ossicles
- _____ semicircular canals
- _____ cochlea
- _____ oval window

DESCRIPTION

- a) fluid-filled chambers used for balance
 - b) tiny bones that amplify sound
 - c) snail-shaped organ that contains hearing receptors
 - d) thin membrane that vibrates when sound waves strike it
 - e) membrane that transmits sounds to inner ear
2. Indicate in which parts of the ear (outer, middle, or inner) each of the following are found:
 - a) ossicles
 - b) tympanum
 - c) pinna
 - d) cochlea
 - e) oval window

DO AND SEND 7

1. There are five pathways in the hearing process. Briefly explain how hearing loss can occur at the following pathways.
 - a) air must be conducted from the external ear to the ear drum
 - b) sound waves must be conducted through the bones of the middle ear
 - c) sound waves must be conducted through the water of the inner ear
 - d) sound waves must be conducted along the auditory nerve to the brain
 - e) sound waves must be interpreted by the brain
2. Describe how a hearing aid works.
3. Can people who are totally deaf benefit from a hearing aid?
4. What are the advantages of wearing two hearing aids instead of one?
5. What is a cochlear implant?
6. Summarize the advantages of a cochlear implant.
7. Summarize the advantages and disadvantages of digital hearing aids over analogue hearing aids.

**ENDOCRINE SYSTEM,
MAINTAINING HOMEOSTASIS
INTRODUCTION TO HORMONES
LESSON 8**

**CHEMICAL CONTROL VS
ELECTROCHEMICAL CONTROL**

Cells communicate electrochemically very rapidly. Cells also communicate chemically. Chemical communication is slower but the results last longer.

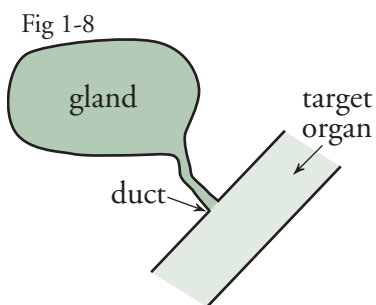
ASSIGNED READING

Living Systems: pages 680 - 681.

Nelson Biology: pages 222 - 225.

In most animals, chemical communication takes place through the glands. Glands are specialized to secrete substances needed by the body. The two major types of glands are:

1. *Exocrine glands* - release chemicals into ducts that empty into an organ where the chemical produces its effect.



Examples of exocrine glands include:

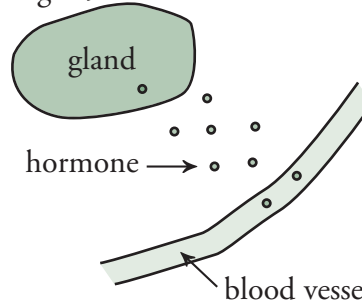
- a) *salivary glands* - release saliva into the mouth

- b) *sweat glands* - release sweat to the skin's surface
- c) *digestive glands* - release enzymes that digest food

2. *Endocrine glands* - release chemicals directly into the bloodstream to carry chemicals to areas where they are needed. Lacking ducts, they are sometimes called ductless glands. Endocrine glands produce chemicals called hormones.

Examples of endocrine glands are:

Fig 1-9



- a) *adrenal gland* - produces adrenaline
- b) *thyroid* - produces thyroxine

TYPES OF HORMONES

Hormones are divided into two main classes based on their chemical structure.

1. *Protein hormones* are composed of long chains of amino acids.
2. *Steroid hormones* are made from cholesterol.

HOW HORMONES WORK

Glands are made up of *regulator cells*. These cells detect a change in the environment (internal or external). When these cells detect a change, they respond by producing a hormone. The hormone circulates throughout the blood stream and is

delivered to cells that respond to the change. The cells affected by hormones are called target cells.

The *one-messenger model* of hormone action means hormones enter the cell membrane directly to exert their effect. Steroid hormones work this way.

Some hormones cannot pass directly through the cell membrane. First, they attach to a special protein on the cell's surface called a *receptor*. The interaction between the hormone and the receptor activates an enzyme which causes the production of a second messenger that produces the desired effect. This is called the *two-messenger model* of hormone action. Protein hormones work this way.

LESSON EXERCISE

Are the following glands exocrine or endocrine? Check your answers in the answer section.

1. Salivary glands produce saliva which empties into the mouth through tiny tubes.
2. The thyroid gland produces a chemical called thyroxine that travels through the bloodstream to various body tissues.
3. The liver produces a chemical called bile that passes into a tube called the common bile duct.
4. During times of stress, the adrenal gland produces adrenaline which passes into our bloodstream.
5. The pituitary gland produces a chemical called ADH which stimulates the kidneys to absorb water.

DO AND SEND 8

Select one of the following ethical issues and present reasoned arguments to support or refute the use of the hormone in the situation.

- a) Doctors prescribing Human Growth Hormone (HGH) as a treatment for individuals who have normal levels of HGH in their systems yet are genetically shorter than average. The prescription is to increase height.

OR

- b) Hormones used in beef and dairy cattle to increase production.

**ENDOCRINE SYSTEM,
MAINTAINING HOMEOSTASIS
PRINCIPAL GLANDS
LESSON 9**

from the hypothalamus. The anterior lobe of the pituitary produces its own hormones while the posterior lobe stores hormones produced by the hypothalamus. The various hormones produced by the pituitary, their target tissues and/or organs, and their primary functions are summarized in the table below.

THE PITUITARY GLAND

The *pituitary gland* is often called the “master gland” because it controls several other endocrine glands. It is at the base of the brain and extends

THYROID GLAND

The thyroid gland is located at the front of the neck. It releases two major hormones:

Anterior Lobe		
Hormones	Target	Functions
growth hormone (GH)	all body tissues	- stimulates the growth of muscle and bone - usually exerts its effects during growth periods, such as infancy and puberty
thyroid-stimulating hormone (TSH)	thyroid gland	- stimulates the thyroid gland to produce its hormones
ACTH	adrenal gland	- stimulates the secretion of the stress response hormones from the adrenal gland
prolactin	mammary glands	- stimulates the production of milk
follicle-stimulating hormone (FSH)	ovaries, testes	- in females, stimulates the production of follicles (tiny sacs where eggs develop) - in males, stimulates the production of sperm
luteinizing hormone (LH)	ovaries, testes	- in females, stimulates ovulation (release of egg) - in males, stimulates the production of testosterone
Posterior Lobe		
oxytocin	uterus, mammary glands	- stimulates uterine contractions during birth - stimulates release of milk from ducts in the breast during lactation
ADH	kidneys	- stimulates the reabsorption of water by the kidneys (this conserves water in body)

1. THYROXINE

This hormone affects almost all tissues of the body. It regulates the metabolism of the body, which means the rate at which the body burns calories for energy. The more thyroxine produced by an individual, the higher the metabolism. This means the body burns sugar quickly, and as a result, the body is generally quite warm and the individual doesn't gain weight easily.

The less thyroxine produced, the lower an individual's metabolism and the slower the body burns sugar. Sugar is broken down slowly and excess sugar is converted into glycogen to be stored in the liver. Once the glycogen stores are filled, the excess sugar is converted into fat. Individuals with low thyroxine levels tend to gain weight easily.

2. CALCITONIN

Another hormone produced by the thyroid gland is calcitonin. This hormone targets bone cells. It prevents loss of calcium from our bones by taking calcium from our blood and storing it in our bones.

THE PARATHYROID GLANDS

There are two pairs of parathyroid glands embedded in the tissue of the thyroid. These glands produce a hormone called *parathyroid hormone* or *parathormone*. This hormone targets our bones, kidneys, and digestive tract and regulates the amount of calcium in the blood. When calcium levels in our blood drop, parathormone causes calcium to be removed from our bones and added to the blood. It will also cause the kidneys to reabsorb calcium from the fluid waste that will become urine. Parathormone

activates any Vitamin D absorbed by the body during digestion.

ADRENAL GLANDS

On top of each kidney is an adrenal gland. Each adrenal gland has two regions: the adrenal cortex on the outside and the adrenal medulla on the inside.

ADRENAL CORTEX

The adrenal cortex is stimulated by ACTH secreted by the pituitary. In response, it produces two hormones:

1. CORTISOL

This hormone targets most body tissues and helps the body recover from the effects of stress and inflammation. It increases the amount of amino acids in our blood which the liver converts into glucose when we need extra energy.

2. ALDOSTERONE

This hormone stimulates the kidneys to remove sodium and other salts from the urine and return them to the blood to retain normal blood pressure and maintain homeostasis. If we lose too much salt, water leaves the blood and blood pressure drops.

ADRENAL MEDULLA

The adrenal medulla produces hormones in response to signals from the sympathetic nervous system. This gland produces the emergency or "fight-or-flight" response. It targets body tissues by secreting two hormones that work together to allow humans to cope with stress and emergencies. These hormones are called *epinephrine* (or adrenaline) and *norepinephrine* (or noradrenaline).

These hormones allow the body to cope with stress by:

- increasing heart rate
- increasing blood pressure
- increasing breathing rate
- increasing blood sugar
- dilating blood vessels

These reactions cause more oxygen and nutrients to be delivered to our body cells so we can cope with stress. More glucose and oxygen are shunted to our voluntary muscles, increasing muscular performance.

THE PANCREAS

The pancreas is near the stomach. It has both an exocrine and endocrine function. Its specialized cells produce digestive enzymes which are released to the small intestine through the *pancreatic duct* (exocrine function). It also contains clusters of cells called *Islets of Langerhans* which produce two hormones - insulin and glucagon. These hormones help regulate the amount of glucose in our blood (endocrine function).

During digestion, carbohydrates are broken down into glucose. Glucose is:

1. delivered to our body cells to be used immediately as a source of energy
2. transported to the liver and converted to a substance called glycogen
3. stored in muscle cells, also as glycogen
4. stored in fat cells

When glucose levels in our blood rise (following a meal), insulin is produced. Insulin removes glucose from the blood and delivers it to our body cells. Insulin makes our body cells more permeable to

glucose, thereby lowering our blood sugar. When levels of sugar in the blood drop too low, glucagon, the second hormone produced by the pancreas, causes glycogen in the liver to be converted back into glucose. This increases blood sugar levels back to their normal values.

PINEAL GLAND

This small gland is attached to the thalamus and stimulated by optic nerves.

The pineal gland produces *melatonin* which targets body tissues. When stimulated by darkness, it promotes sleep. It suppresses the activity of the reproductive organs until puberty, at which time these organs become active. It is thought to aid immune system functions.

This gland may contribute to seasonal affective disorder (SAD). When hours of daylight are decreased during winter months, people often experience symptoms such as loss of energy, weight gain, oversleeping and withdrawal.

ASSIGNED READING

Living Systems: Pages 685-687.

Nelson Biology: Pages 226-235.

LESSON EXERCISE

Match the hormones to their correct function.

Place the letter of the function in the space in front of the hormone name. Check your answers in the answer key.

1. ____ Insulin
2. ____ Oxytocin
3. ____ ACTH
4. ____ Glucagon

5. ____ Thyroxine
 6. ____ Prolactin
 7. ____ Aldosterone
 8. ____ Adrenaline
 9. ____ Calcitonin
 10. ____ Melatonin
 11. ____ Growth hormone
 12. ____ Luteinizing hormone
 13. ____ Follicle-stimulating hormone
 14. ____ Thyroid-stimulating hormone

- a) Slightly below larynx
 b) On top of the kidneys
 c) In the pelvic cavity
 d) Outside the pelvic cavity
 e) Attached to the base of the brain
 f) Below the stomach near the liver

- a) Stimulates the thyroid gland
 b) Decreases blood calcium levels
 c) Causes production of milk by the breasts
 d) Stimulates sleep
 e) Regulates the metabolism of the body
 f) Increases the recovery of salt by kidneys
 g) Increases heart rate, blood pressure and sugar levels
 h) Causes uterus to contract during childbirth
 i) Stimulates the adrenal cortex
 j) Speeds up the removal of sugar from bloodstream
 k) Causes the increased release of glucose into blood
 l) Stimulates the ovary to release eggs
 m) Stimulates the gonads to make gametes
 n) Stimulates body growth

Match the hormones to the glands.

1. Pituitary gland
 2. Adrenal glands
 3. Thyroid gland
 4. Pancreas
 5. Testes
 6. Ovaries
 ____ Insulin
 ____ Estrogen
 ____ Thyroxine
 ____ Calcitonin
 ____ Testosterone
 ____ Growth hormone
 ____ Follicle-stimulating hormone
 ____ Thyroid-stimulating hormone
 ____ ACTH
 ____ Aldosterone
 ____ Parathormone

Match the glands to their locations in the body.

1. ____ Pituitary gland
 2. ____ Adrenal glands
 3. ____ Thyroid gland
 4. ____ Pancreas
 5. ____ Testes
 6. ____ Ovaries

Match the hormones to the target organs.

1. ____ Insulin
 2. ____ Oxytocin
 3. ____ Glucagon
 4. ____ Thyroxine
 5. ____ Prolactin
 6. ____ Aldosterone
 7. ____ Calcitonin

8. ____ Growth hormone
 9. ____ Luteinizing hormone
 10. ____ FSH
 11. ____ TSH
 12. ____ ACTH
 13. ____ ADH
-
- a) Testes
 - b) Breasts
 - c) All general body cells
 - d) Thyroid gland
 - e) Ovaries
 - f) Adrenal gland
 - g) Heart and nervous system
 - h) Liver
 - i) Kidneys
 - j) Bones

DO AND SEND 9

In the 20th century humans found many ways to use products developed by the petrochemical industry. The range of products included: pesticides, plastics, agricultural fertilizers, industrial chemicals and PCBs in electrical equipment.

Scientists are currently researching these products and their environmental impact. It is thought the breakdown of these chemicals can alter or disrupt biological systems, specifically the endocrine system.

Natural hormones affect target cells. They enter a cell and bind to receptor molecules, like a key entering a lock. Binding activates the receptor to stimulate a cellular response.

Endocrine disruptors from manufactured materials mimic natural hormones. The hormones released through the breakdown of chemicals in the environment enter the bloodstream and bind to specific receptors inside cells. The response may be normal or abnormal. Environmental hormones may affect bodily functions stimulated by receptor responses, like synthesis, secretion, storage, release, transport, creation, binding or other cellular responses.

Review the literature on this subject using EBSCO. Locate articles about natural synthetic chemicals and their impact on the endocrine systems. To locate appropriate articles consider the following list of terms.

- Estrogen
- Xenoestrogen
- Endocrine system
- Environmental estrogen
- Endocrine disrupters
- Man-made estrogens
- Endocrine blockers
- Phytoestrogen

An understanding of these terms will support your research. Use the information you gather to respond to the following questions.

QUESTIONS:

1. Summarize the ways that endocrine disrupters can affect normal hormone action.
2. Distinguish between phytoestrogens and man-made estrogens.
3. Humans are exposed to environmental estrogens in our diet and through industrial and household products. Give one specific example of an environmental estrogen that we take into our body in each of the following ways:
 - a) in our diet
 - b) through industrial products
 - c) through household products
4. List five examples of possible links between environmental estrogens and human health problems.
5. Using synthroid as an example, examine ways natural and synthetic hormones affect the body.

FEEDBACK MECHANISMS FOR MAINTAINING HOMEOSTASIS

EXAMPLES OF FEEDBACK

LESSON 10

FEEDBACK

Hormones are regulated by feedback mechanisms that control their release.

Negative feedback mechanisms return a condition to its normal value. If a condition decreases below normal, feedback mechanisms will trigger hormone release to increase it back to its normal value. If a condition increases above normal, feedback mechanisms will trigger a process to lower the condition to its normal value.

Think of the way a heat thermostat works. When the temperature drops below a certain value, this drop is detected, the furnace turns on and restores the temperature to its set value.

Sometimes, hormones are regulated by *positive feedback*. In this case, when the level of one hormone rises, this causes the level of a second hormone to rise also.

EXAMPLES OF FEEDBACK

1. REGULATION OF THYROXINE

When levels of thyroxine in our body drop below normal values, negative feedback causes the pituitary gland to start producing TSH (thyroid stimulating hormone). TSH stimulates the thyroid to start producing more thyroxine. When thyroxine levels have returned to normal, the pituitary stops producing TSH, and the thyroid lowers its production of thyroxine.

2. REGULATION OF CALCIUM

The thyroid gland and the parathyroid glands work together to regulate blood calcium. Calcium is needed for strong bones and teeth and for proper functioning of the nervous system.

When levels of calcium in the blood are high, the thyroid produces calcitonin. This hormone causes the calcium in the blood to be absorbed by our bones. This reaction lowers blood calcium.

When levels of blood calcium are too low, the parathyroid glands secrete parathyroid hormone. This hormone increases blood calcium in several ways: it removes calcium from our bones, it causes the kidneys to reabsorb more calcium from the fluid waste that will become urine and it activates any Vitamin D that was absorbed into the body during digestion.

3. REGULATION OF BLOOD SUGAR

The pancreas secretes two hormones to regulate blood sugar levels. When the levels of glucose in blood rise, insulin is produced. The insulin removes glucose from the blood and delivers it to our body cells.

When levels of sugar in the blood drop too low, glucagon (the second hormone produced by the pancreas) causes glycogen in the liver to be converted back into glucose. This increases blood sugar levels back to their normal values.

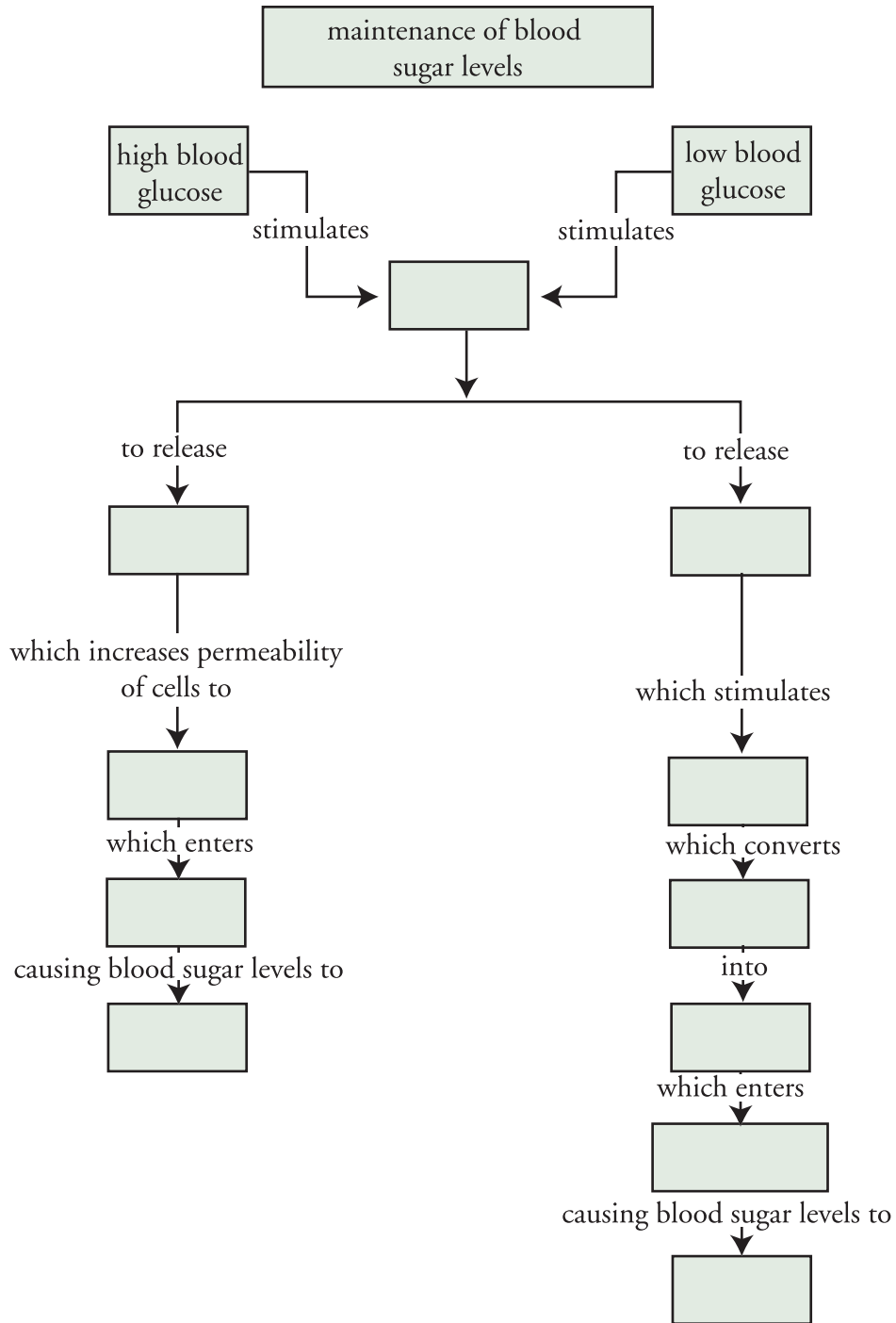
ASSIGNED READING

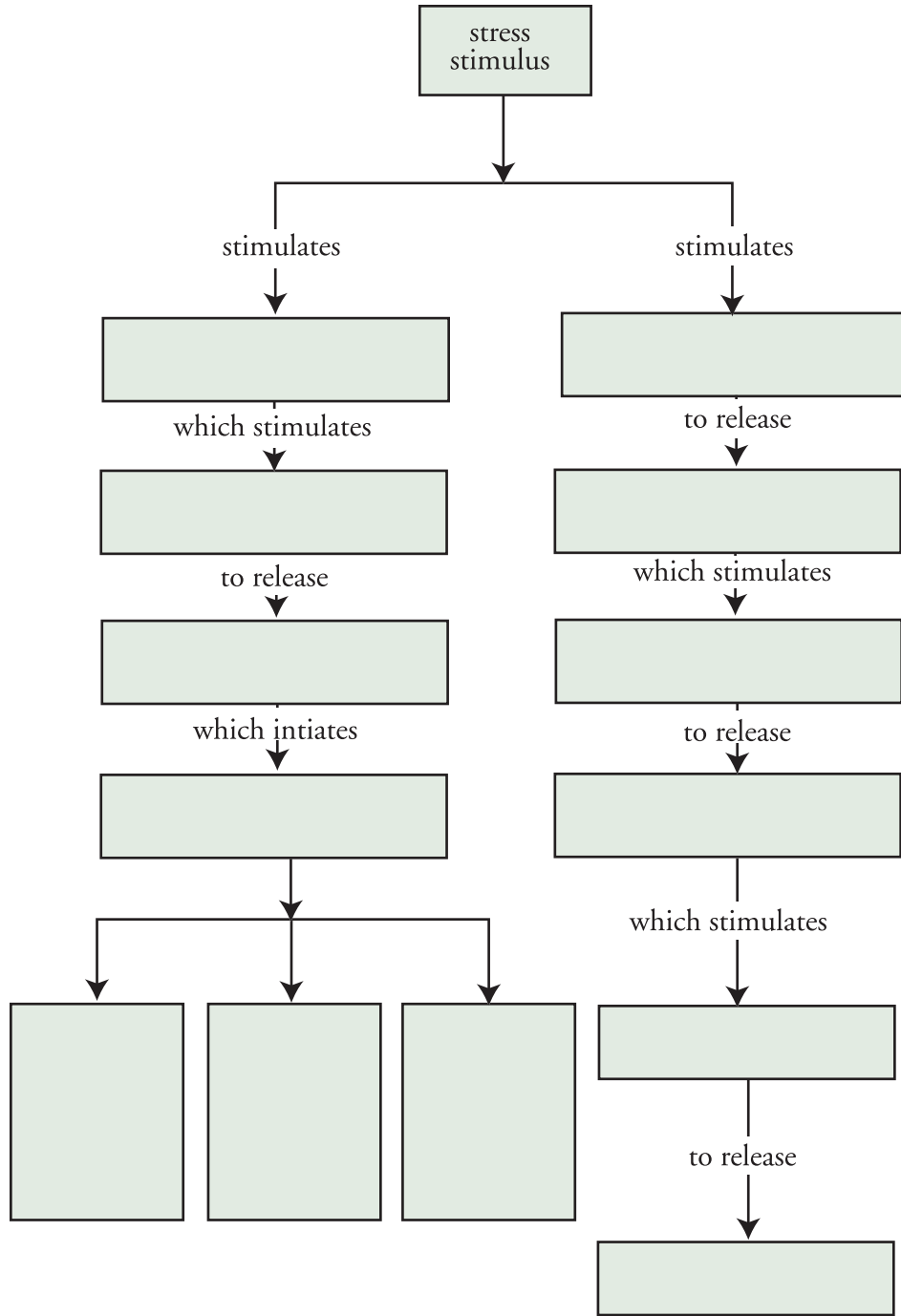
Living Systems: Pages 681-682.

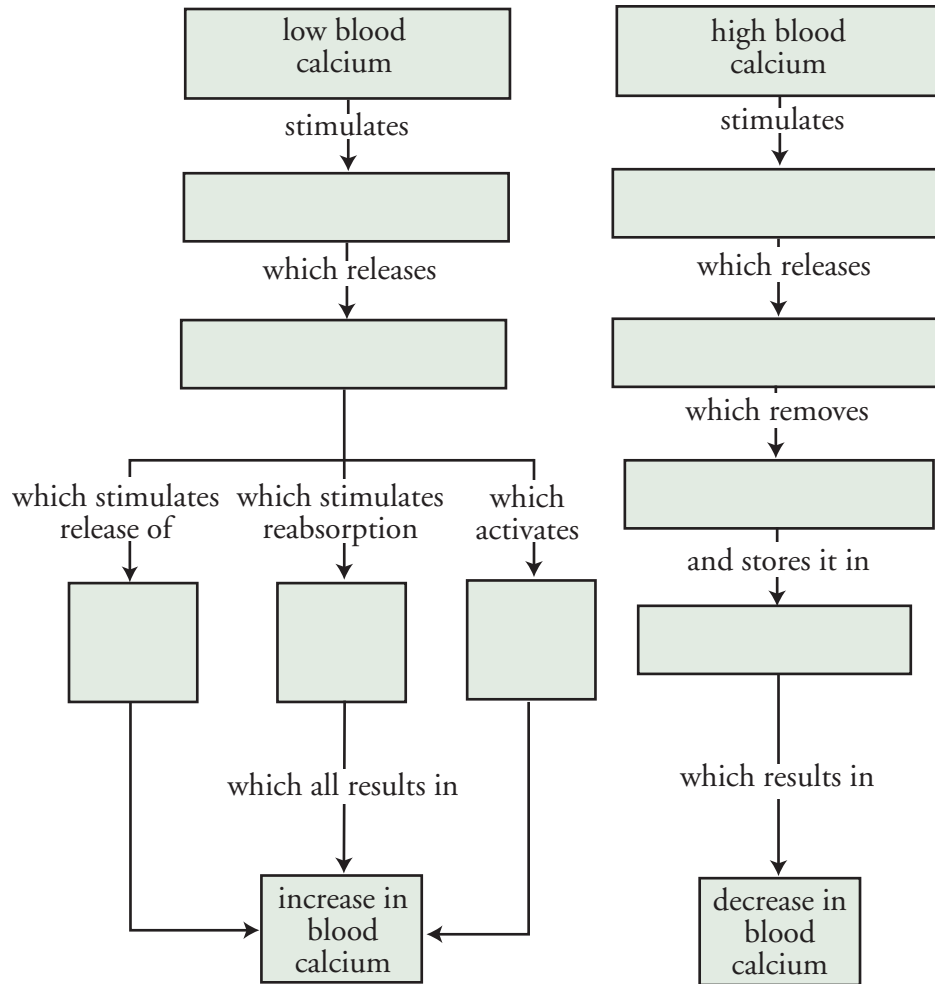
Nelson Biology: Pages 225.

LESSON EXERCISE

Complete the following flow charts which show several hormone feedback loops. Check your answers in the answer key.







DO AND SEND 10

The concentration of glucose in the human bloodstream must be maintained in a very specific range for the body to function properly. Normal blood glucose concentrations range from 70 to 110 milligrams of glucose per 100 millilitres of blood. Any concentration below this range is called hypoglycemia and anything above it is called hyperglycemia.

Diabetes mellitus is a genetic disorder. The pancreas fails to produce enough insulin. Without adequate amounts of insulin, blood sugar levels remain extremely high, producing hyperglycemia.

There are several different types of diabetes. Type I diabetes is called early-onset diabetes, insulin-dependent, or juvenile diabetes. It usually occurs in individuals under the age of 20 and is caused by a lack of insulin production by the pancreas. Type 1 diabetics must take insulin every day. About 10-20 per cent of diabetics have Type 1. Researchers are now developing alternatives to insulin like pills and aerosol sprays, similar to puffers used by those with asthma.

Type II diabetes is called adult diabetes, insulin-independent, or maturity-onset diabetes. It usually occurs in adults over the age of 40. These individuals can make insulin but the body cells do not respond, and fail to accept glucose. This type of diabetes can be treated by proper diet and exercise, and in severe cases may require insulin injection. About 80 - 90

per cent of diabetics have Type II.

There is a third type of diabetes called Type III diabetes or gestational diabetes. It occurs only during pregnancy and disappears after birth. It often reverts to Type II five to ten years after childbirth. It occurs in three per cent of all pregnancies. Predisposing factors include: a family history of diabetes, age, weight, carrying baby over nine months, and a previous history of miscarriage.

Diabetes is caused by too much sugar in the blood. The kidneys are unable to reabsorb all the glucose they filter, so glucose appears in the urine. Because there is too much sugar in the blood, water diffuses out of body cells and enters the blood to create equilibrium. The loss of water from body cells stimulates thirst, causing the kidneys to work to eliminate the excess water from the body. When body cells are not receiving nourishment, fatigue and increased appetite result.

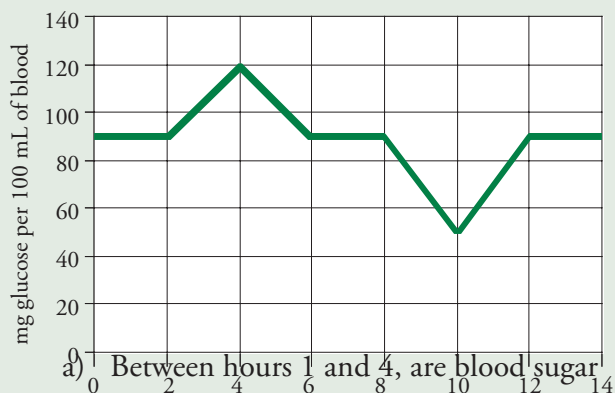
Long-term effects of diabetes include strokes, blindness, kidney failure and circulatory problems.

If too much insulin is present in the bloodstream, (a diabetic might inject too much insulin, or not eat after taking insulin) blood glucose levels can become dangerously low and lead to insulin shock. An individual in insulin shock may experience disorientation, convulsions, and lose consciousness. They need sugar immediately.

QUESTIONS

1. Explain how the pancreas is both an endocrine gland and an exocrine gland.
2. What are the target cells for insulin? For glucagon?
3. Which hormone lowers blood sugar? Which hormone raises it?
4. What is hyperglycemia?
5. Explain how negative feedback operates to regulate blood sugar levels.
6. What is the difference between glycogen and glucagon?
7. State three differences between Type I and Type II diabetes.
8. What are four symptoms of diabetes and what causes each symptom?
9. Which type of diabetes responds best to insulin injections? Explain why.
10. What two conditions can produce insulin shock? Why does someone in insulin shock need to have sugar?
11. Before being tested for blood glucose levels, a person must fast for several hours prior to the test. Why?
12. The graph at the top of the next column shows the concentration of blood sugar. Examine the graph to answer questions a) to e).

Blood Glucose Levels



- a) Between hours 1 and 4, are blood sugar levels within the normal range? Explain.
 - b) At hour 4, blood sugar level rises. What might have happened to cause the level to rise?
 - c) Between hours 4-6, the blood sugar level begin to drop. What pancreatic hormone brought these levels down?
 - d) Between hours 6-8, the level dropped very low. Provide a reasonable explanation for this drop in blood sugar.
 - e) What restored the blood sugar level to normal?
13. Prepare a one-page report on the roles played by Frederick Banting and Charles Best in the discovery of insulin.

FEEDBACK MECHANISMS FOR MAINTAINING HOMEOSTASIS ENDOCRINE DISORDERS

LESSON 11

INTRODUCTION

Disease is the result of a disruption in homeostasis that may be caused by glands malfunctioning or not producing proper levels of hormones.

Approximately two per cent of Canadians have hypothyroidism but many go undiagnosed. Women face a much greater risk of hypothyroidism than men.

The thyroid is one of the endocrine glands, which make hormones to regulate physiological functions in your body. The thyroid gland lies across the base of the neck, behind the larynx. These hormones are secreted and carried by the bloodstream to all the tissues in your body to control how fast and efficiently the cells in your body work.

When the thyroid gland does not make enough thyroid hormone to maintain various body functions common diseases may be diagnosed. The two most common are an over- (hyperthyroidism) or under- (hypothyroidism) active gland.

Hypothyroidism means your body does not have enough thyroid hormone. Individuals experiencing hypothyroidism may display an imbalance in blood pressure, heartbeat, digestion, moods, and other body functions. The signs and symptoms may be subtle, mistaken for other illnesses or as a

sign of aging. Not everyone with hypothyroidism will have the same signs and symptoms: fatigue, weight gain, dry skin, depression, infertility, menstrual problems, constipation, slow heartbeat, muscle cramps or pain (myalgia). A blood test may be performed to determine the amount of thyroid-stimulating hormone in your bloodstream.

Thyroid hormone production is a complex process. In the brain a hormone is released to cause the pituitary gland to secrete thyroid stimulating hormone (TSH). These hormones help oxygen enter cells, and stimulate metabolism. The thyroid hormones also control the level of pituitary hormone TSH. The more triiodothyronine and thyroxine released by the thyroid, the less TSH is produced in the pituitary. This is an example of negative feedback.

DO AND SEND 11

SUBMIT AT THE END OF THIS UNIT

Select a hormone and investigate the effects of its over secretion and under secretion in the body. Prepare a visual display to illustrate this and write a 500 word, double-spaced paper reporting your findings. Hormones may include: human growth hormone, aldosterone, cortisol, thyroxine, insulin, or glucagon.

CHEMICAL CONTROL IN PLANTS

PLANT HORMONES

LESSON 12

ASSIGNED READING

Living Systems: Pages 672-679.

Nelson Biology: Pages 463-465.

INTRODUCTION

Plants, like animals, have cells that produce hormones. An understanding of plant hormones has conferred benefits on farmers, plant scientists, and the food industry. The study of pheromones led to improved control of detrimental infestations.

This knowledge has been applied to create beneficial interventions in the environment. Pheromone traps are used to track the spread of gypsy moth populations or to find populations in new areas. Inside each trap is a 6-8 cm strip coated with female gypsy moth pheromones - the bait for the trap. Female gypsy moths do not fly; they use pheromones to attract male moths. The males, thinking they sense a female releasing a mating pheromone, fly into the trap and are caught. Traps are set and collected after an interval, and the number of gypsy moths in each trap is counted. When the number of gypsy moths in an area reaches a certain level of infestation a farmer will apply pesticides to crops. Pheromone traps may be used to control new gypsy moth populations but are ineffective against infestations as the volume of insects will cause defoliation. Traps alert farmers that gypsy moths are active in an area. Farmers benefit from knowledge of gypsy moth

pheromones. Their knowledge allows improved risk analysis and decisions with respect to infestations and pesticide applications.

DO AND SEND 12

Answer the questions below to help you learn more about plant hormones.

1. What is a tropism?
2. There are several types of tropisms. Explain the difference between hydrotropism, phototropism, and geotropism.
3. One example of a plant hormone is auxin. Explain how auxins cause plants to bend toward the light.
4. State three other ways that auxins affect plant growth.
5. State some of the ways that gibberellins affect plant growth.
6. Select an insect, other than the gypsy moth, that produces a pheromone. What is the purpose of the pheromone, e.g., communication, mating, warning and how may human's knowledge of the hormone be beneficial for agricultural or forestry purposes.