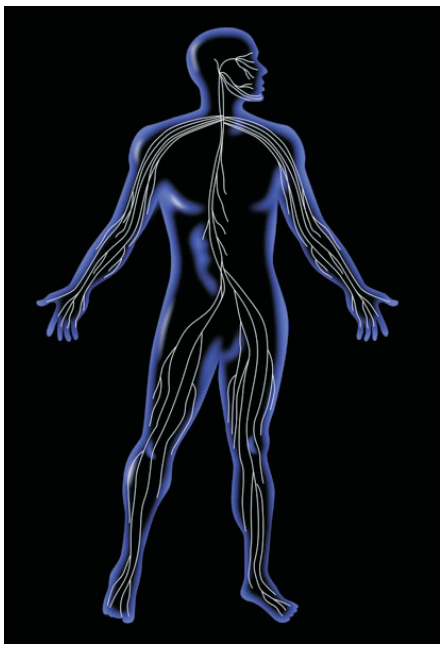
Autonomic Nervous System

TO DRIVE A CAR WELL, you need a gas and a brake pedal. These pedals work as a team, complementing one another. One pedal speeds you up, and the other slows you down. One gets you to your destination, and the other helps you rest at your destination. Just like a car, your body has a system that works in the same complementary fashion. It is the autonomic nervous system.



Objective:

Describe the actions of the autonomic nervous system, the sympathetic nervous system, and the parasympathetic nervous system.

Key Terms:

- acetylcholine
- adrenergic
- autonomic nervous system
- cholinergic
- epinephrine
- "fight or flight" response
- norepinephrine
- parasympathetic nervous system
- sympathetic nervous system

The Autonomic Nervous System

Do you remember the last time you were extremely frightened or angry? You may have felt your heart pumping. Perhaps you were breathing rapidly. You may have started to perspire a bit too. These symptoms are typical for the sensation known as the "adrenaline rush." Your autonomic nervous system is responsible for these responses.

ACTIONS OF THE AUTONOMIC NERVOUS SYSTEM

The **autonomic nervous system** is a division of the peripheral nervous system. The autonomic nervous system controls the activities of many internal organs (e.g., the lungs, heart, blood vessels, digestive organs, and glands). It is responsible for maintaining internal balance within the body.

The autonomic nervous system is considered part of the peripheral nervous system, even though it is controlled by centers in the brain stem, spinal cord, and hypothalamus. The autonomic nervous system is divided into the sympathetic and parasympathetic nervous systems.

TABLE 1. The Autonomic Nervous System Is Divided into the Parasympathetic and Sympathetic Nervous Systems

Autonomic Nervous System	
Parasympathetic	**Sympathetic**
Constricts pupil	Dilates pupil
Inhibits tear glands	Stimulates tear glands
Increases salivation	Inhibits salivation, increases sweating
Slows heart	Accelerates heart
Constricts bronchi	Dilates bronchi
Increases digestive functions of stomach	Decreases digestive functions of stomach
Increases digestive functions of intestine	Decreases digestive functions of intestine
Contracts bladder	Inhibits bladder contraction
	Secretes adrenalin

ACTIONS OF THE SYMPATHETIC NERVOUS SYSTEM

The **sympathetic nervous system** is a division of the autonomic nervous system. The sympathetic nervous system allows body functions to speed up. This response usually occurs rapidly. It is a temporary and short-lived response. The sympathetic nervous system is activated when a person is put under stress by emotional or physical causes.

When stimulated, the bronchioles dilate for better gas exchange, the heart rate increases, arteries to the heart and voluntary muscles dilate, and pupils dilate. In addition, there is an increase in perspiration.

The sympathetic nervous system is commonly known for its role in the body's **"fight or flight" response**, which requires a person to stay and "fight" the enemy or run away from the danger ("flight"). Others may call this reaction an "adrenaline rush."

DIGGING DEEPER...

UNCOVERING ADDITIONAL FACTS: Actions of the Sympathetic and Parasympathetic Nervous System

Prepare a poster that shows the actions of the sympathetic and parasympathetic nervous system on various organs. Use different colors to differentiate the opposing effects of the two systems on these organs.

Sympathetic neurons are found in the thoracic and lumbar sections of the spinal cord. These neurons initiate a response by releasing the neurotransmitters, **epinephrine** (adrenaline) and **norepinephrine** (noradrenaline), to activate a response from the end organs involved. This system is referred to as **adrenergic** (activated by adrenaline).

FIGURE 1. The "fight or flight" response is triggered during stressful situations, including extreme sports.

ACTIONS OF THE PARASYMPATHETIC NERVOUS SYSTEM

The **parasympathetic nervous system** is a division of the autonomic nervous system. It is responsible for body functions slowing down. The parasympathetic nervous system is activated when a person is relaxing or when the sympathetic nervous system has been stimulated for too long. Parasympathetic neurons are found in the brain stem and in the spinal cord below the second lumbar area. Because of the location of these neurons, the parasympathetic division is referred to as the craniosacral division.

The neurons of the parasympathetic division initiate a response by releasing the neurotransmitter, **acetylcholine**, which activates a response from the end organs involved. This system is referred to as **cholinergic** (activated by acetylcholine). The parasympathetic system acts as a balance for the sympathetic nervous system once the danger has passed. This system causes the pupils to constrict, the heart rate to decrease, and the bronchioles to constrict.

Summary:

The autonomic nervous system is a division of the peripheral nervous system. It controls the activities of many internal organs (e.g., the lungs, heart, blood vessels, digestive organs, and glands). The autonomic nervous system is divided into the sympathetic and parasympathetic nervous systems.

The sympathetic nervous system allows body functions to speed up. This response usually occurs rapidly. It is a temporary and short-lived response. This division is stimulated when a person is put under stress by emotional or physical causes. When stimulated, the bronchioles dilate for better gas exchange, the heart rate increases, arteries to the heart and voluntary muscles dilate, and pupils dilate. In addition, there is an increase in perspiration. These sensations associated with the sympathetic nervous system are often described as the "fight or flight" response.

Conversely, the parasympathetic nervous system is responsible for body functions slowing down. This division of the nervous system is activated when a person is

relaxing or when the sympathetic nervous system is stimulated too long. Parasympathetic neurons are found in the brain stem and in the spinal cord below the second lumbar area. Because of the location of these neurons, the parasympathetic division is referred to as the craniosacral division.

Checking Your Knowledge:

1. The autonomic nervous system controls the activities of many internal organs. List three.
2. The autonomic nervous system is divided into which two systems?
3. Name two neurotransmitters involved in the activities of the autonomic nervous system.
4. What term means "activated by acetylcholine"?
5. When a person is put under stress by emotional or physical causes, which division is stimulated?

Expanding Your Knowledge:

Keep track of your daily actions and non-actions during a typical day. Your list may include waking to a startling song on the alarm radio, almost missing the bus, eating lunch, catching several red lights on the way to work, getting your homework done, relaxing to music, texting friends, resting before sleep, etc. Keep track of any bodily sensations (e.g., your pulse, sweating, and breathing). Then mark each activity as triggered and/or controlled by the sympathetic or parasympathetic system. What did you observe?

Web Links:

Autonomic Nervous System
http://faculty.washington.edu/chudler/auto.html

Autonomic Nervous System Images
http://www.google.com/images?q=autonomic+nervous+system&rls=com.microsoft:en-us:IE-SearchBox&oe=&um=1&ie=UTF-8&source=univ&ei=wJtQTZuUG8S4tgf39OnGCQ&sa=X&oi=image_result_group&ct=title&resnum=4&ved=0CEcQsAQwAw&biw=1579&bih=715

Autonomic Nervous System Video
http://www.youtube.com/watch?v=JvuugFKe1PE

Comparison of Sympathetic and Parasympathetic Nervous System Video
http://www.youtube.com/watch?v=J968Wco1u0s&feature=related