10.6: Interaction of Organ Systems

Teamwork

Every player on a softball team has a special job to perform. Each of the orange team’s players in Figure 1 has his part of the infield or outfield covered if the ball comes his way. Other players on the orange team cover other parts of the field or pitch or catch the ball. Playing softball clearly requires teamwork. The human body is like a softball team in that regard. All the organ systems of the human body must work together as a team to keep the body alive and well. Teamwork within the body begins with communication.

Communication among Organ Systems

Communication among organ systems is vital if they are to work together as a team. They must be able to respond to each other and change their responses as needed to keep the body in balance. Communication among organ systems is controlled mainly by the autonomic nervous system and the endocrine system.
The autonomic nervous system is the part of the nervous system that controls involuntary functions. For example, the autonomic nervous system controls heart rate, blood flow, and digestion. You don’t have to tell your heart to beat faster or to consciously squeeze muscles to push food through the digestive system. In fact, you don’t have to even think about these functions at all. The autonomic nervous system orchestrates all the signals needed to control them. It sends messages between parts of the nervous system and between the nervous system and other organ systems via chemical messengers called neurotransmitters.

Figure \(\PageIndex{2}\): The figure illustrates the hypothalamus, pituitary gland, brain stem, spinal cord, cerebellum, pineal gland, and cerebrum. (Mandeep Grewal modified from Public domain; National Cancer Institute via Wikimedia.org)
The endocrine system is the system of glands that secrete hormones directly into the bloodstream. Once in the blood, endocrine hormones circulate to cells everywhere in the body. The endocrine system is under control of the hypothalamus, a part of the brain. The hypothalamus secretes hormones that travel directly to cells of the pituitary gland, which is located beneath it. The pituitary gland is the master gland of the endocrine system. Most of its hormones either
turn on or turn off other endocrine glands. For example, if the pituitary gland secretes thyroid stimulating hormone, the hormone travels through the circulation to the thyroid gland, which is stimulated to secrete thyroid hormone. Thyroid hormone then travels to cells throughout the body, where it increases their metabolism.

Examples of Organ System Interactions

An increase in cellular metabolism requires more cellular respiration. Cellular respiration is a good example of organ system interactions because it is a basic life process that occurs in all living cells.

Cellular Respiration

Cellular respiration is the intracellular process that breaks down glucose with oxygen to produce carbon dioxide and energy in the form of ATP molecules. It is the process by which cells obtain usable energy to power other cellular processes. Which organ systems are involved in cellular respiration? The glucose needed for cellular respiration comes from the digestive system via the cardiovascular system. The oxygen needed for cellular respiration comes from the respiratory system also via the cardiovascular system. The carbon dioxide produced in cellular respiration leaves the body by the opposite route. In short, cellular respiration requires at a minimum the digestive, cardiovascular, and respiratory systems.

Fight-or-Flight Response

The well-known fight-or-flight response is a good example of how the nervous and endocrine systems control other organ system responses. The fight-or-flight response begins when the nervous system perceives sudden danger, as shown in Figure \(\PageIndex{2}\)). The brain sends a message to the endocrine system (via the pituitary gland) for the adrenal glands to secrete their hormones cortisol and adrenaline. These hormones flood the circulation and affect other organ systems throughout the body, including the cardiovascular, urinary, sensory, and digestive systems. Specific responses include increased heart rate, bladder relaxation, tunnel vision, and a shunting of blood away from the digestive system and toward the muscles, brain, and other vital organs needed to fight or flee.

Digesting Food

Digesting food requires teamwork between the digestive system and several other organ systems, including the nervous, cardiovascular, and muscular systems. When you eat a meal, the organs of the digestive system need more blood to perform their digestive functions. Food entering the digestive systems causes nerve impulses to be sent to the brain; in response, the brain sends messages to the cardiovascular system to increase heart rate and dilate blood vessels in the digestive organs. Food passes through the organs of the digestive tract by rhythmic contractions of smooth muscles in the walls of the organs, so the muscular system is also needed for digestion. After food is digested, nutrients from the food are absorbed into the blood of the vessels lining the small intestine. Any remaining food waste is excreted through the large intestine.

Playing Softball

The men playing softball in Figure \(\PageIndex{1}\)) are using multiple organ systems in this voluntary activity. Their
nervous systems are focused on observing and preparing to respond to the next play. Their other systems are being controlled by the autonomic nervous system. Organ systems they are using include the muscular, skeletal, respiratory, and cardiovascular systems. Can you explain how each of these organ systems is involved in playing softball?
Feature: Reliable Sources

Teamwork among organ systems allows the human organism to work like a finely tuned machine. Or at least it does until one of the organ systems fails. When that happens, other organ systems interacting in the same overall process will also be affected. This is especially likely if the system affected plays a controlling role in the process. An example is type 1 diabetes. This disorder occurs when the pancreas does not secrete the endocrine hormone insulin. Insulin normally is secreted in response to an increasing level of glucose in the blood, and it brings the level of glucose back to normal by stimulating body cells to take up insulin from the blood.

Learn more about type 1 diabetes. Use several reliable Internet sources to answer the following questions:

1. What causes the endocrine system to fail to produce insulin in type 1 diabetes?
2. Which organ systems are affected by high blood glucose levels if type 1 diabetes is not controlled? What are some of the specific effects?
3. How can blood glucose levels be controlled in patients with type 1 diabetes?

Summary

- Organ systems of the human body must work together to keep the body alive and functioning normally. This requires communication among organ systems. This is controlled by the autonomic nervous system and endocrine system. The autonomic nervous controls involuntary body functions, such as heart rate and digestion. The endocrine system secretes hormones into the blood that travel to body cells and influence their activities.
- Cellular respiration is a good example of organ system interactions because it is a basic life process that occurs in all living cells. It is the intracellular process that breaks down glucose with oxygen to produce carbon dioxide and energy. Cellular respiration requires the interaction of the digestive, cardiovascular, and respiratory systems.
- The fight-or-flight response is a good example of how the nervous and endocrine systems control other organ system responses. It is triggered by a message from the brain to the endocrine system and prepares the body for flight or a fight. Many organ systems are stimulated to respond, including the cardiovascular, respiratory, and digestive systems.
- Digesting food requires teamwork between the digestive system and several other organ systems, including the nervous, cardiovascular, and muscular systems.
- Playing softball or doing other voluntary physical activities may involve the interaction of nervous, muscular, skeletal, respiratory, and cardiovascular systems.

Review

1. What is the autonomic nervous system?
2. How do the autonomic nervous system and endocrine system communicate with other organ systems so the systems can interact?
3. Explain how the brain communicates with the endocrine system.
4. What is the role of the pituitary gland in the endocrine system?
5. Identify organ systems that play a role in cellular respiration.
6. How does the hormone adrenaline prepare the body to fight or flee? What specific physiological changes does it bring about?

7. Explain the role of the muscular system in the digestion of food.

8. Describe how three different organ systems are involved when a player makes a particular play in softball, such as catching a fly ball.

9. True or False. The autonomic nervous system controls conscious movements.

10. True or False. Hormones travel throughout the body.

11. True or False. The pituitary gland directly secretes thyroid hormone.

12. What are two types of molecules that the body uses to communicate between organ systems?

13. Explain why hormones can have such a wide variety of effects on the body.

14. Heart rate can be affected by:

   A. Hormones
   
   B. Neurotransmitters
   
   C. The fight-or-flight response
   
   D. All of the above

15. Which gland secretes the hormone cortisol?

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Explore More

https://bio.libretexts.org/link?16779#Explore_More

Without the muscles lining the GI tract, you would be unable to digest food. Watch this short animation of food moving through the GI tract. It illustrates very clearly the necessary interaction of the muscular and digestive systems in the digestive process.
Learn more about adrenaline and it's role in the fight vs. flight stress responses here:
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