

Fear: Body Alert!

Introduction

Fear: A distressing emotion aroused by impending danger, evil, pain, etc., whether the threat is real or imagined.

Synonyms: foreboding, apprehension, consternation, dismay, dread, terror, fright, panic, horror, trepidation, qualm.



1. List at least four things or situations that trigger your fear response.

- _____
- _____
- _____
- _____

2. List at least four changes that occur in your body when you respond to a frightening situation.

- _____
- _____
- _____
- _____

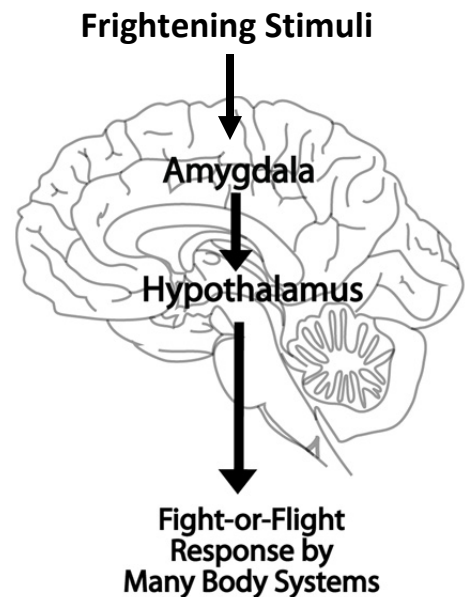
Part 1: Fear and the Nervous System

Fear and the Fight-or-Flight Response

Fear is a chain reaction in the brain that happens when you encounter a potentially harmful stimulus. The amygdala is the part of your brain that receives information from many parts of the brain and interprets this information to generate the emotion of fear. When the amygdala generates a fear emotion, it sends impulses to another part of the brain, the hypothalamus.

The hypothalamus then sends impulses to many different parts of the body to trigger a fight-or-flight response. During the fight-or-flight response, many body systems undergo changes to give your body a burst of energy needed to defend yourself (fight) or to escape (flight) in a potentially harmful situation.

Fight-or-flight responses are unlearned reactions that humans and many other animals automatically make to increase their chances for survival in a potentially dangerous situation. Organisms that feared the right things and made a fight-or-flight response were more likely to survive and pass on their genes to their offspring.



3. What is the purpose of fear and the fight-or-flight response?

4. Explain why people do not need to be taught to make a fight-or-flight response.

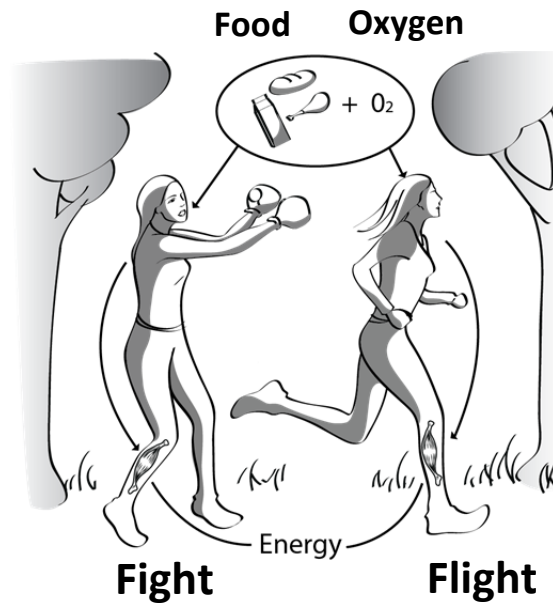
5. What part of the brain would best be called the "fear emotion center"?

6. What part of the brain sends signals to many different parts of the body to make the fight-or-flight response?

Fight-or Flight Response

During the fight-or-flight response, many body systems undergo changes to give your body a burst of energy and the strength needed to defend yourself or to run away from a dangerous situation.

Both fight and flight require food and oxygen for cellular respiration that provides the energy for vigorous muscle activity.



The fight-or-flight response:

- **Stimulates** (increases) the activities of parts of the body necessary for vigorous muscle activity such as the circulatory system and respiratory system. These systems increase the delivery of oxygen and food to muscles. Cellular respiration in the muscle uses the oxygen and food to provide energy for fighting or running.
- **Inhibits** (decreases) the activities of parts of the body that are not immediately essential for fighting or running, such as the digestive system, the immune system, the urinary system, and the reproductive system.

7. Your lab kit contains a bag of 18 cards. Use the information in the reading above to sort the cards into two piles.

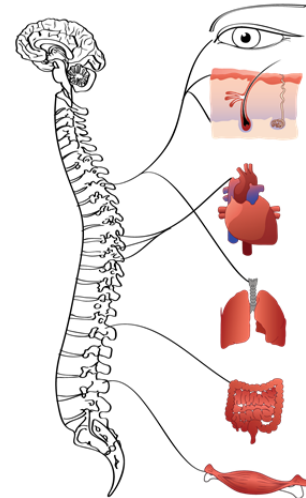
- **FIGHT-or-FLIGHT** responses needed to prepare the body for the vigorous muscle activity essential for fighting or running
- **RELAX** responses needed to return to normal

8. Save the two separate piles of cards! Put them into the envelopes labeled "Fight-or Flight" and "Relax." You will need both piles of cards later in this lab activity.

The sympathetic nervous system

To get messages to many different parts of the body, the hypothalamus sends impulses through the **sympathetic nervous system**. The sympathetic nervous system is composed of branching nerves which are connected to many different parts of the body.

Nerve impulses travel very rapidly through the branches of the sympathetic nervous system. The effect of the sympathetic nervous system on body systems is very rapid but relatively brief.



9. Use the **Sympathetic Nervous System** diagram in your kit. This diagram shows the branching nerves in the sympathetic nervous system and the parts of the body that receive signals during the fight-or-flight response.
10. Place the FIGHT-or-FLIGHT cards on the side of the diagram labeled “Sympathetic Nervous System” to indicate how the parts of the body respond to nerve impulses traveling over the sympathetic nervous system. *Hint: some of the cards could be placed on several different organs. Place the card on one of the related organs.*
11. Ask your teacher to check your work. Teacher initials _____
12. List four of the fight-or-flight responses (from the cards) in the first column of the chart below. Then complete the chart by describing how each response is important for preparing the body for vigorous muscle activity. Be specific!

Fight-or-Flight Responses	How does this response prepare the body for the vigorous physical activity needed for running or defending yourself?

Part 2: Fear and the Endocrine System

Fear Hormones

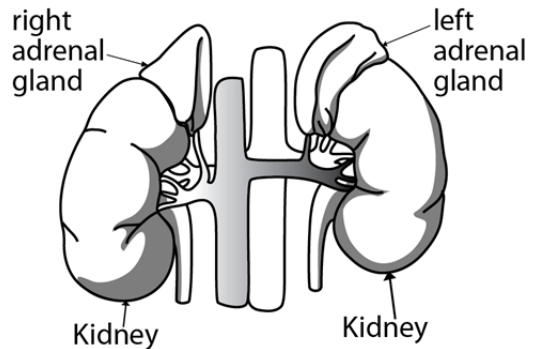
The other way to get messages to many different parts of the body is through hormones (chemical messengers) secreted by the endocrine system. The adrenal gland is an endocrine gland that produces two fear hormones—adrenaline and cortisol. These hormones are carried in the bloodstream to all parts of your body.

Fear hormones are secreted by the adrenal gland, an endocrine gland located on top of your kidneys. The fear hormones circulate through the bloodstream to all cells of your body.

The effect of adrenaline (also called epinephrine) is similar to the effect of the sympathetic nerve action. Adrenaline increases heart rate, increases breathing rate, dilates blood vessels to the lungs and muscles. Adrenaline also decreases blood flow to the brain and decreases digestion.

Cortisol increases blood sugar level by converting stored glycogen and fats into blood sugar. Cortisol also suppresses the immune response and inflammation.

Fear hormones result in a longer lasting and more widespread fight-or-flight response than the effects of the nervous system. Fear hormone action explains why you may feel the fight-or-flight response even after you realize there really is no danger.



1. What endocrine glands produces and secretes fear hormones—adrenaline and cortisol?

2. The fear hormones, adrenaline and cortisol, can be detected in the blood plasma (liquid part of the blood). Your lab kit contains samples of simulated blood plasma collected from the same person at three different times:

- Immediately before a loud, frightening noise
- 1 minute after a loud, frightening noise
- 10 minutes after a loud, frightening noise

Place 1 drop of each of the blood plasma samples in both circles of the appropriate **rows** on the Hormone Test Sheet.

Hormone Test Sheet	Adrenaline Test	Cortisol Test
Immediately before noise	<input type="checkbox"/>	<input type="checkbox"/>
1 minute after noise	<input type="checkbox"/>	<input type="checkbox"/>
10 minutes after noise	<input type="checkbox"/>	<input type="checkbox"/>

3. Add 1 drop of Adrenaline Test Solution to both of the circles in the Adrenaline Test **column**. Use the Adrenaline Color Chart to determine the levels of adrenaline. Record the data you collect on the table below.
4. Add 1 strip of Cortisol Test Paper to both of the circles in the Cortisol Test **column**. Use the Cortisol Color Chart to determine the levels of adrenaline. Record the data you collect on the table below.

Time Sample was collected	Adrenaline Level (micrograms/100 ml)	Cortisol Level (micrograms/100 ml)
Immediately before noise		
1 minute after noise		
10 minutes after noise		

5. Wash and dry the Hormone Test Sheet.
6. Based on the information in the data table:
 - Which hormone (adrenaline or cortisol) is secreted most rapidly after a frightening event?

 - Which hormone (adrenaline or cortisol) remains in the bloodstream for a longer time?

Base your answers to questions 7 through 10 on the information in the Fear Hormones reading.

7. Circle the appropriate words on the right to indicate how **adrenaline** (also called epinephrine) would affect each of the following:

Heart rate	increases	decreases
Breathing rate	increases	decreases
Airways that lead to lungs	dilates	constricts
Digestion	increases	decreases

8. Adrenaline increases breathing rate and opens the airways to the lungs. Explain why this is important for the vigorous muscle activity needed for a fight-or-flight response.

9. Cortisol elevates blood glucose (sugar) level. Explain why this is important in a frightening situation.

10. Adrenaline increases heartbeat rate and dilates (opens) blood vessels to the muscles. Explain why this is important for the vigorous muscle activity needed for a fight-or-flight response.

11. Circle the hormone that is most closely associated with each of the following statements:

This hormone may be used as a medication to reduce inflammation, allergic reactions, and diseases in which the immune system attacks the body.	Adrenaline (also called epinephrine)	Cortisol
This hormone may be used as a medication when the heart stops beating or when an allergic reaction closes of airways.	Adrenaline(also called epinephrine)	Cortisol
During periods of prolonged starvation, this hormone is secreted to maintain blood sugar levels.	Adrenaline (also called epinephrine)	Cortisol

12. Compare the nervous system and the endocrine system response to a frightening situation.

- Which is faster? _____
- Which is longer lasting? _____
- Which has a more widespread effect? _____

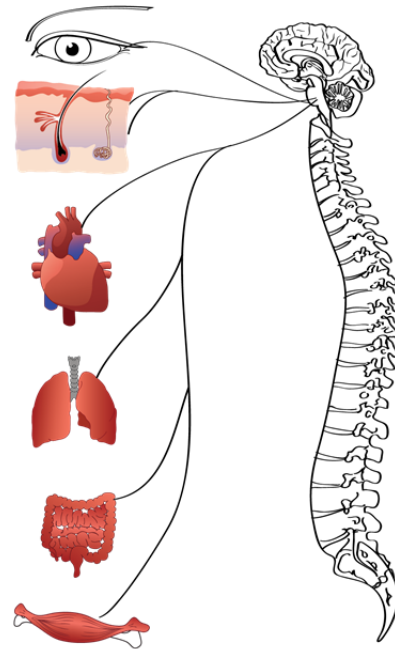
Part 3: How do you recover from a fear response?

The parasympathetic nervous system

Your body cannot maintain a prolonged fight-or-flight response. After an individual has fought or fled a dangerous situation, their body needs to shut down the fight-or-flight response and return to normal.

The reversal of the fight-or-flight response is caused by the actions of the parasympathetic nervous system.

The **parasympathetic nervous system** consists of branching nerves that carry nerve impulses to many parts of the body. It causes the body to restore homeostasis (a balanced state) by relaxing and restoring basic life processes needed for maintaining health.



13. Place the RELAX cards on the side of the diagram labeled “Parasympathetic Nervous System” to indicate how the parts of the body respond to nerve impulses traveling over the parasympathetic nervous system. *Hint: some of the cards could be placed on several different organs. Place the card on one of the related organs.*

14. Ask your teacher to check your work. Teacher initials _____

15. What do the body changes triggered by the parasympathetic nervous system have in common?

16. Compare the action of the parasympathetic and the sympathetic nervous system.

Part 4: What is Stress?

Read the information below about health problems that may result from chronic stress. As you read, underline health problems that may be associated with chronic stress.

Stress and Your Health

Daily life can involve many stimuli that are perceived as threatening. Problems at work or at school, money or social problems, and medical problems can trigger a chronic (long term) fight-or-flight response. Even anticipating (worrying about) things that might happen in the future can trigger the same response as actually experiencing it.

Chronic stress occurs when the fight-or-flight response does not shut down to allow for the proper balance between fear and relaxation. Stress can increase a person's risk of health problems.

The fight-or-flight response uses calories so the urge to eat makes sense after running. But, eating in response to daily stresses can lead to weight gain. In addition, stress increases cortisol levels causing elevated blood sugar levels that can lead to both weight gain and diabetes.

When the fight-or-flight response causes blood pressure and heart rate to remain high, it puts extra strain on blood vessel walls. As a result, the linings of blood vessels can become damaged. An interruption of blood flow to the heart can lead to a heart attack. Blood vessels in the brain can also be blocked, resulting in brain-damaging strokes.

People suffering from stress secrete cortisol at much higher rates than normal people. There is evidence that abnormally high cortisol levels may actually be the initial trigger for depression in some individuals. High cortisol levels also result in sleep deprivation (lack of normal amounts of sleep).

Stress also affects the function of the immune system, the body's natural means of fighting off infection. Stressed individuals produce lower levels of antibodies when exposed to pathogens. They also produce higher levels of cytokines, inflammation triggering chemicals secreted when fighting infections. Excessive inflammation is thought to increase the risks for heart disease, diabetes, and some forms of cancer.

Feeling stressed mentally and physically may have serious health consequences. It is important to consult a mental health care provider to discuss the causes of your stress and learn about specific actions you can take to reduce stress.

1. How would YOU define “chronic stress”?

2. List two examples of things or situations YOU find stressful?

- _____
- _____

3. What hormone seems to be responsible for most of the negative health effects of stress?

4. List at least five potential negative health effects of stress.

- _____
- _____
- _____
- _____
- _____

5. List at least five **positive** actions that people could take to relax and reduce stress.

- _____
- _____
- _____
- _____
- _____