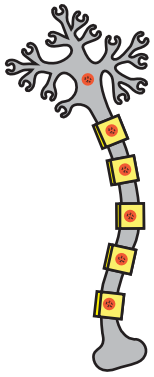
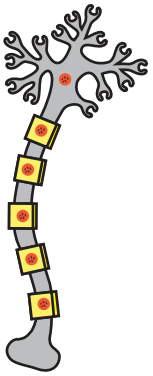
Modeling Reflex Arcs



Student Handout II

"Take a walk" through the nervous system by completing the Simplified Overview of the Nervous System graphic organizer (page 5). Use this as a road map to the major divisions of the nervous system.

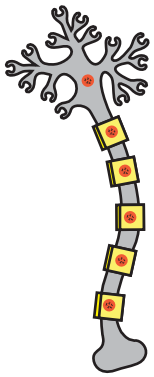
A **reflex arc** is a simple signal conduction pathway to and from the central nervous system (CNS). The most common form of reflex arc consists of an **afferent neuron**, an **interneuron** and an **efferent neuron**.



Signals from **afferent**, or **sensory**, neurons **approach** the central nervous system. **Efferent**, or **motor**, neurons **exit** the CNS and conduct signals to effectors. Effectors may be muscle or glandular tissue. **Interneurons**, found exclusively in the CNS, conduct signals from afferent neurons toward efferent neurons.

All reflex arcs have five essential components:

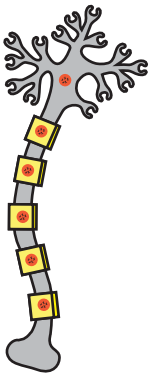
1. The site of the stimulus action is called the **receptor**.
2. The **afferent or sensory neuron** transmits afferent impulses to the CNS.
3. The **integration center** is located within the CNS where information is processed.
4. The **efferent or motor neuron** conducts efferent impulses from the integration center to the appropriate effectors.
5. The **effector** is the muscle or glandular tissue that response to the efferent impulse.



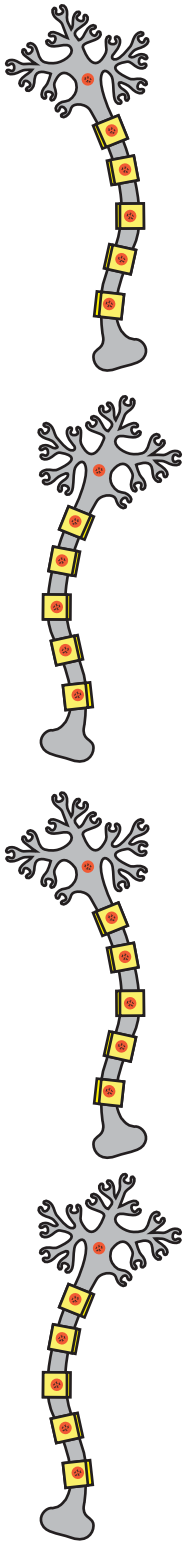
Case 1. The Withdrawal Reflex

The **withdrawal** or **flexor reflex** is a rapid, predictable motor response to a painful stimulus that causes an automatic withdrawal of the threatened body part from the stimulus.

Imagine that you reach into a desk drawer to retrieve a writing utensil to jot down some notes about the amazing lesson your teacher is presenting on reflexes. *Someone* placed a pair of scissors in the drawer so that the point jabs your finger. You instantly pull away in pain!



Modeling Reflex Arcs



Use the cross section of the spinal cord (page 6), the multipolar neuron, the unipolar neuron and the interneuron to construct a model of this withdrawal reflex.

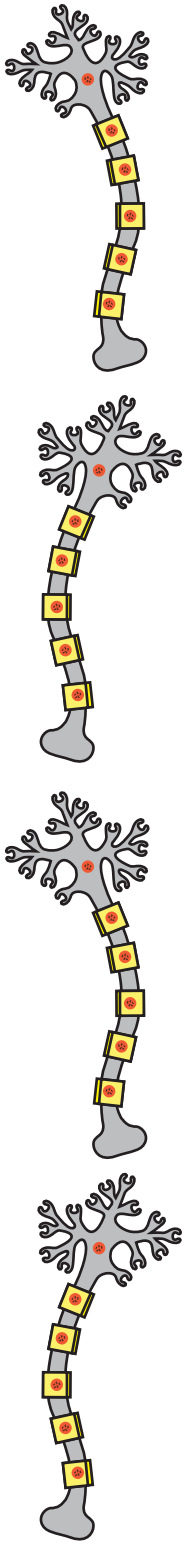
1. Sketch and label your withdrawal reflex pathway in the space below.
2. Use arrows to indicate the direction of the path of the signal.
3. Label the five components of your reflex arc.
4. Which neuron type did you use to represent the afferent neuron? _____
5. How many synapses are in your model? _____
6. Reflexes with only one synapse are referred to as **monosynaptic** while reflexes with multiple synapses are referred to as **polysynaptic**. Is your reflex a monosynaptic or a polysynaptic reflex? _____

Case 2. The Stretch Reflex

The **stretch reflex** is a rapid motor response in which the muscle reacts and tries to maintain a constancy of muscle length when a load is applied. The **patellar** or **knee-jerk reflex** is an example of a stretch reflex that helps to keep your knees from buckling when you are standing upright.

Now you report to your doctor for your annual physical. She has you sit on the examination table and proceeds to hit your knee with a reflex hammer. You involuntarily kick her in the stomach!

Modeling Reflex Arcs



Use the cross section of the spinal cord, the multipolar neuron and the unipolar neuron to construct a model of the patellar reflex (knee-jerk reflex).

1. Sketch your patellar reflex pathway in the space below.
2. Use arrows to indicate the direction of the path of the signal.
3. Label the five components of your reflex arc.
4. Which neuron type did you use to represent the efferent neuron? _____
5. How many synapses are in your model? _____
6. Is the patellar reflex a monosynaptic or a polysynaptic reflex? _____
7. What purpose to you think the patellar reflex serves in the body? _____

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8. Reflexes in which the response occurs on the same side of the body that is stimulated are called **ipsilateral** reflexes. Reflexes in which the response occurs on the opposite side of the body form the stimulus are referred to as **contralateral** reflexes. Are the patellar and withdrawal reflexes modeled ipsilateral or contralateral reflexes? Explain.

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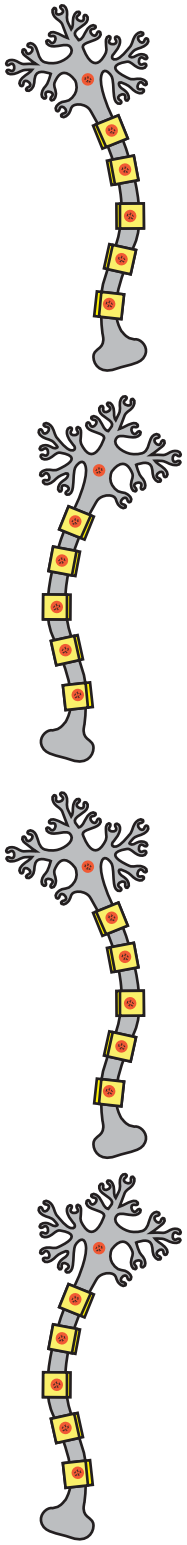
Modeling Reflex Arcs



Case 3. The Crossed Extensor Reflex

The **crossed extensor reflex** is a complex spinal reflex consisting of an ipsilateral withdrawal reflex and a contralateral extensor reflex.

You are enjoying a sunset walk along the beach. As you are strolling along, you step on a piece of broken glass! You notice that you immediately pull your foot away from the painful stimulus AND you tighten the muscles in the opposite leg in order to prevent falling over!

Use the cross section of the spinal cord, the two multipolar neurons, the two interneurons and the unipolar neuron to construct a model of the crossed extensor reflex.

1. Sketch your crossed extensor reflex pathway in the space below.
2. Use arrows to indicate the direction of the path of the signal.
3. Label the components of your reflex arc.
4. How many synapses are in your model? _____
5. Classify the crossed extensor reflex as either monosynaptic or polysynaptic.

_____

6. Explain how the crossed extensor reflex is both ipsilateral and contralateral. _____

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7. Describe another example of a crossed extensor reflex. _____

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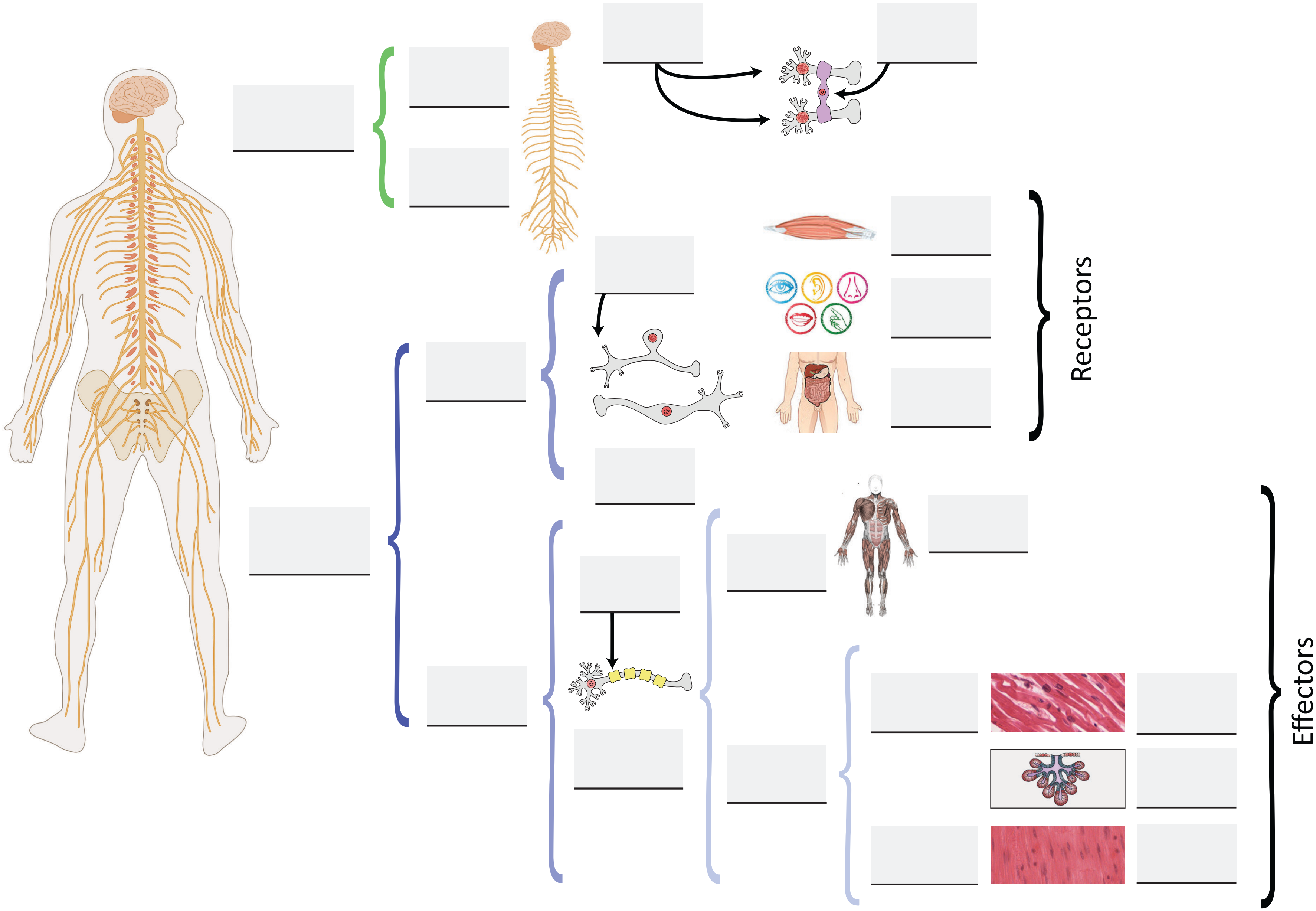
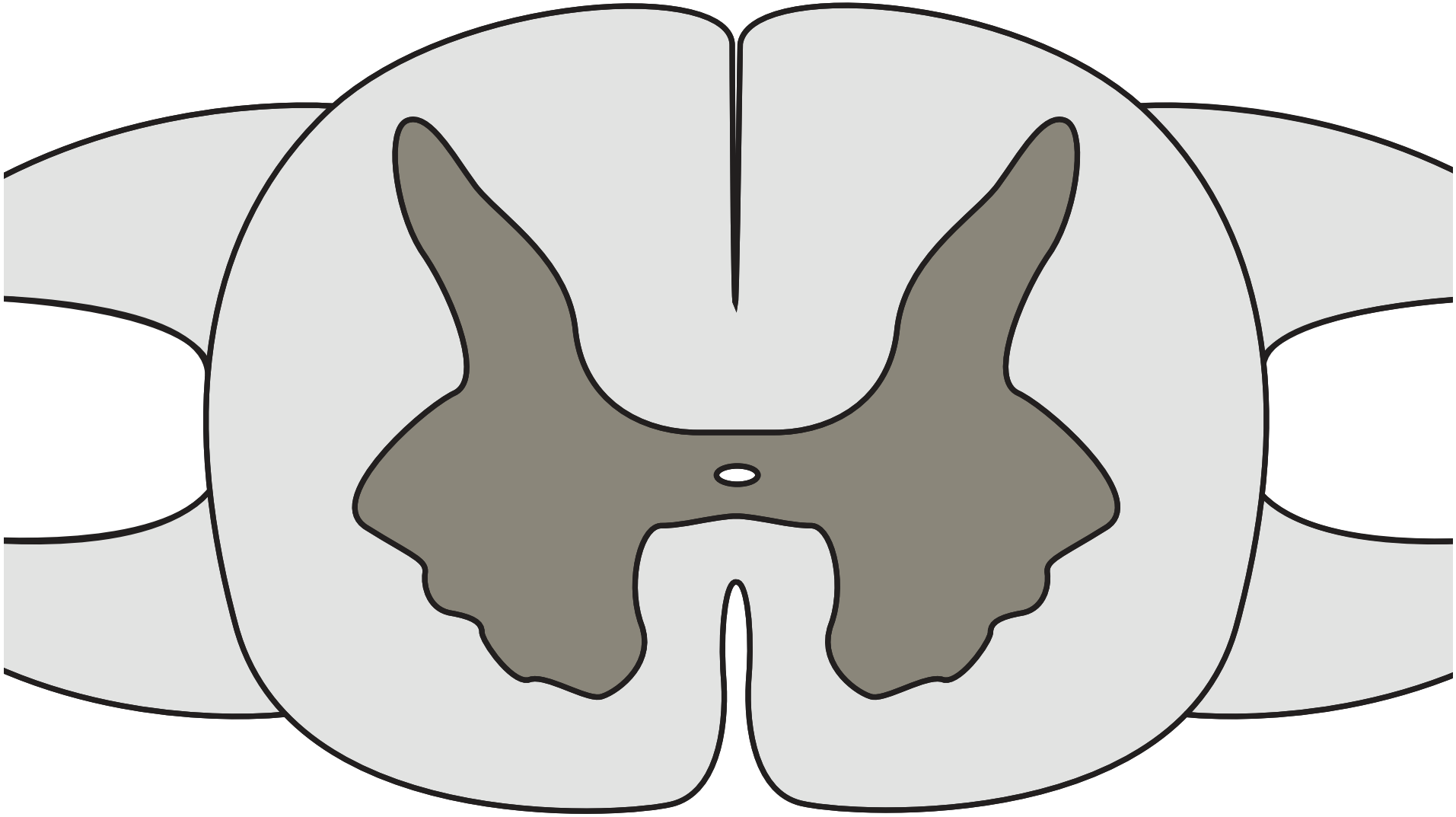
A Simplified Overview of the Nervous System



Modeling a Simple Neuronal Pathway



Cross Section of the Spinal Cord