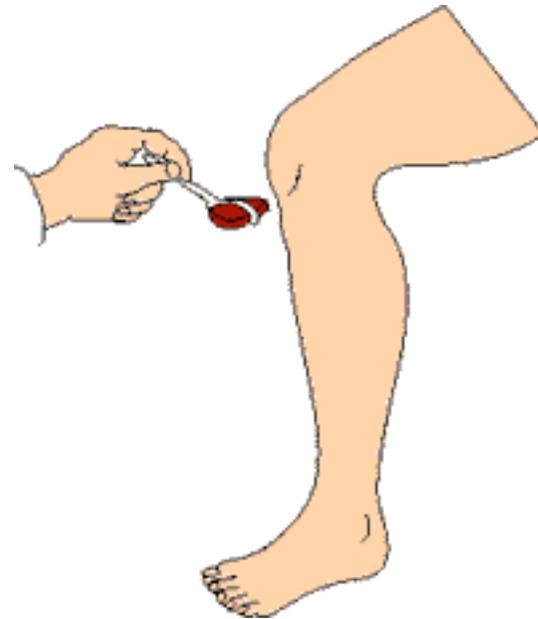


The Reflex Arc

How a Stimulus Elicits a Response

A Knee-Jerk Response

- What happened?
- When the hammer hit the knee the foot jerked up.
- Why?



Reacting to Changes

- You need to keep the conditions inside your body constant. Doing this is called **homeostasis**. Small changes inside your body can cause its cells to be damaged or destroyed. Yet, there are big changes going on outside your body.
- You need to detect a change in the environment (a **stimulus**) and react to the change (a **response**) in a way that maintains homeostasis. When you do this without thinking, it is called a **reflex**.

Reacting to Changes

- It can get very hot or very cold outside, but the temperature inside your body stays the same. How?
- When it gets cold outside (stimulus) you shiver (response) and keep the temperature inside your body from dropping.
- When it gets hot outside (stimulus) you perspire (response) and keep the temperature inside your body from rising.

Posture

- In order to maintain your posture (even bad posture - stop slouching) your muscles are constantly monitoring their shape. A change in shape of a muscle (the stimulus) causes the muscle to readjust its shape (the response) and maintain your posture.
- The knee-jerk reflex is based on the hammer changing the shape of a muscle.

Revisiting the Knee-Jerk Response

- What is the stimulus?
The hammer hits the tendon.

- What is the response?
The muscle contracts, causing the foot to jerk upward.



Other Reflexes

| Stimulus | Response |
|------------------------------------|--------------------|
| The aroma of your favorite food | Salivation |
| A nasty odor | Nausea |
| A bright light shining in your eye | Pupils get smaller |
| An insect flying towards your eye | Blinking |

How is a Stimulus Detected?

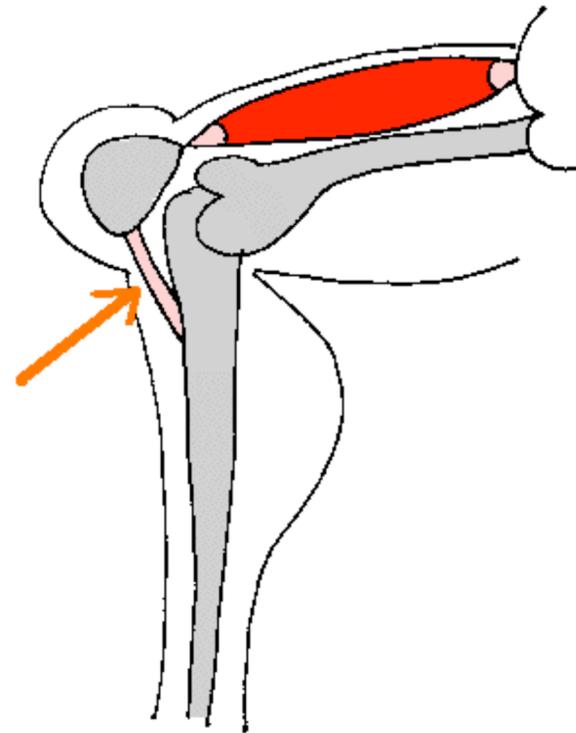
- Some cells are specialized to react to a specific stimulus. These are called **receptors** (they receive a stimulus). The receptor cells of your eyes are stimulated by light.

The Response

- When the receptor is stimulated, it sends a message to a part of your body that effects the correct response. This is called the **effector**.

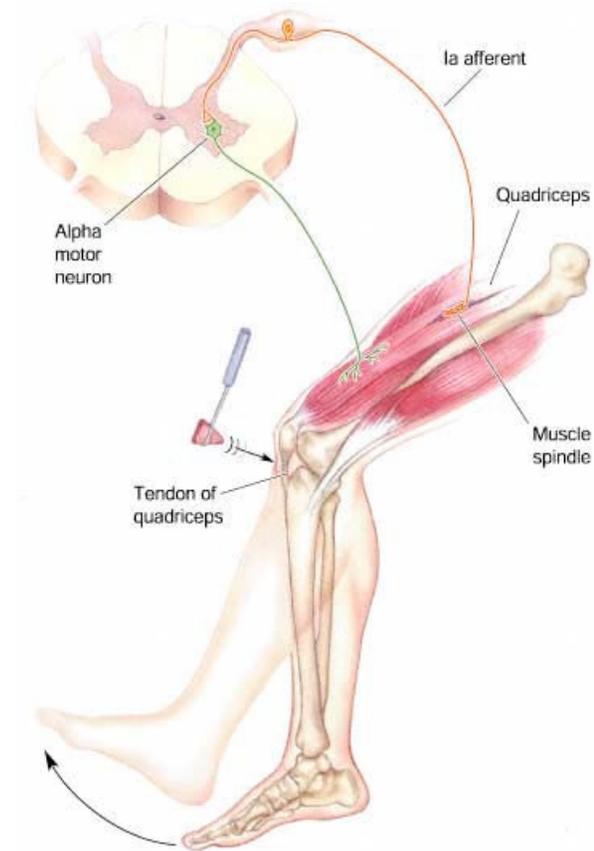
How is the Hammer Tap Detected?

- The muscles in your leg have **stretch receptors**. They react to a change in length of the muscle. When the hammer hits the tendon at the knee, it makes a muscle in the front of your thigh longer (stretches it). That stimulates the stretch receptors in that muscle.



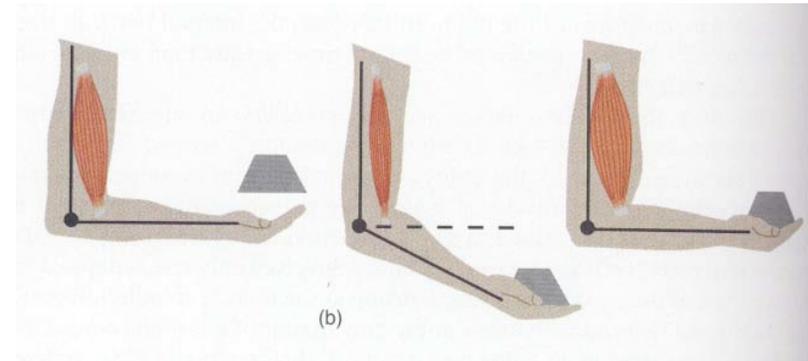
The Knee-Jerk Response

- When the stretch receptors are stimulated, they send a message to the muscles of your thigh.
- The muscles in the front of your thigh contract.
- The muscles in the back of your thigh relax.
- Your foot jerks.



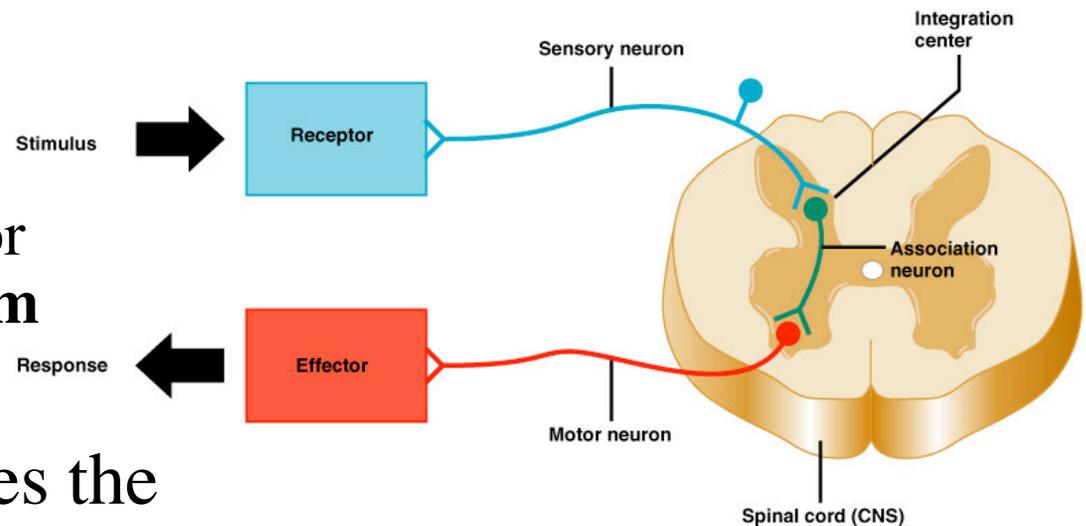
Change in Muscle Length

- Here is a similar reflex in the arm, showing muscle length.
- The weight dropping into the hand is the stimulus. Like the hammer tapping the knee, it stretches a muscle.
- The response is the muscle contracting, jerking the arm up.



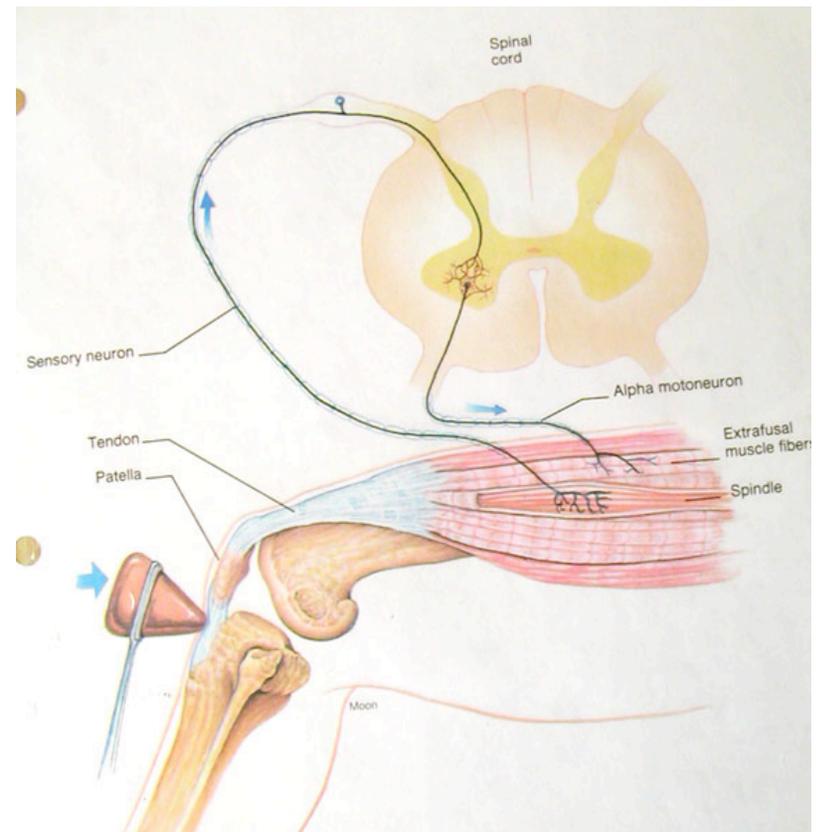
How the Message Travels From the Receptor to the Effector.

- Nerve cells (**neurons**) carry the message from the stimulated receptors to the correct effectors.
- A **sensory neuron** carries the message from the receptor to the **central nervous system** (the spinal cord and brain).
- A **motor neuron** carries the message from the central nervous system to the effector.
- This is a **reflex arc**.



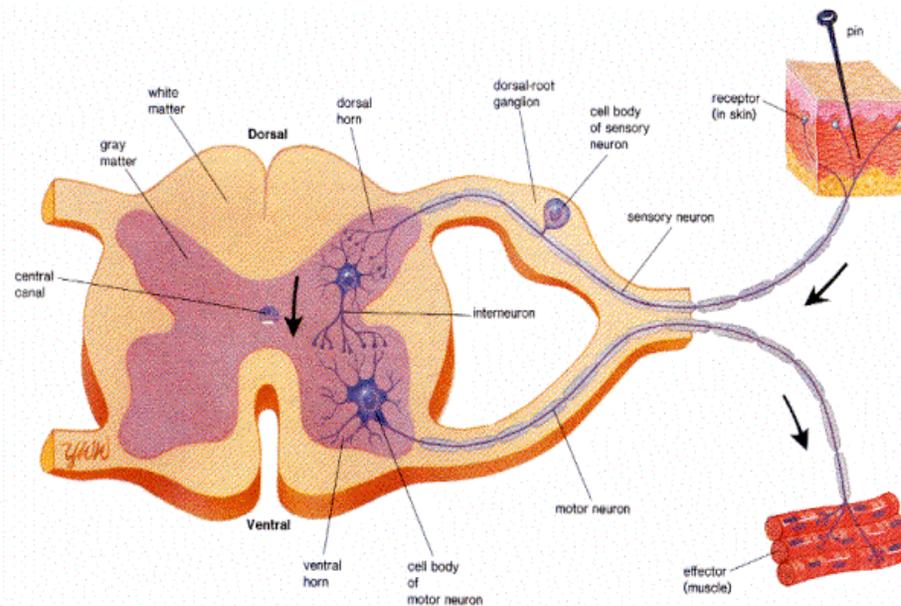
Reflex Arcs

- In a knee-jerk reflex arc the sensory neuron directly connects to the motor neuron in the spinal cord. This is called a simple reflex arc.
- Follow the sensory neuron from the spindle (receptor) to where it connects with the motor neuron in the spinal cord.
- Follow the motor neuron to the muscle (effector).



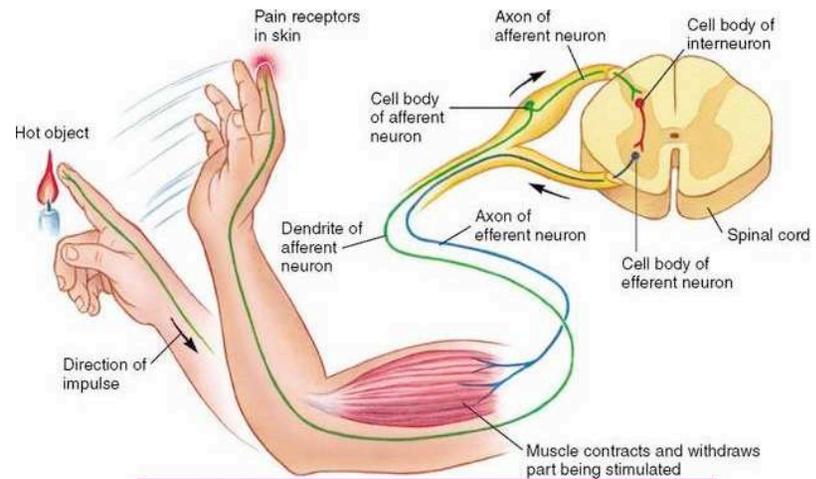
Reflex Arcs

- In most reflex arcs the sensory neuron connects to motor neurons through **association neurons (interneurons)** in the central nervous system.
- Note the interneuron in the spinal cord.



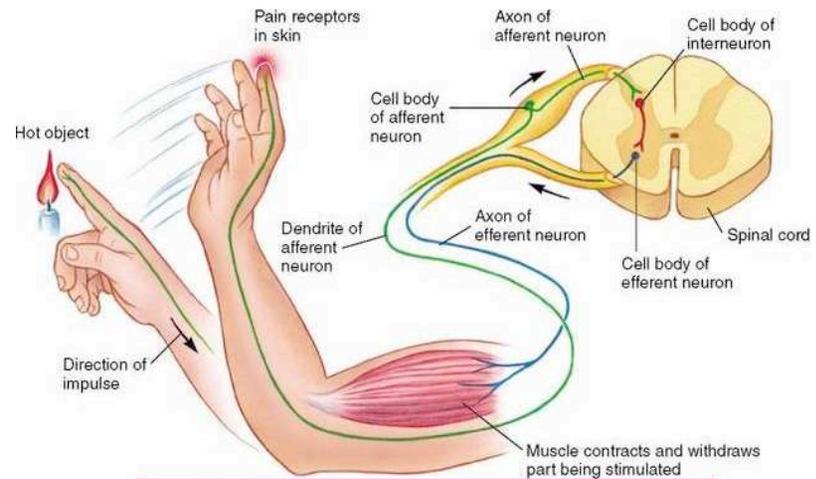
The Correct Pathway.

- If you put your finger on a hot stove, what is the stimulus?
- What is the correct response?
- Would it help your finger if the response was your foot moving?



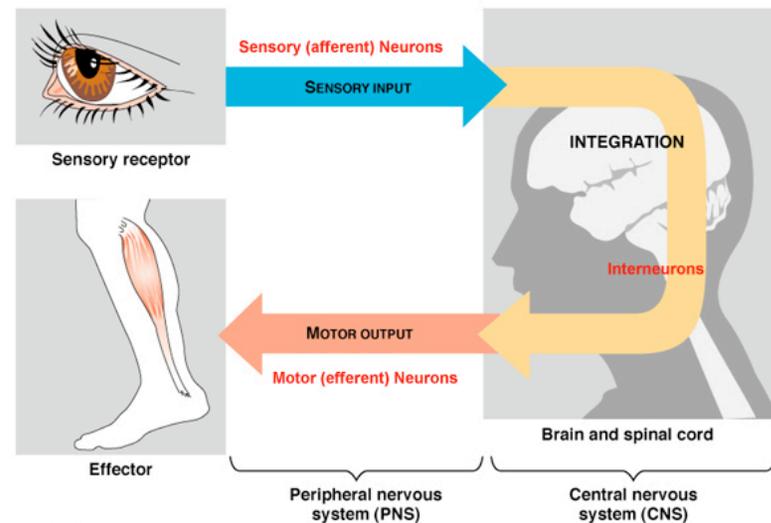
The Correct Pathway.

- The correct connection between the sensory neuron carrying the message from the receptor and the motor neuron carrying the message to the effector is the work of the interneurons of the central nervous system. Making the right connections is called **integration**.



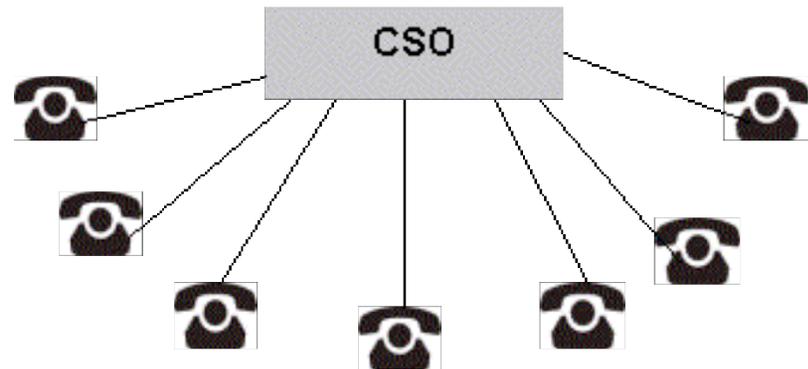
A Conscious Stimulus-Response

- We react to all stimuli in basically the same way as a reflex. The integration just gets more complex.
- Complex behavior involves complex integration in the brain.



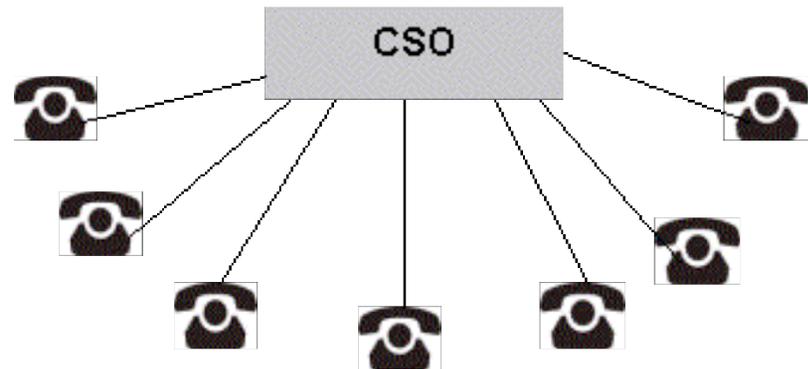
Making the Right Connection

- Integration in the central nervous system works like the central switching office (CSO) of a telephone system
- When you phone a friend, the call is not directly carried by a wire going from your phone to your friend's.



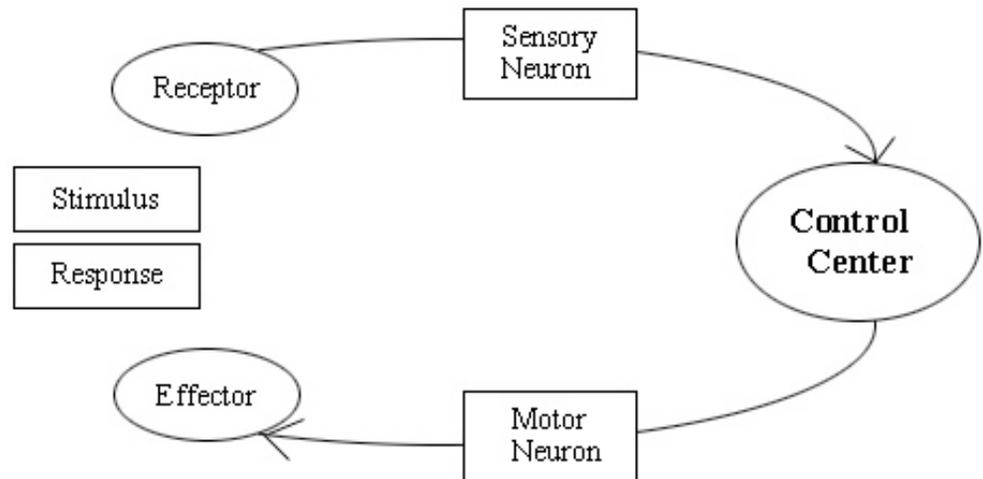
Making the Right Connection

- The wire from your phone goes to the CSO.
- The CSO connects your wire to the wire going between the CSO and your friend's phone (integration).
- Hello.



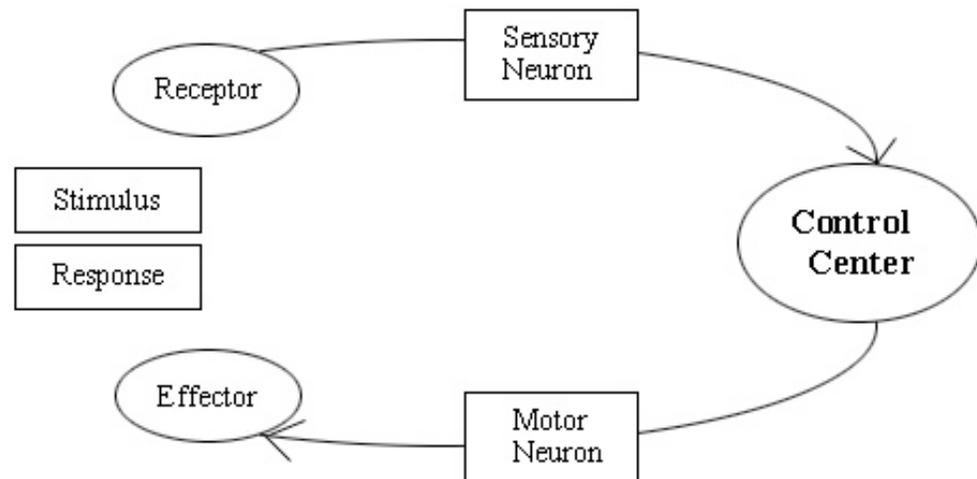
Review

- When the receptor detects the stimulus, it excites a sensory neuron.
- The message travels through the sensory neuron to an interneuron in the central nervous system (labeled control center).



Review

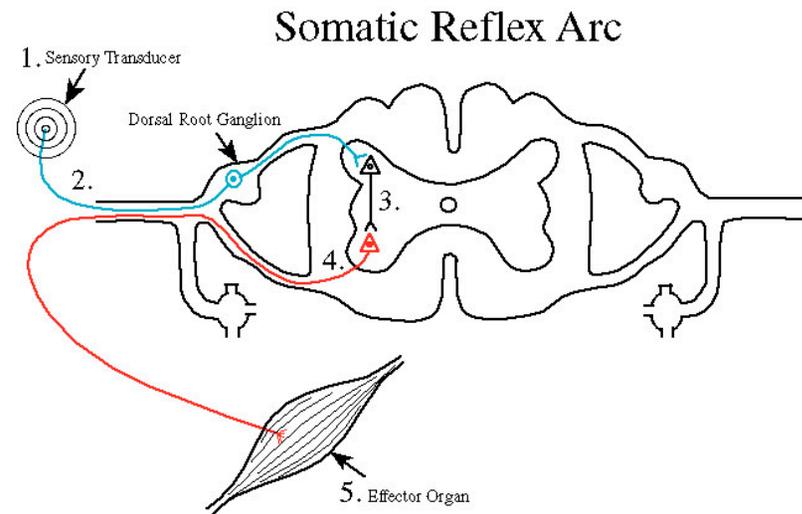
- The message travels through the interneuron to a motor neuron.
- The message travels through the motor neuron to the effector.
- The effector is stimulated and its reaction is the response.



Name the Neurons

- Neuron 2

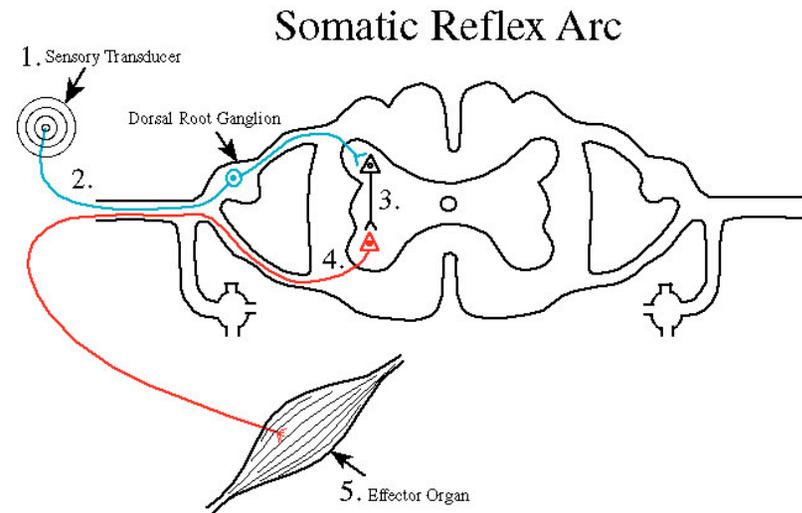
Sensory Neuron



Name the Neurons

- Neuron 3

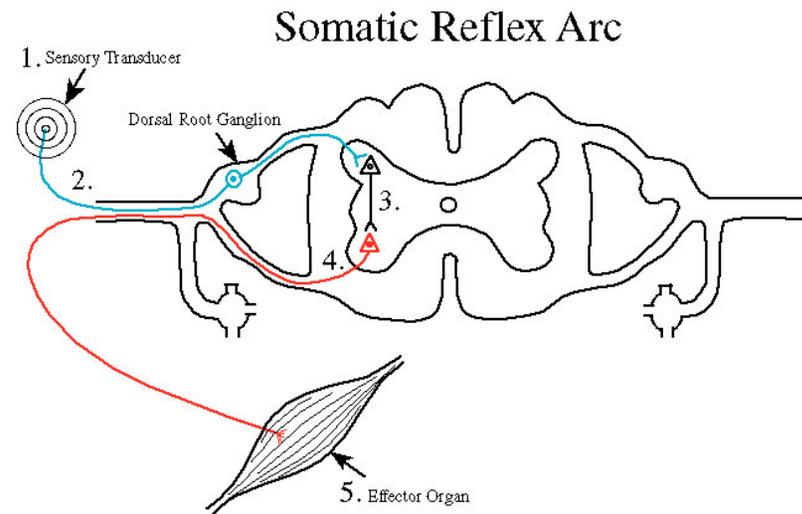
Interneuron



Name the Neurons

- Neuron 4

Motor Neuron



What is “the message” we have been talking about?

- Tune in next lesson to find out.

