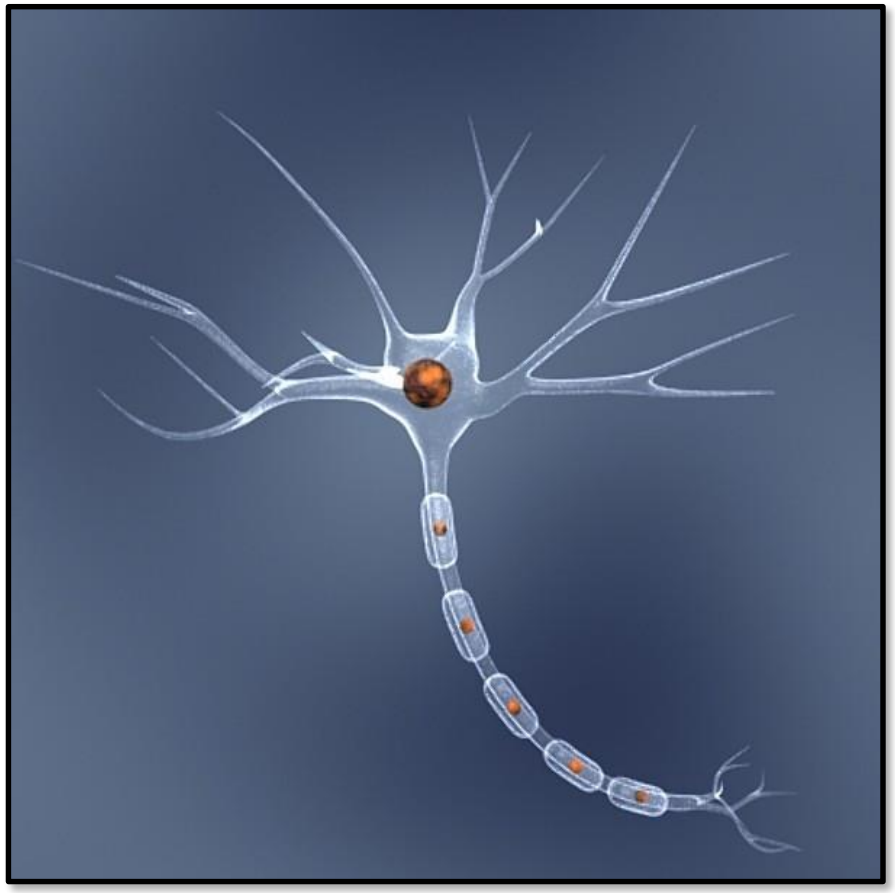
THE NERVOUS SYSTEM III

Small Review

Review

- What is this?
  - A neuron
- What does it do?
  - Receives and transmits information



Sending a signal

- How are signals sent in the nervous system?
  - Message travels from neuron to neuron
    - Always **dendrite to axon terminal**
    - **Neurotransmitters** are released by the axon terminal and travel across the **synapse** to the next neuron's dendrite

I need a volunteer!

What’s happening?

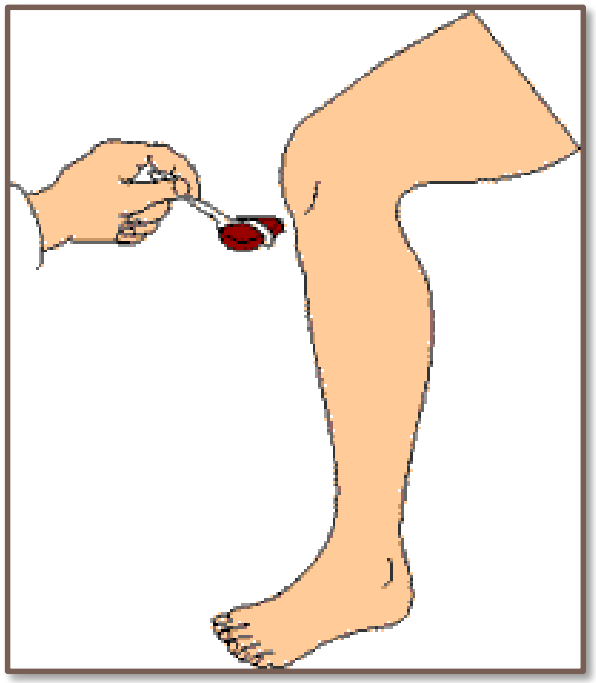
Try it yourself! (or on a friend)

1) Sit on your chair (or desk) so your leg is hanging freely
2) Locate your knee cap and then locate the tendon below it
3) Tap the tendon with your fingers

What's happening? What do you notice? What do you feel?

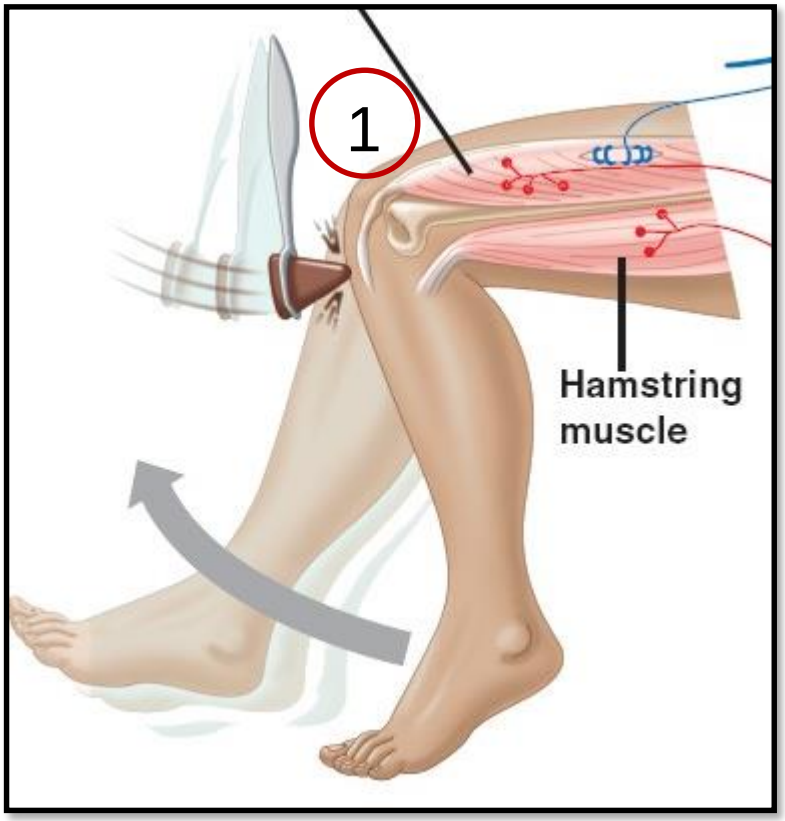
Discussion

What was happening?
What did you observe?
What did you feel?



Before-During-After

1) Hit the tendon

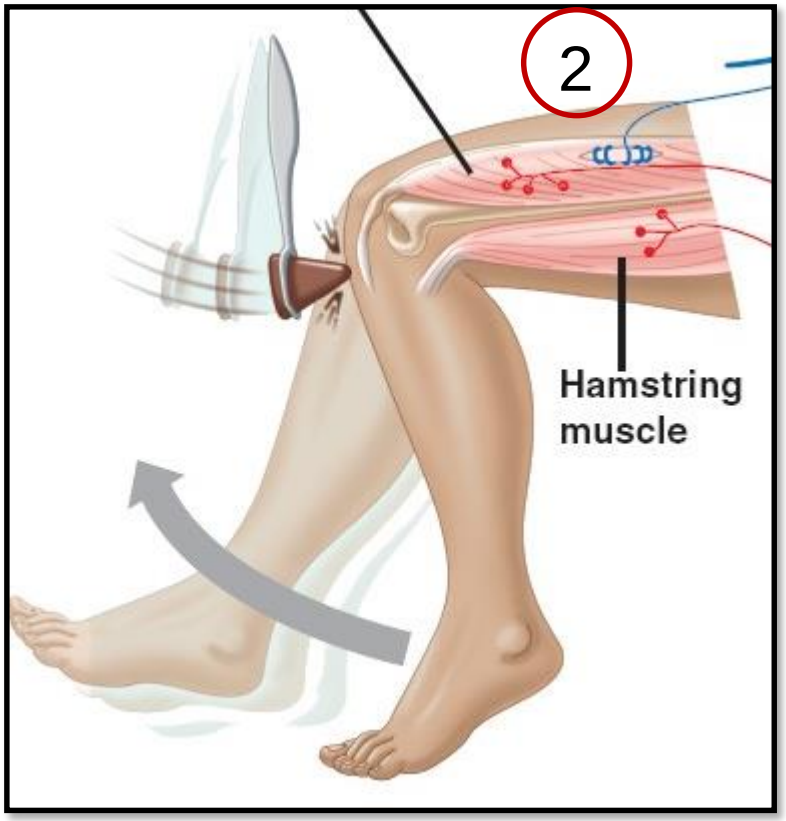


Receive a message

- This is the **stimulus**

Before-During-After

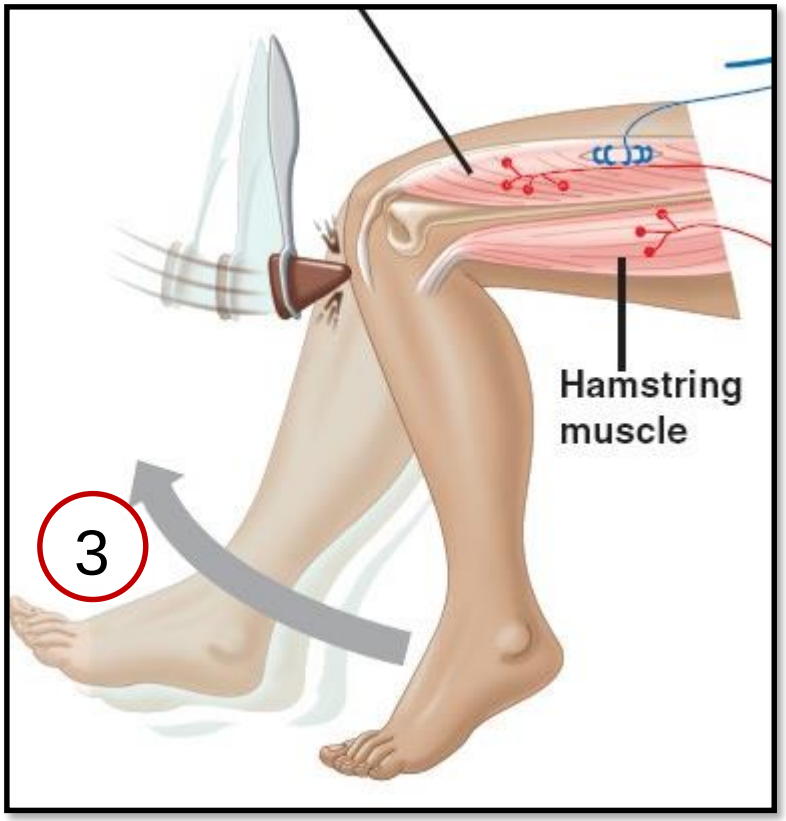
2) Signal is sent



Message is **transmitted**

Before-During-After

3) Leg kicks out



A **reaction** occurs

- Knee-jerk

This is a **Reflex**!

Reflexes

- What are **reflexes**?
  - A **rapid** and **involuntary** reaction to a stimulus
- What is a **stimulus**?
  - Anything that can be **perceived** by a living organism and can **trigger a reaction**.

Reflexes

In the knee-jerk test, what is the stimulus and what is the reaction?

Stimulus = hitting the knee
Reaction = kick

Voluntary vs Involuntary Actions

- **Voluntary movement:**
  - Involves the **skeletal muscles**
  - Responsible for the **conscious control** of our movement
  - Signals from the **brain** cause **contractions of the muscles**
  - These are things you **CHOOSE** to do

Voluntary vs Involuntary Actions

- **Involuntary movement:**
  - Involves the **skeletal muscles**
  - Responsible for **automatic reactions**
  - Signals from the **nervous system** cause **contractions of the muscles**
  - These are things that happen **without you thinking** about them

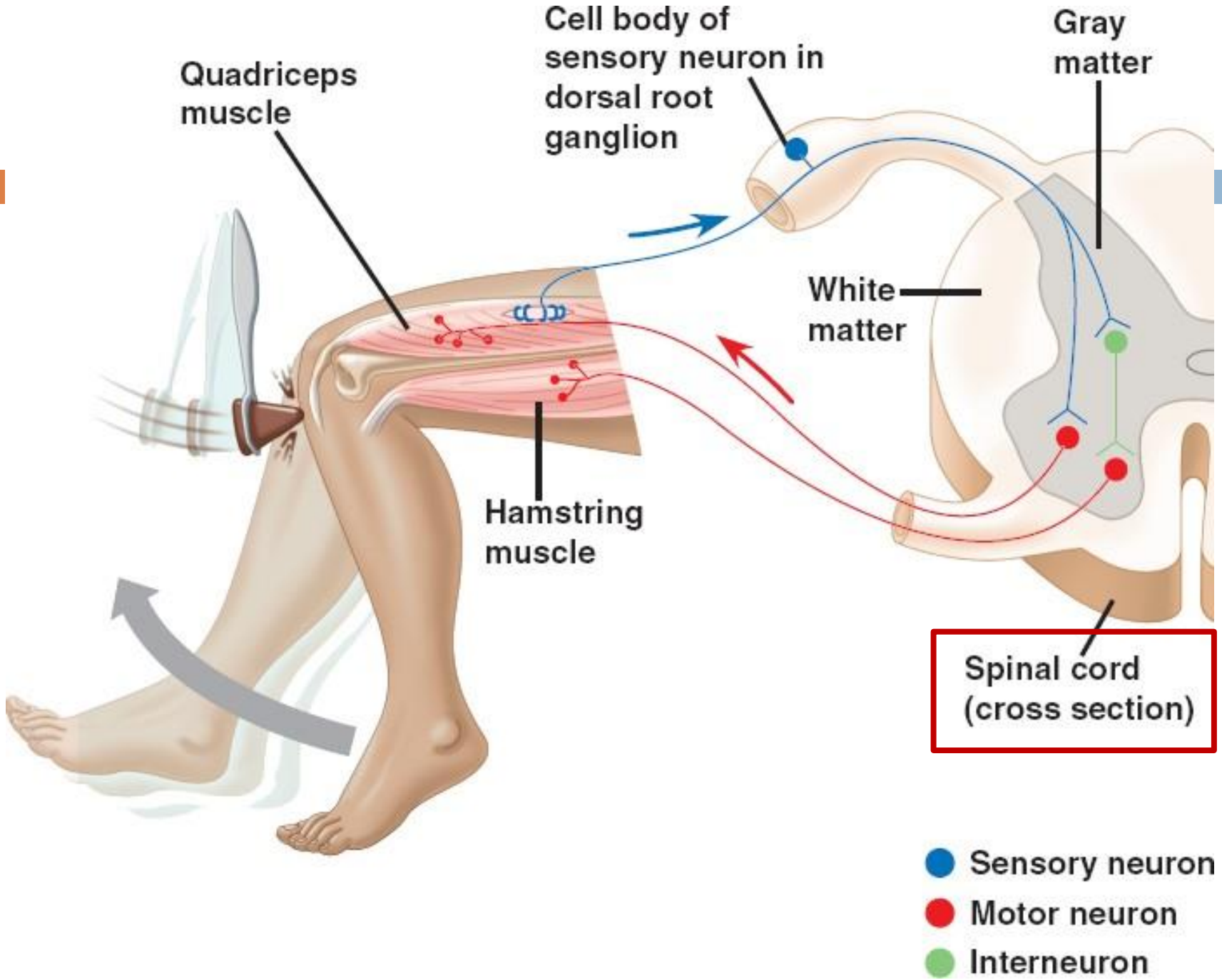
Reflexes

- **Reflex arc:**
  - The **pathway** taken by a **nerve impulse** during a reflex
    - Basically a series of neurons

Reflexes

- Where is the reflex signal going?
  - The brain?
  - No! To the **spinal cord**

Brain actually processes the information after the reflex has happened


Quadriceps muscle
Cell body of sensory neuron in dorsal root ganglion
Gray matter
White matter
Hamstring muscle
Spinal cord (cross section)
Sensory neuron
Motor neuron
Interneuron

Reflexes

- What's happening in our bodies?
  - We receive a stimulus
  - A nerve impulse message is transferred
  - This message is received and decoded
  - A new message is sent in return
  - There is an action

Where is this happening?

Reflexes

General process	Knee-jerk example
1)We receive a stimulus	The stimulus is: **tap from hammer**
2)A nerve impulse message is transferred	Message is transferred along **sensory** neurons

Reflexes

General process	Knee-jerk example
3) This message is received and decoded	Message is received and decoded by the **spinal cord**
4) A new message is sent in return	Message is transferred along **motor** neurons
5) There is a reaction	The reaction is: **kick (knee jerk)**

Central Nervous System (CNS)

- Remember:
  - **CNS** is composed of the **brain** and the **spinal cord**

Central Nervous System (CNS)

- **Spinal cord**
  - **Organ** in the nervous system that **carries information** from the various parts of the body to the brain. It's like a large communication cable
    - The spinal cord is also known as the **reflex centre**

Peripheral Nervous System (PNS)

- Where is this information coming from?

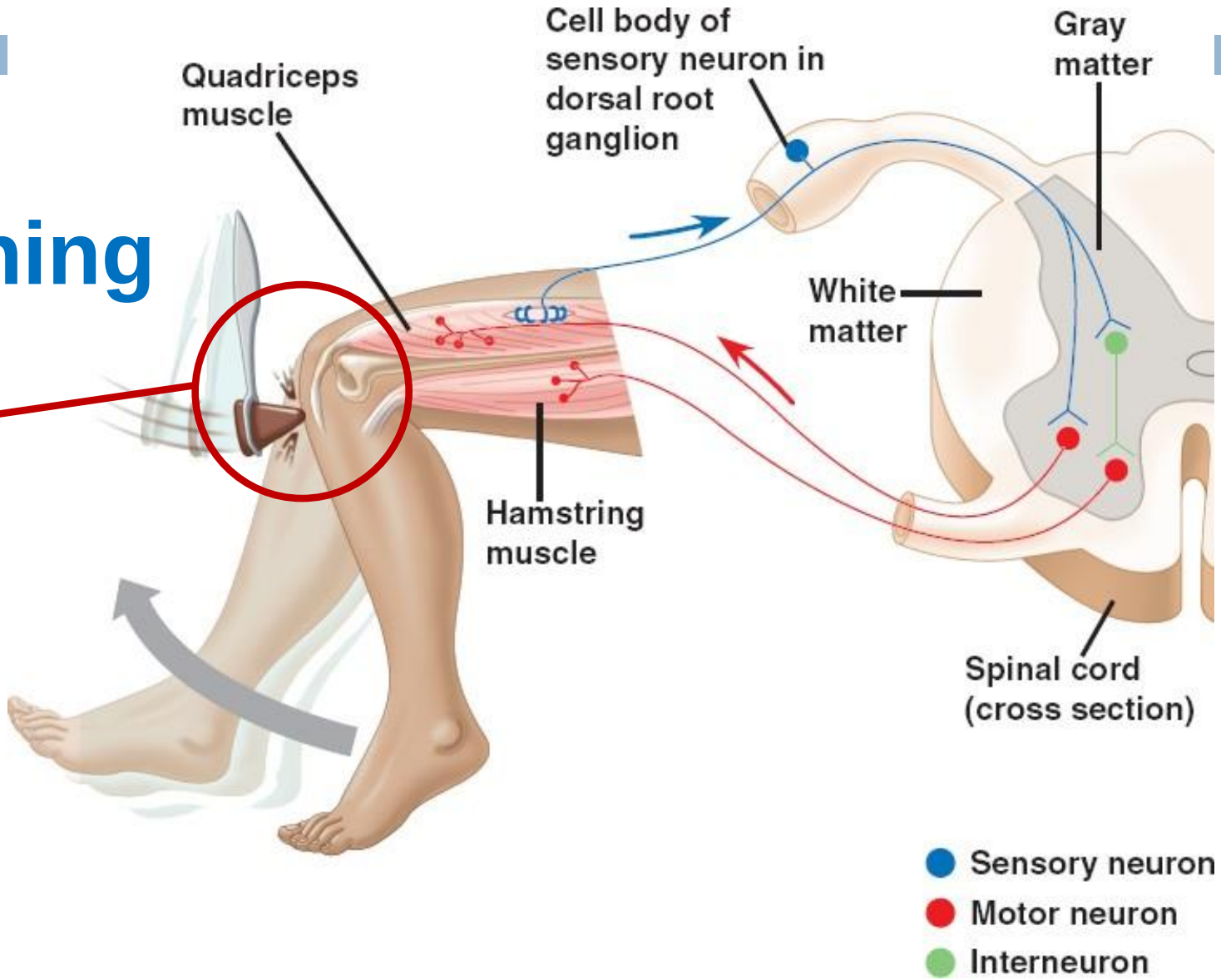
The Peripheral Nervous System (PNS)

Peripheral Nervous System (PNS)

- **Peripheral nervous system:** **connects** different parts of the body to the **central nervous system (CNS)**

Let's look at our example again

What's happening here?



Sensory receptors

- **Sensory receptors:**
  - The structures that pick up **stimuli** and transform them into **nerve impulses**
    - Transfer impulse to **sensory** nerves

Types of neurons

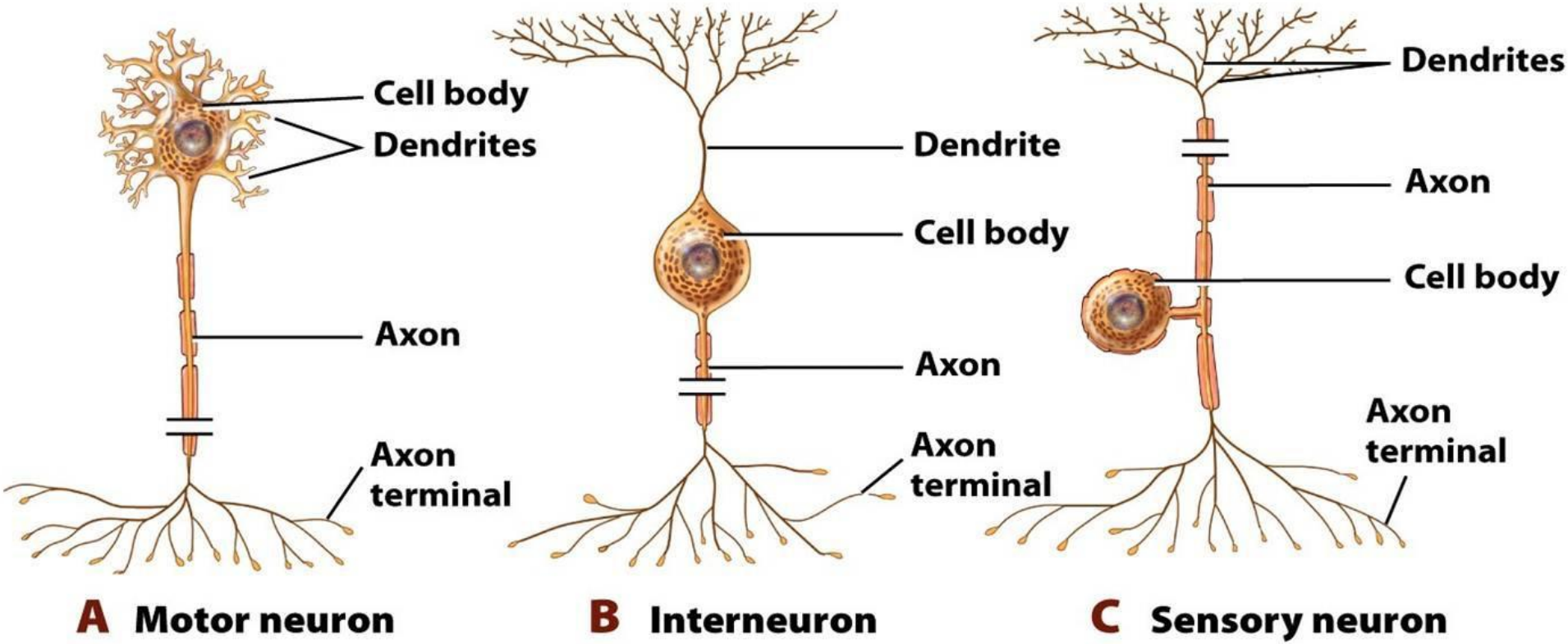
- There are three types of neurons:
- **Sensory neurons**
  - Transmit information from the **sensory receptors** to the **CNS**

Types of neurons

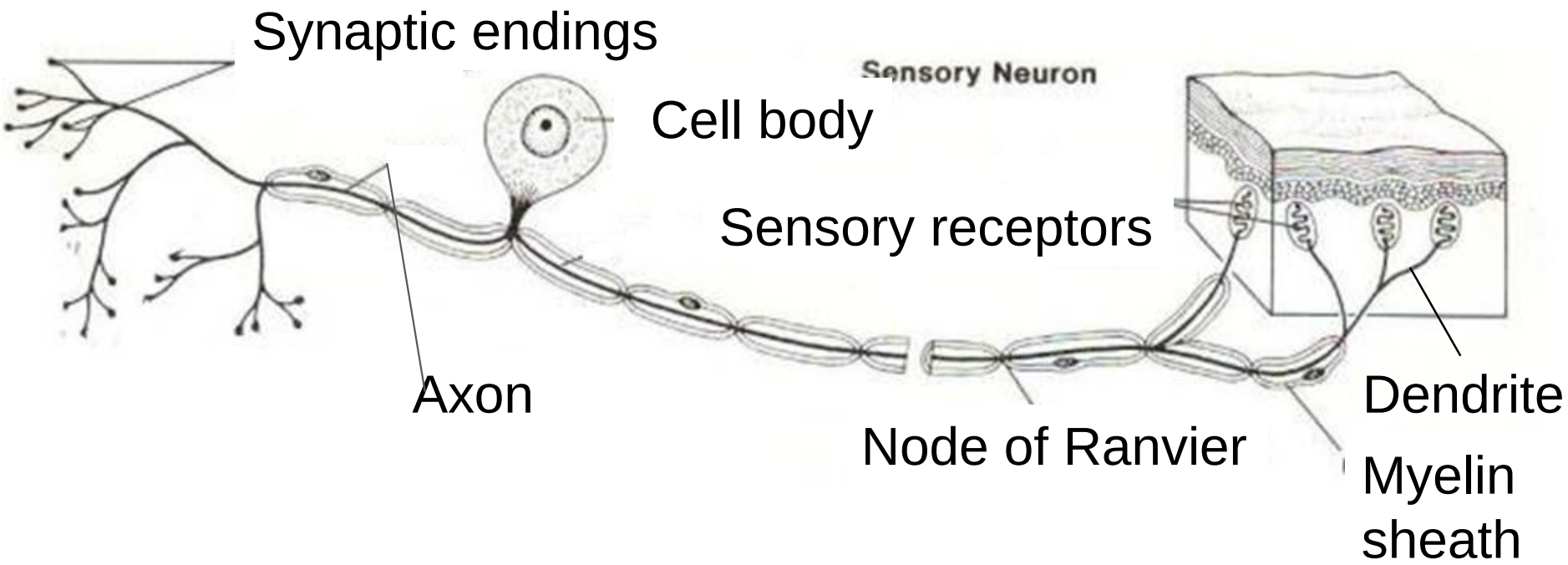
- There are three types of neurons:
- **Motor neurons**
  - Transmit impulses from **CNS** to **the muscles** in order to produce movement (voluntary or involuntary)

Types of neurons

- There are three types of neurons:
- **Interneurons**
  - Neurons that **form connections** between other neurons
    - Neither sensory nor motor


Cell body
Dendrites
Axon
Axon terminal
A Motor neuron
Dendrite
Cell body
Axon
Axon terminal
B Interneuron
Dendrites
Axon
Cell body
Axon terminal
C Sensory neuron

Sensory Neuron



Nerve Impulse

Reflex Pathway

1) The **sensory receptors** pick up a stimulus and change it into electrical impulses.

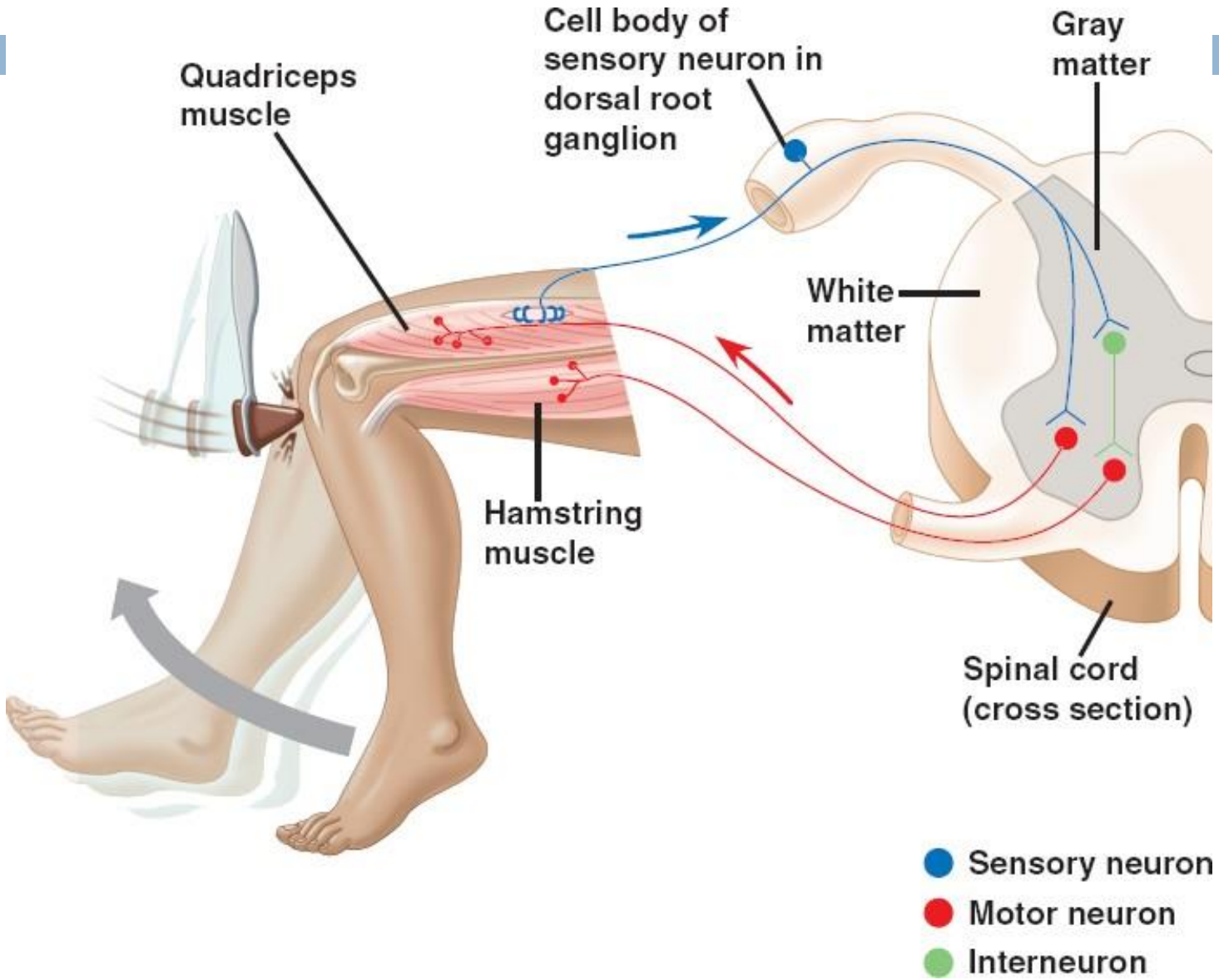
2) The **sensory** nerve carries the message to the CNS.

Reflex Pathway

3) The **interneuron** (found in the **grey matter** of the spinal cord) received the information and interprets it. It then sends out a response signal.

4) The **motor** *nerve* transmits the signal to the muscles and makes it react.
   - This reaction can be **voluntary** or **involuntary**

Let's look at our example again



Response Time Test

Response Time

1) Work with the person sitting next to you
2) Get a ruler
3) Hold the ruler near the end (highest number) and let it hang down. Have the other person put his or her hand at the bottom of the ruler and have them ready to grab the ruler
   - they should not be touching the ruler
4) The person holding the ruler will drop it randomly (wait between 3 to 10 seconds) and the other person will have to catch it.
5) Record the level (cm) at which they catch the ruler.
   - Test the same person 3 to 5 times then switch

What is the stimulus?

Seeing the ruler drop

What is the reaction?

Closing your hand

General process	Ruler Drop Test
1)We receive a stimulus	The stimulus is: **seeing the ruler drop**
2) A nerve impulse message is transferred	Message is transferred along **sensory** neurons

General process	Ruler Drop Test
3) **This message is received and decoded**	Message is received and decoded by the **spinal cord**
4) **A new message is sent in return**	Message is transferred along **motor** neurons
5) **There is a reaction**	The reaction is: **closing your hand**

What is the difference between the ruler activity and the knee-jerk test?

Knee-jerk – **involuntary** reflex
Ruler test – **voluntary** movement