

Understanding Pain: Neurophysiological Changes and Treatment Implications

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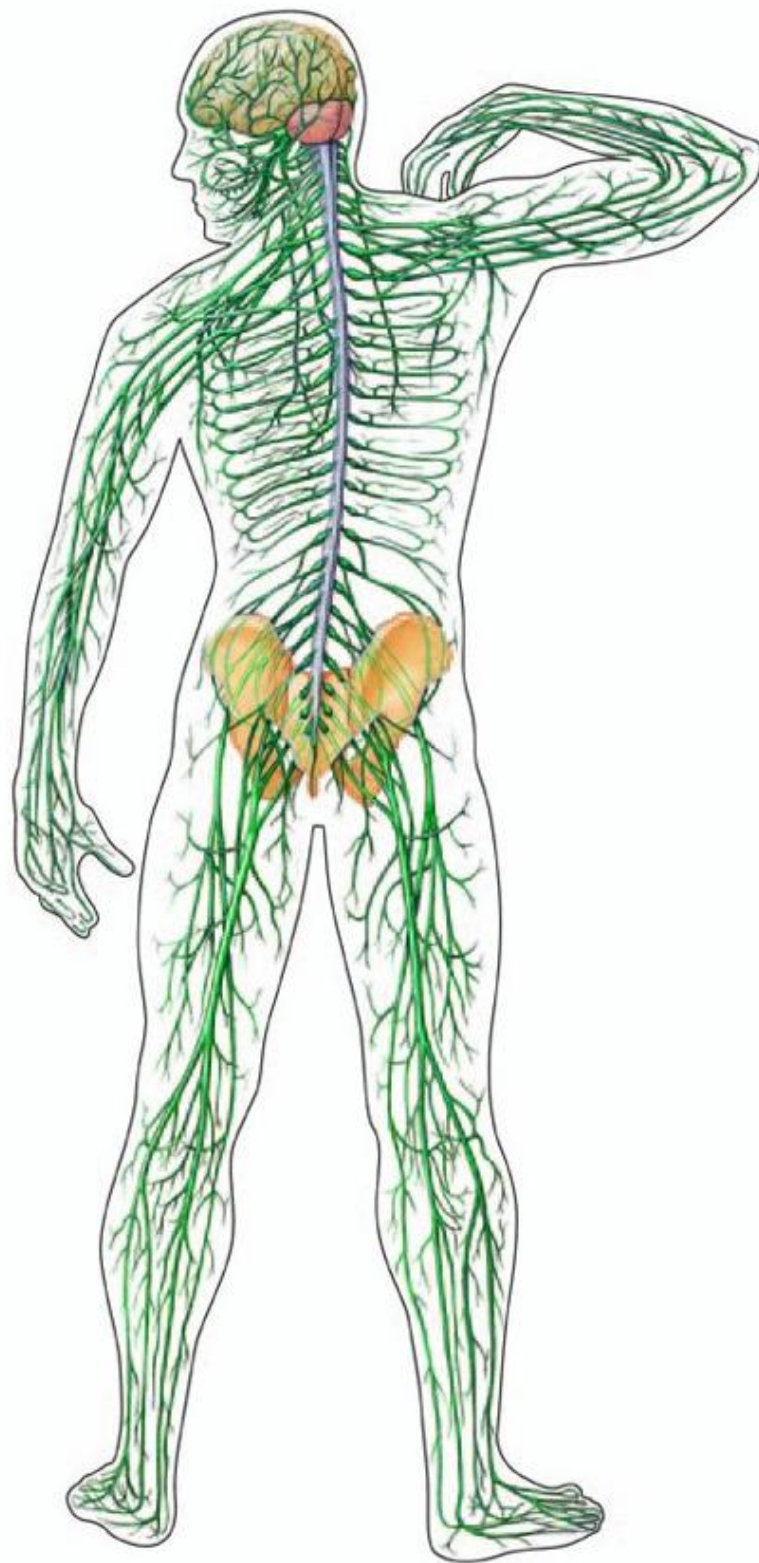
Providence Rehabilitation Services

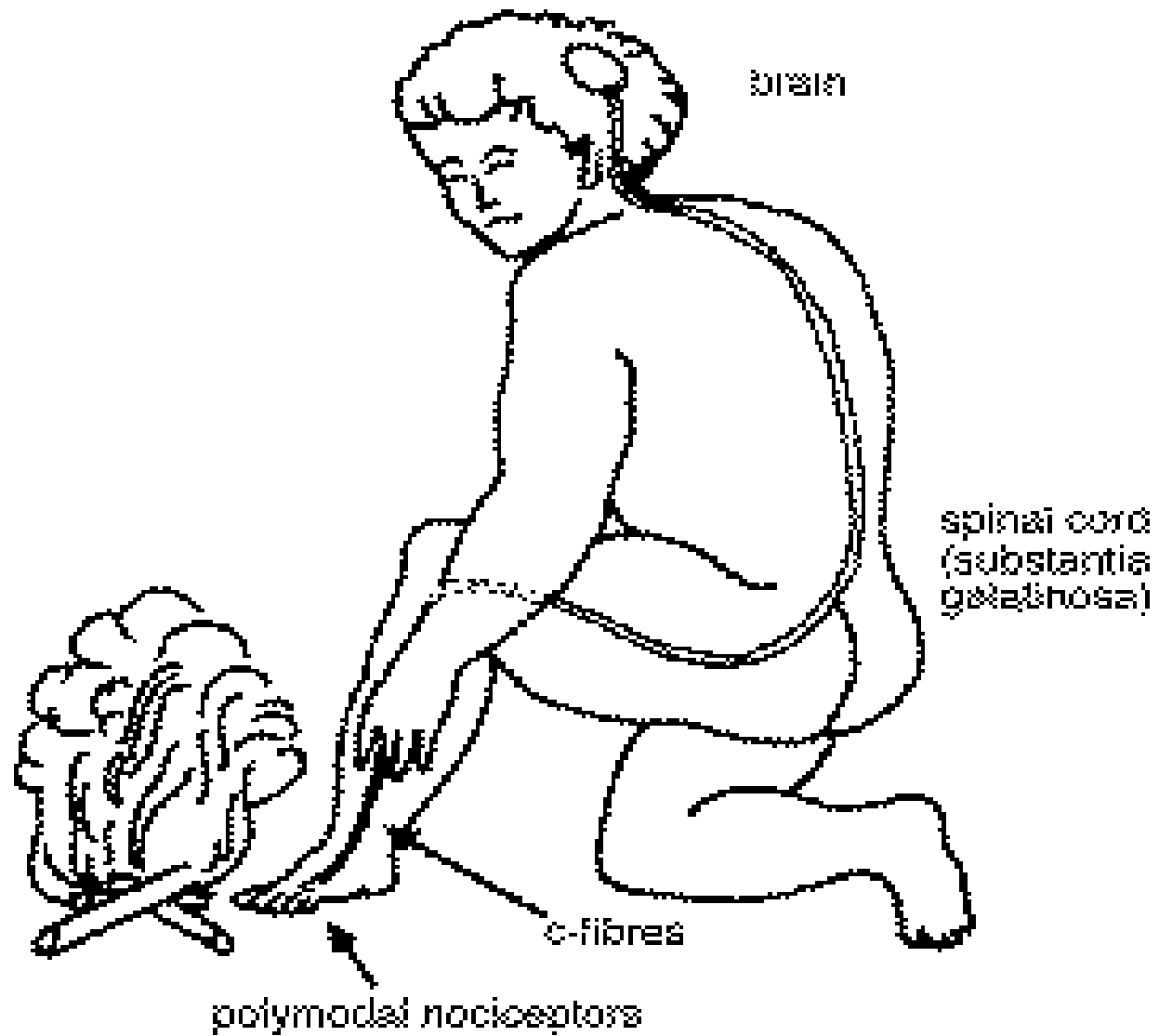
Objectives:

- Identify neuropathic changes occurring in the nervous system with abnormal pain response
- Identify areas of the brain which modify pain information
- Identify how the autonomic nervous system modifies electrical signals which change the pain experience
- Understand appropriate referrals for a patient with abnormal pain response both to and from psychotherapy.
- Be able to explain abnormal pain to your patients

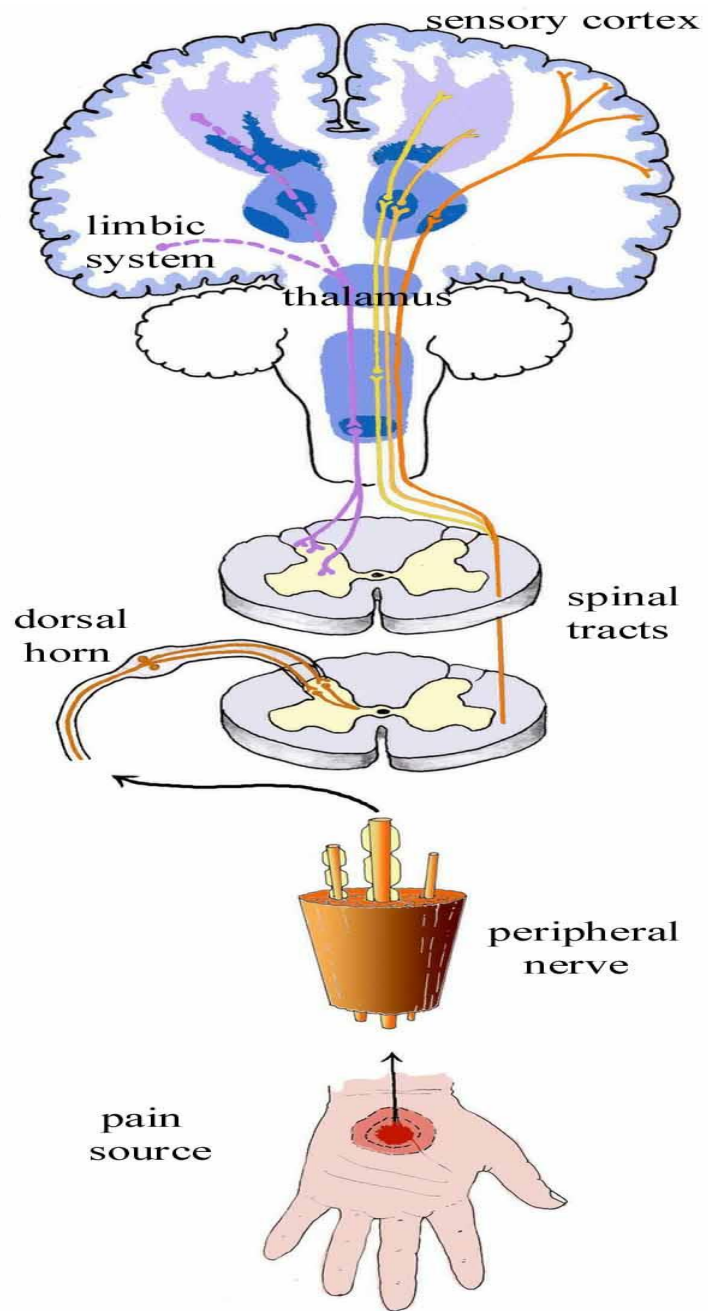
1. It's not pain until it gets to the brain
Before that it's just an electrical signal
2. Pain does not equal danger

Abnormal Pain can occur at any time

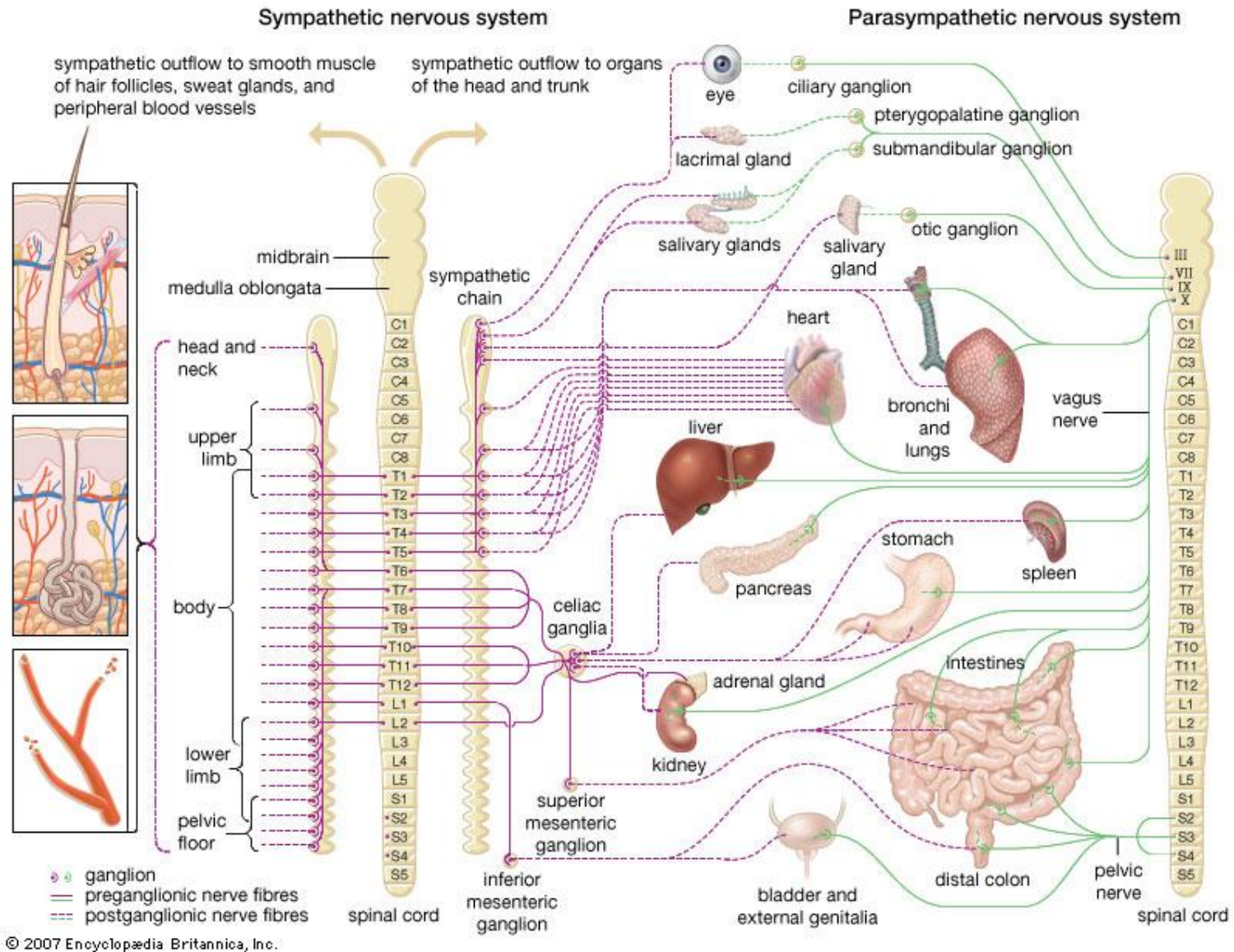




Nociceptive Pathway

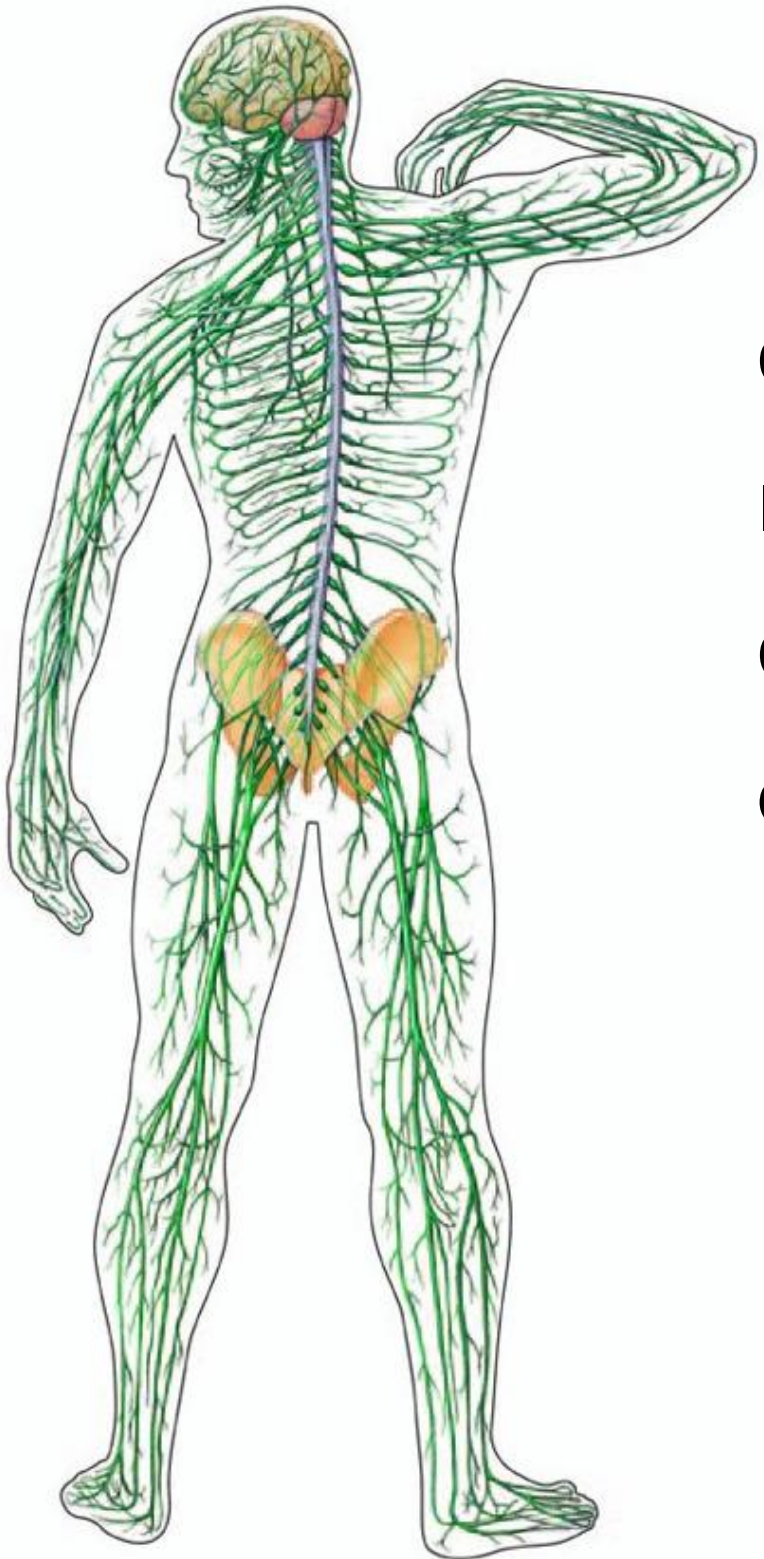


Nociceptive Pathway



Autonomic Nervous System: Sympathetic and Parasympathetic

Pain experience changes the
immune system through hormonal
changes



Changes in Nervous System:

Input: Peripheral nerve

Central: Spinal cord and brain

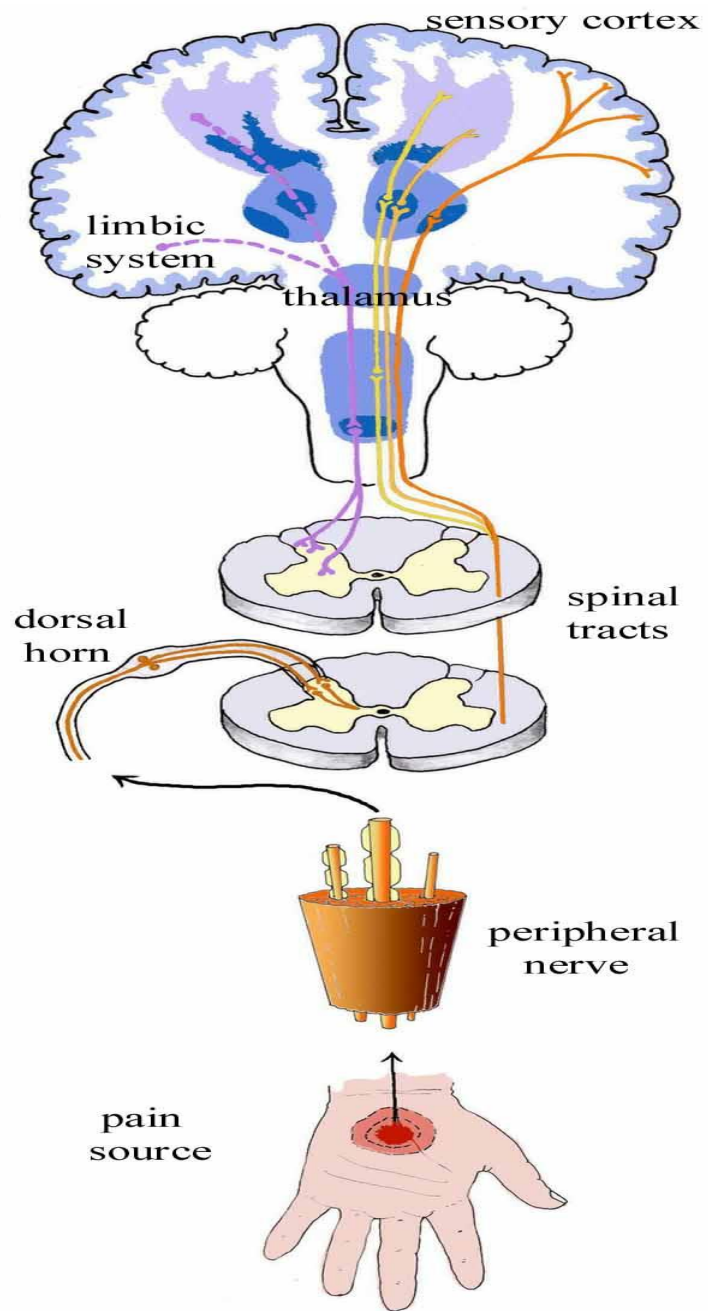
Output: Autonomic and Neuroendocrine

Changes in the Peripheral Nerve
can occur anywhere along the nerve:

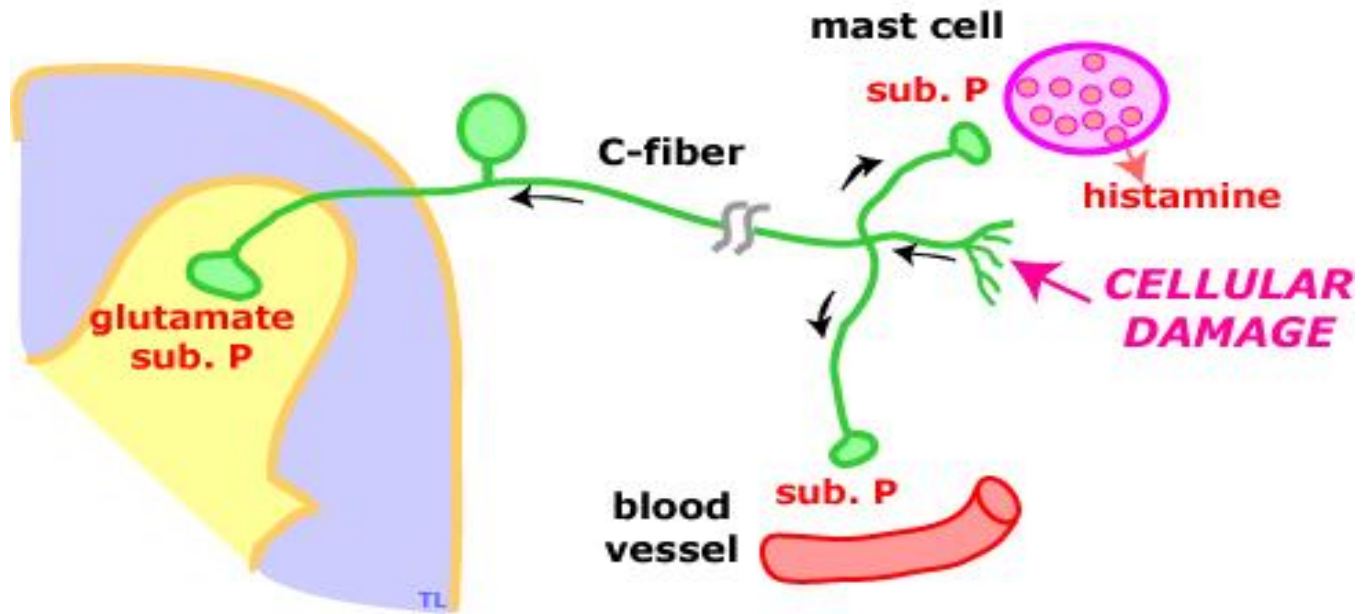
Receptor bed

Axon sheath

Dorsal root ganglion

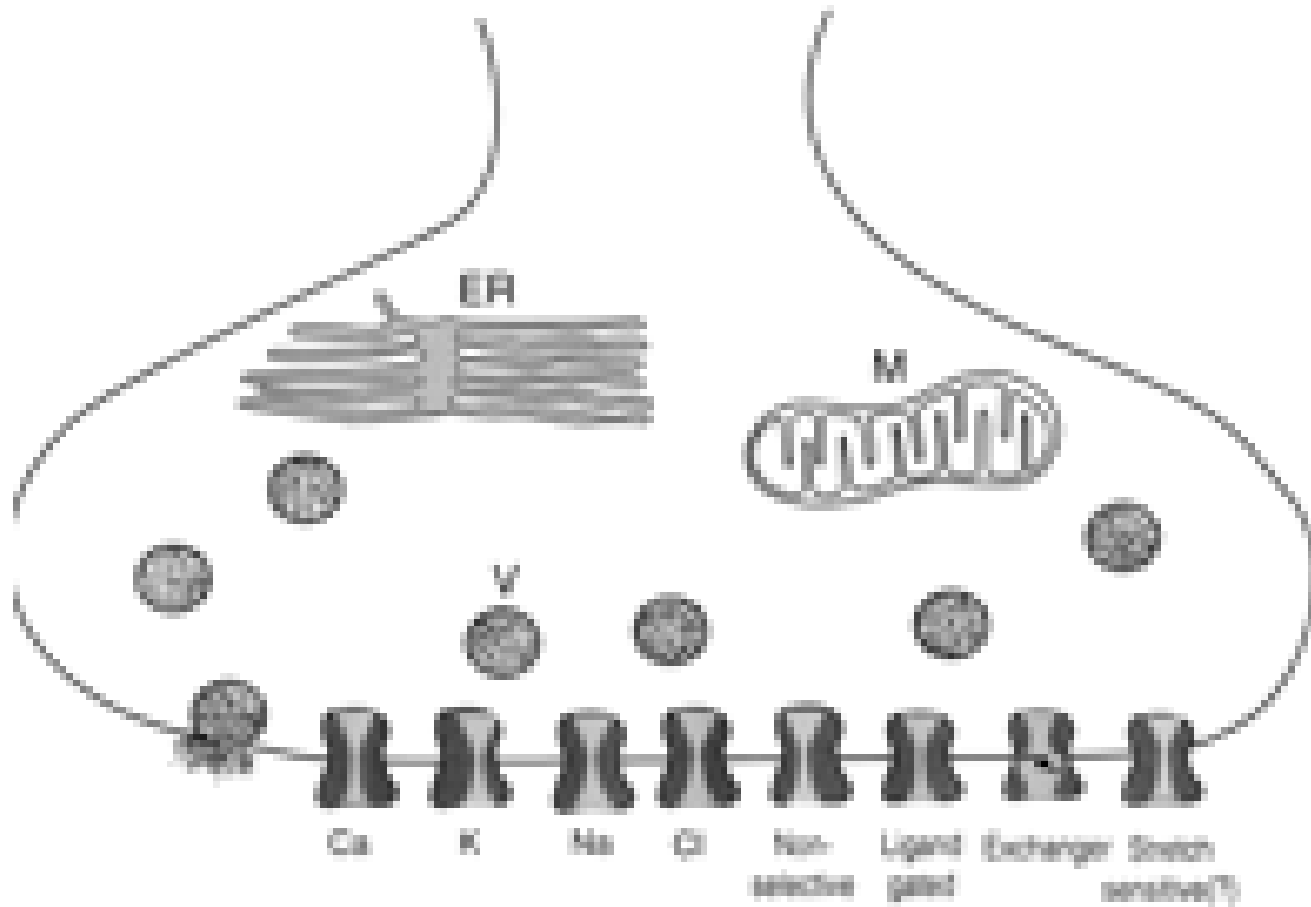


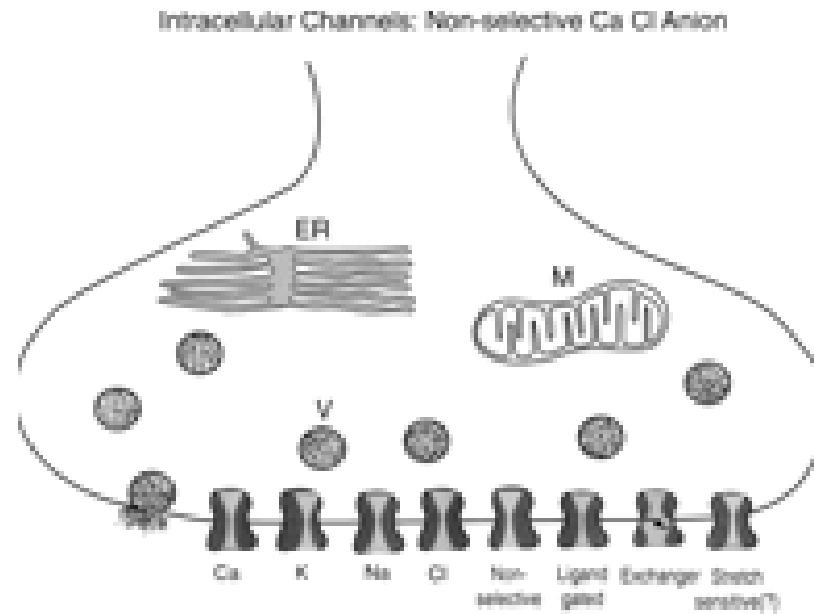
Nociceptive Pathway



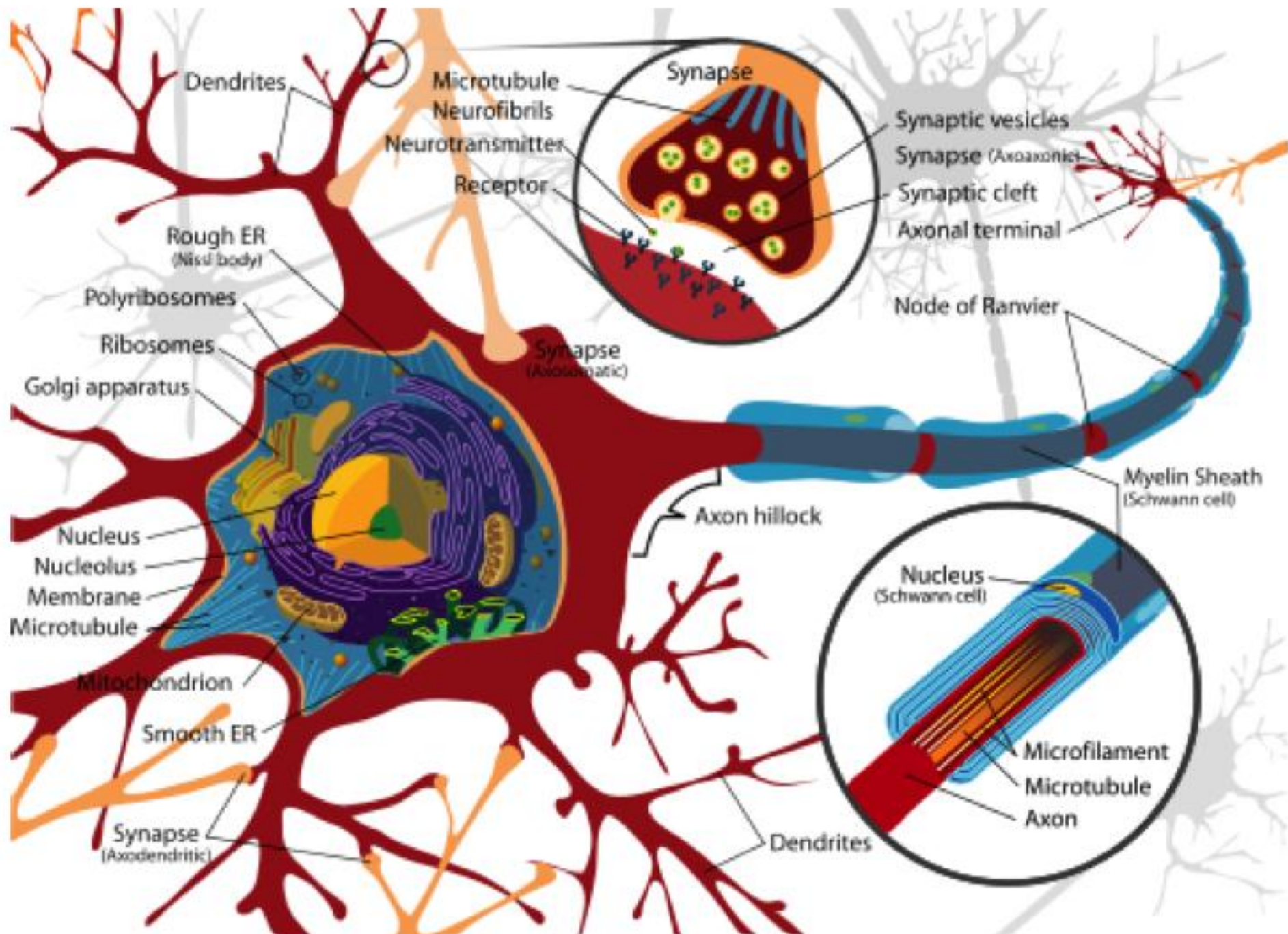
Substance P response to cell damage: promotes inflammatory response

Intracellular Channels: Non-selective Ca Cl Anion

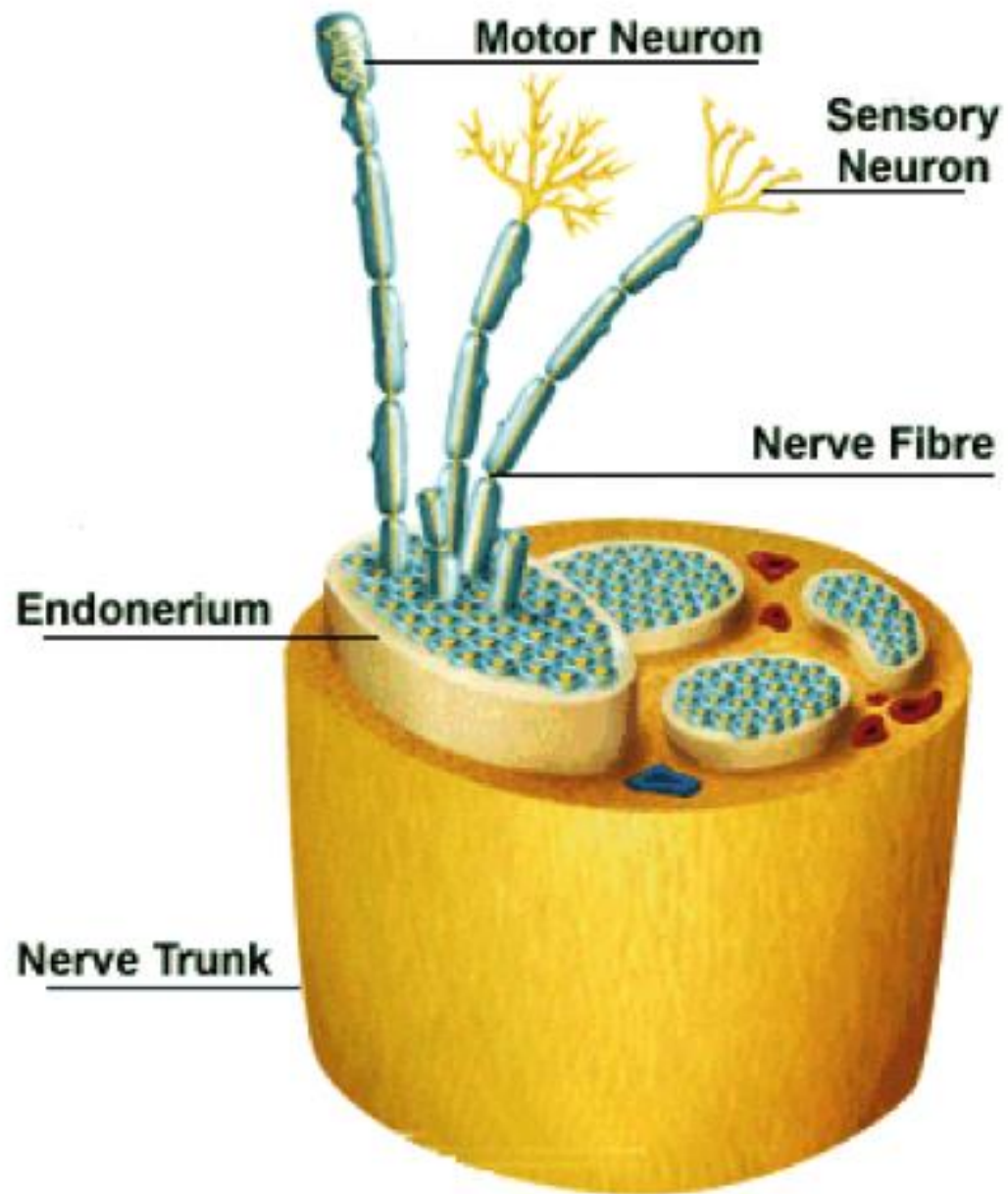


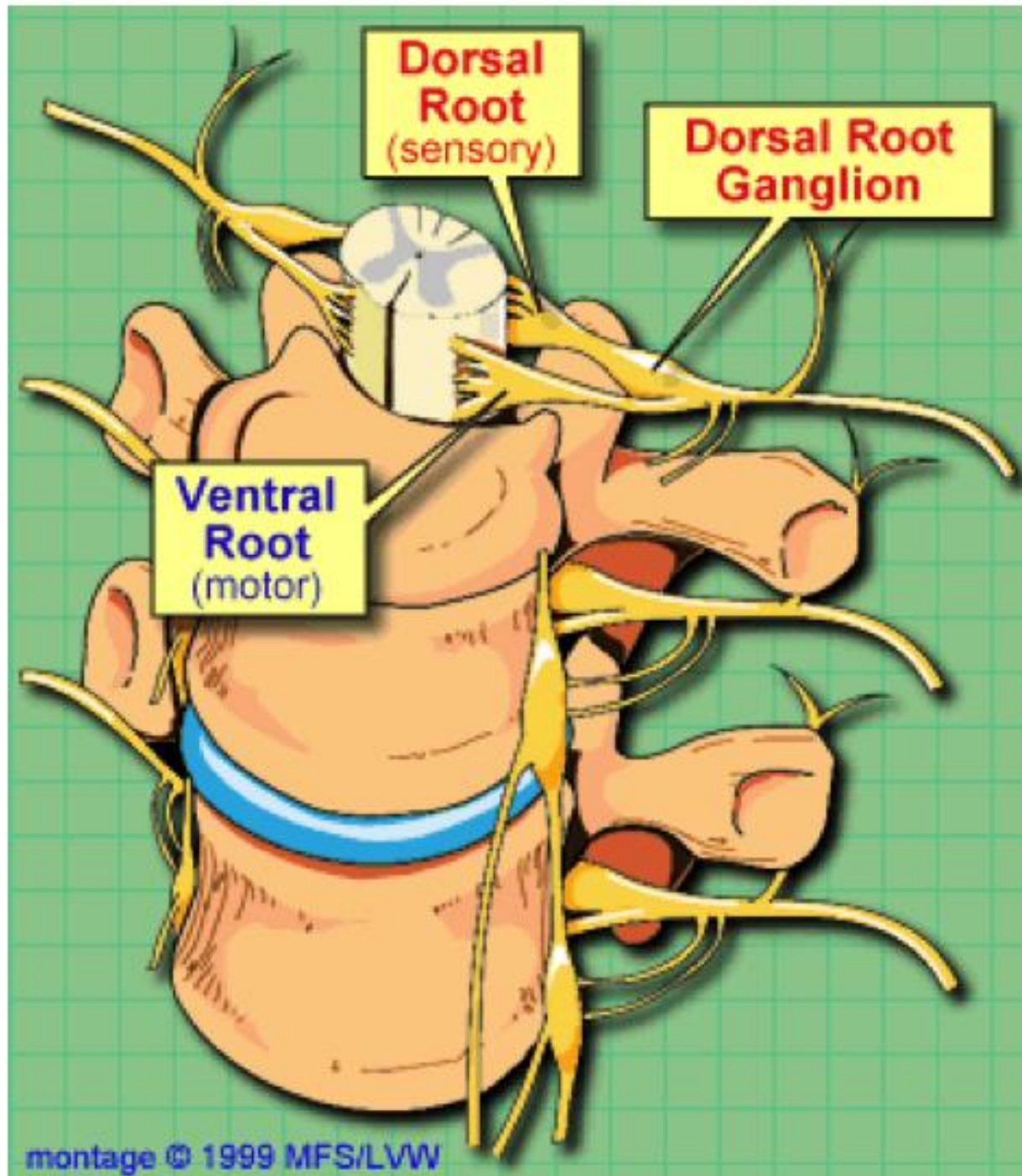


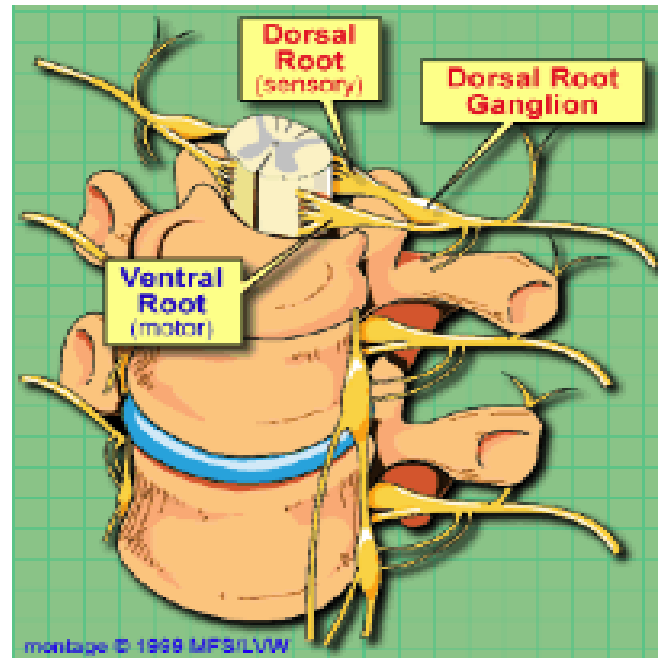
Increase in ion channels



Changes in the axolemma



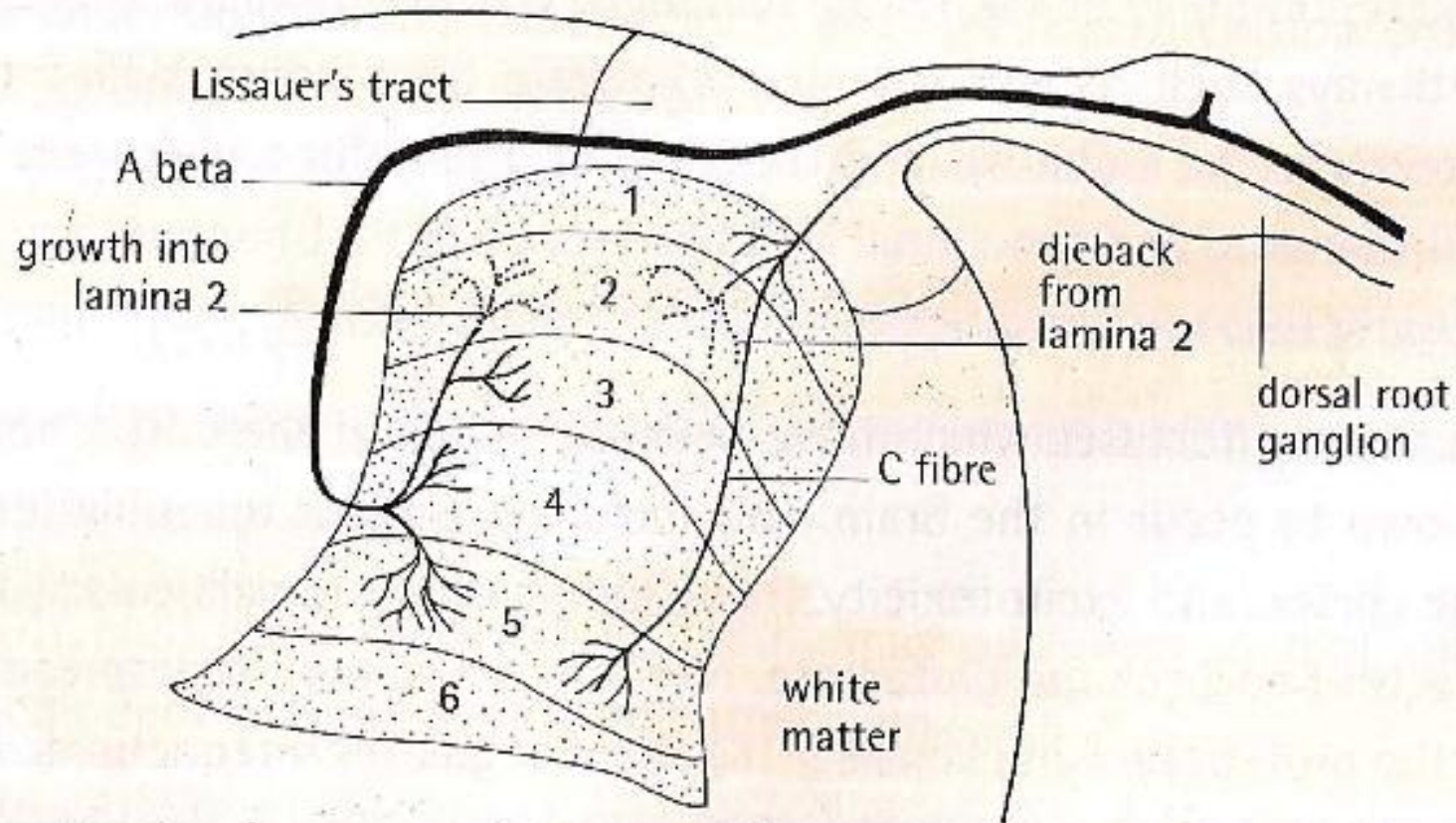




Changes in the Dorsal Root Ganglion: Patient Presentation

- Constant pain without movement provocation
- Pain begins in another area of the extremity

Central Sensitization



Changes at the Dorsal Horn: Laminar Sprouting

Patient Presentation with Central Sensitization:

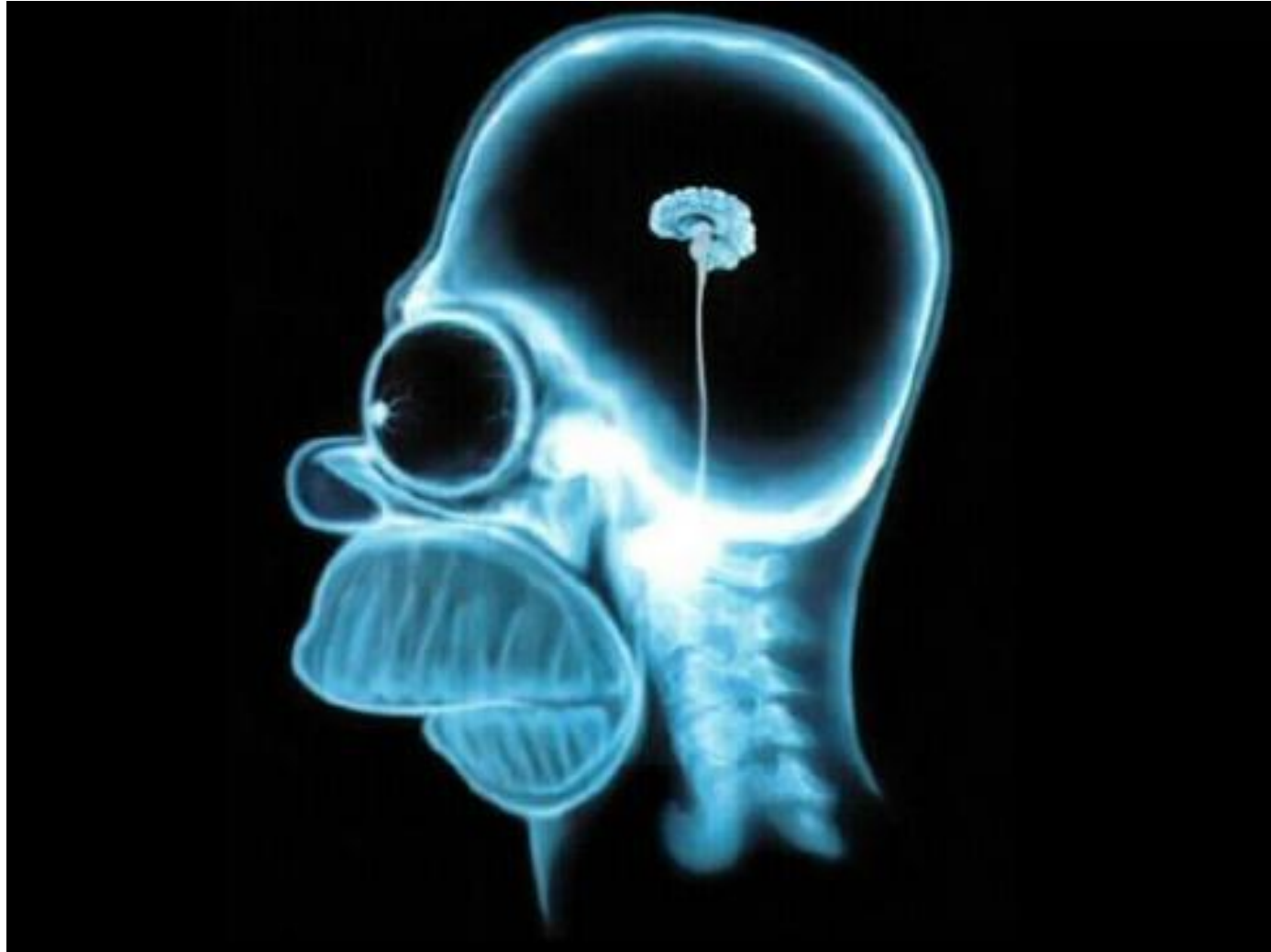
- Persistent pain
- Pain in new areas
- Decreased pain threshold, i.e., magnified response to noxious stimulation.
- Pain that is produced by non-noxious or by mild activity.

Possible interventions for central sensitization: alter transmission to the second order neuron at the spinal cord:

Transcutaneous electrical stimulation (TENS)
Exercise



Endorphins released through exercise



The Brain

Pain processing at the brain:

Multiple sites and functions involved
including

Homuncular smudging

Emotions and pain inter-relationship

Neuromatrix

The complex circuitry of synaptic connections that an electrical signal makes in the brain to different centers of the brain

Premotor and Motor Cortex:
organizing and preparing for movement

Cingulate cortex:
concentration and focus

Amygdala:

fear, fear conditioning and addiction

- **Sensory cortex:**
- sensory discrimination

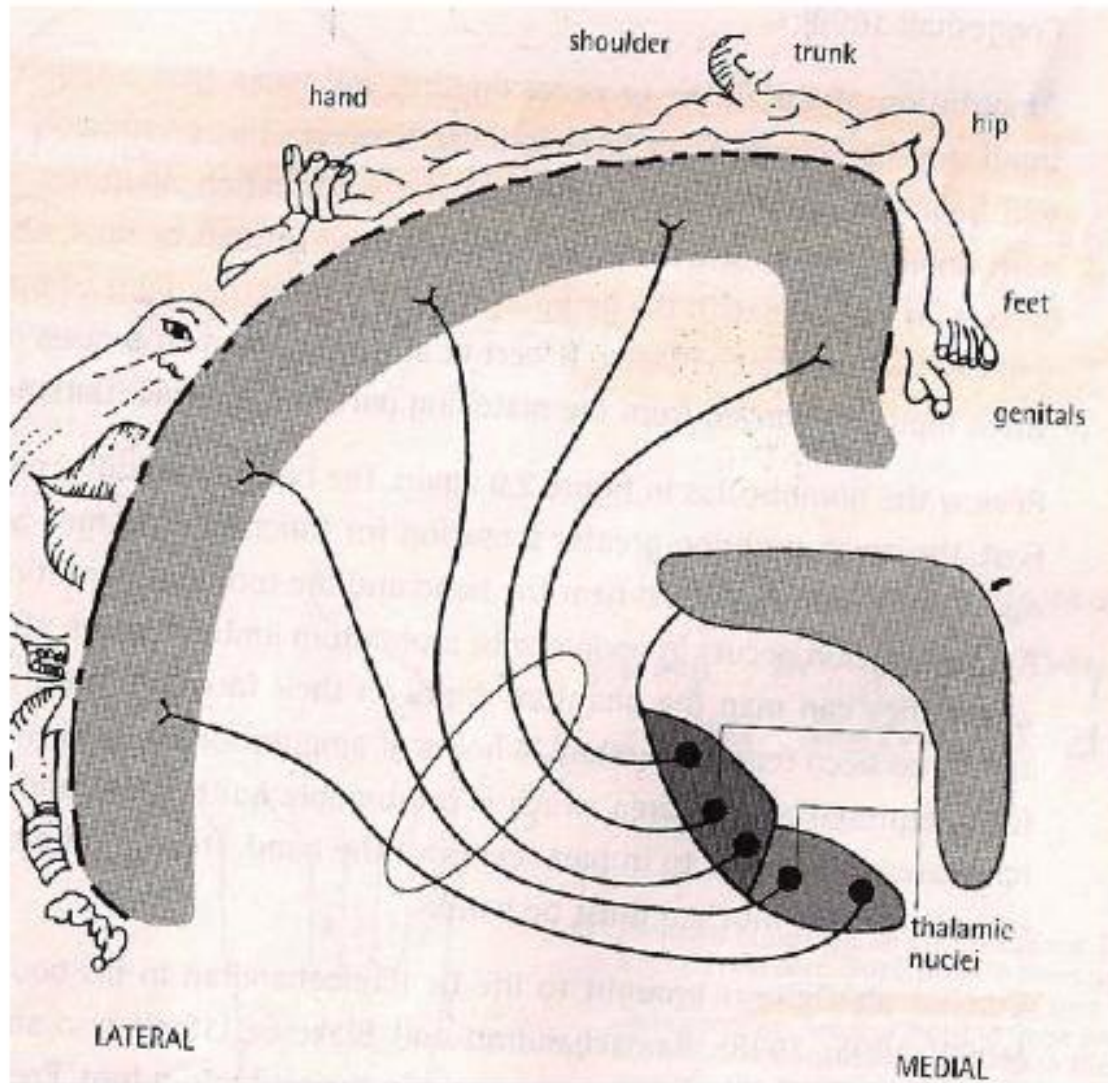
- **Hypothalamus and thalamus:**
 - stress responses, autonomic regulation, motivation

- **Cerebellum:**
- perception of movement

- **Hippocampus:**
- memory, spatial cognition, fear conditioning

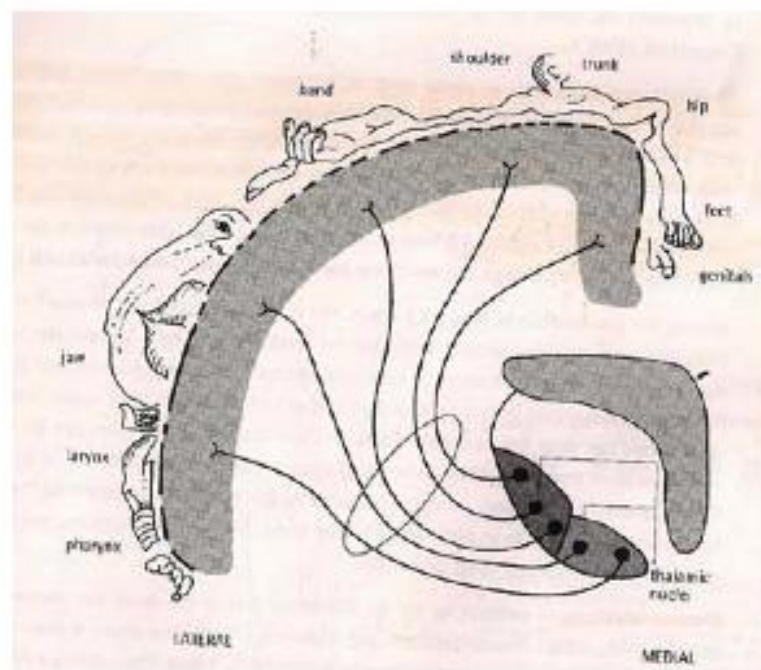
Spinal Cord

Spinal cord: gating from the periphery



Changes at the Brain: Homuncular Smudging

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Homuncular Smudging

Patient Presentation:

- Difficulty differentiating parts of the body
- Pain experienced over a broader area than the specific site stimulated peripherally

Homuncular smudging: Treatment Options

Teach kinesthetic awareness

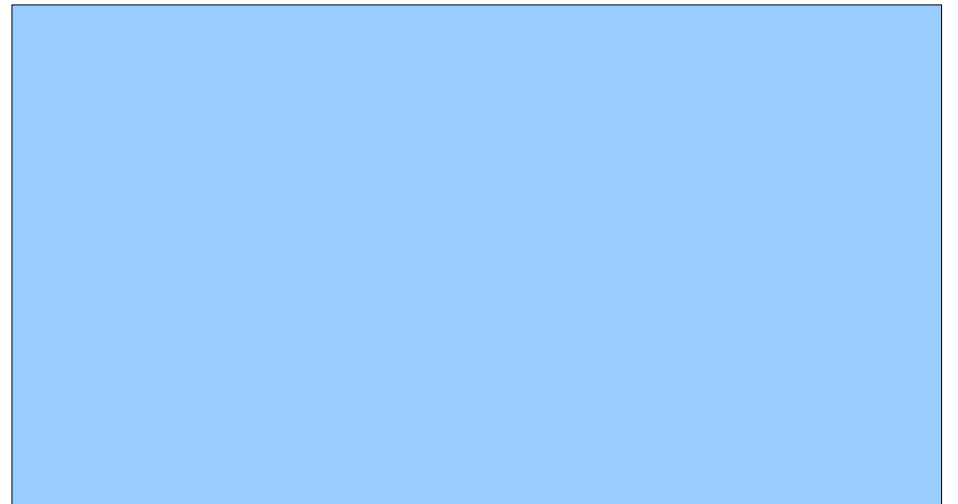
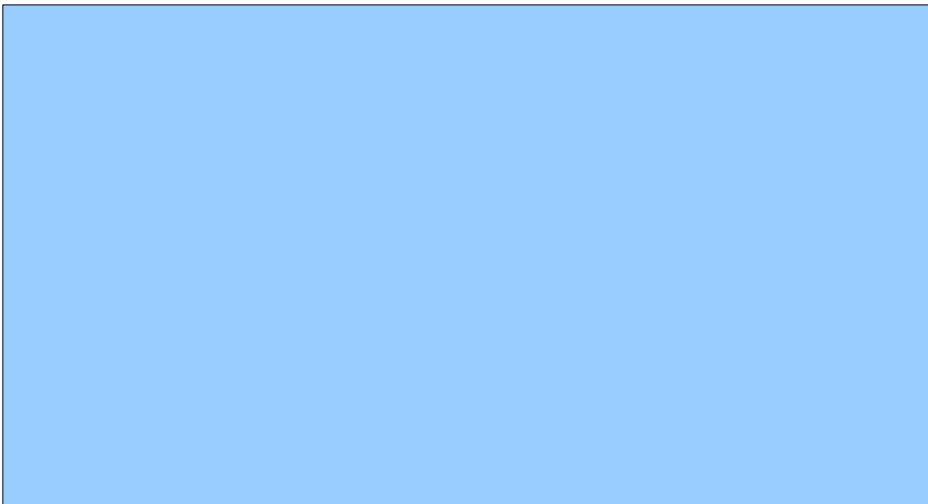
Focus patient on other sensations, restoring patient's relationship to their body as other than painful

Work to restore a normal homuncular map



Phantom Limb Pain: Use of Mirror Therapy

Midline and cognitive deficits



Changes in the Brain: Pain and Depression/Anxiety

Pain and Depression

Spousal attention to pain increases perception of pain

Pain and Anxiety

Output: Physical responses to stress: neuroendocrine and autonomic

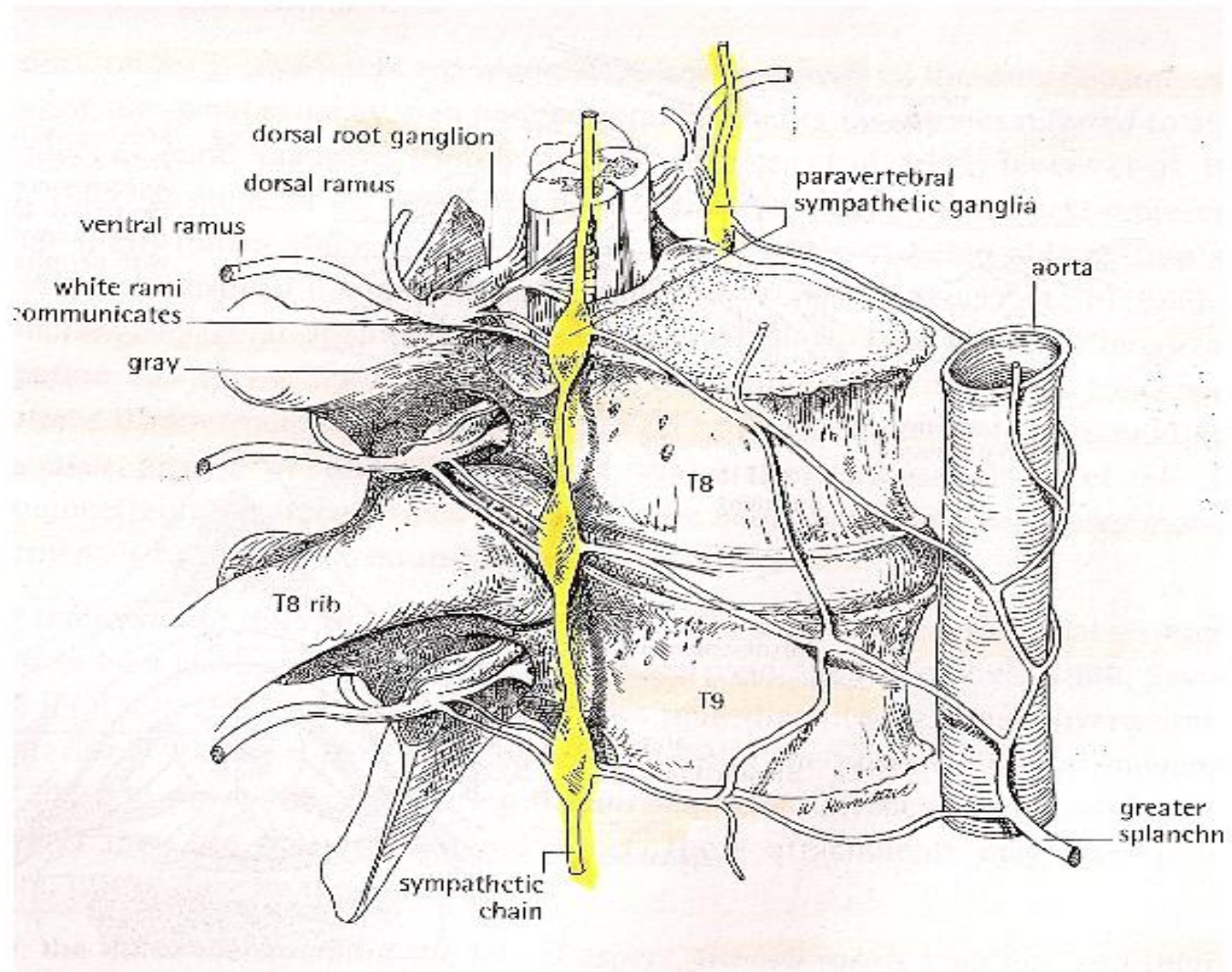


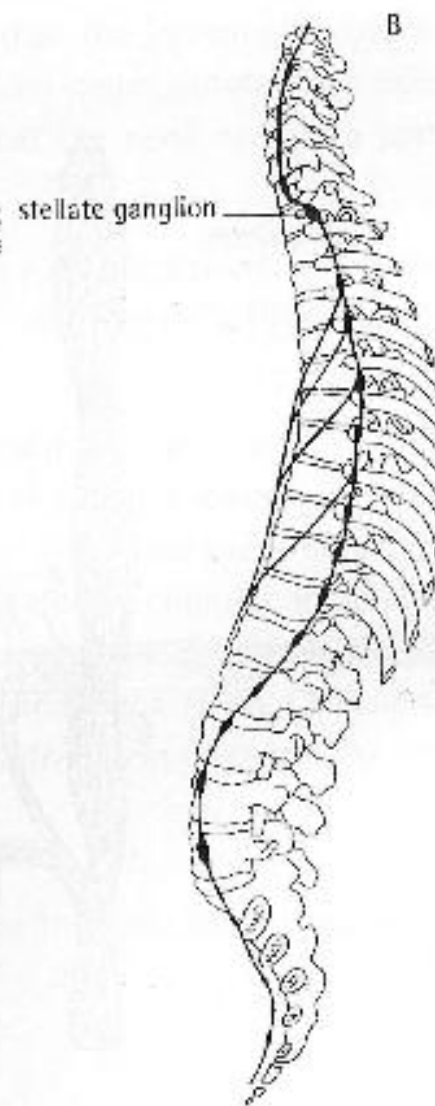
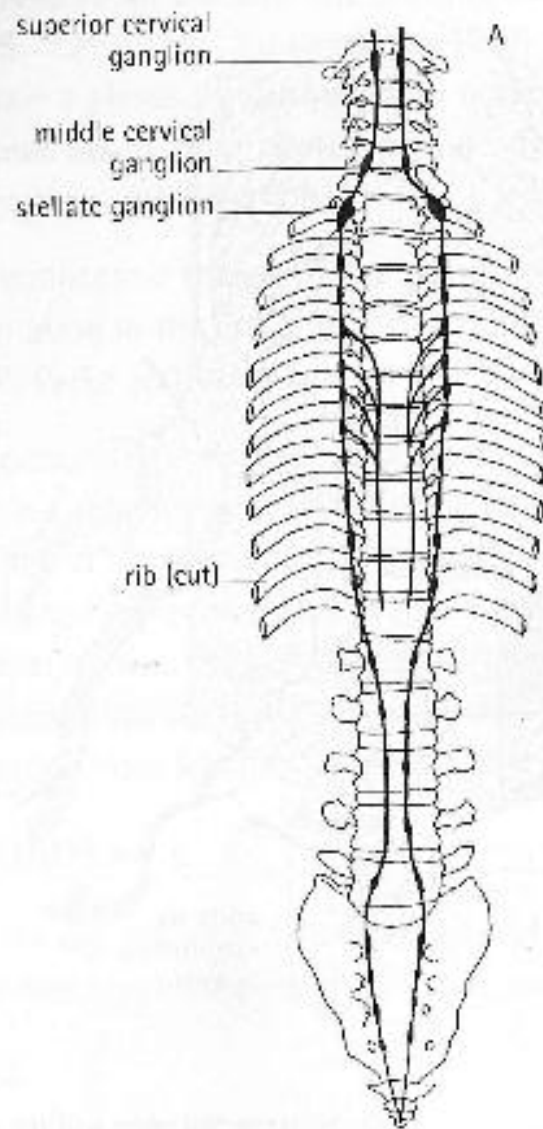


Changes in the Autonomic Nervous System:

Sympathetic involvement causes muscle tension

Stress alters peripheral nerve activity via communicating ramus





Changes at the Sympathetic Nervous System: Ganglionic chain

Changes in the Sympathetic Nervous System:

Therapist treatment Options

- Physiological Quieting including biofeedback
- Manual Therapy to thoracic spine
- Breathing
- Therapeutic exercise for postural mobility and stability and postural lengthening

-When a pain profile/symptoms changes in the absence of new injury, chasing the pain will probably not change the pain

-Chasing pain feeds into a patient's sense of helplessness

-Pain does not equal danger

-It's only an electrical signal until it gets to the brain.

Rethinking Treatment Intervention with Abnormal Pain

Improving function

Instilling self-efficacy

Setting realistic goals with the patient

Normalization of neural tissue

Focus on whole body, not site of pain

Return to activity through customized, gradual progression of therapeutic exercise

Explain Pain

