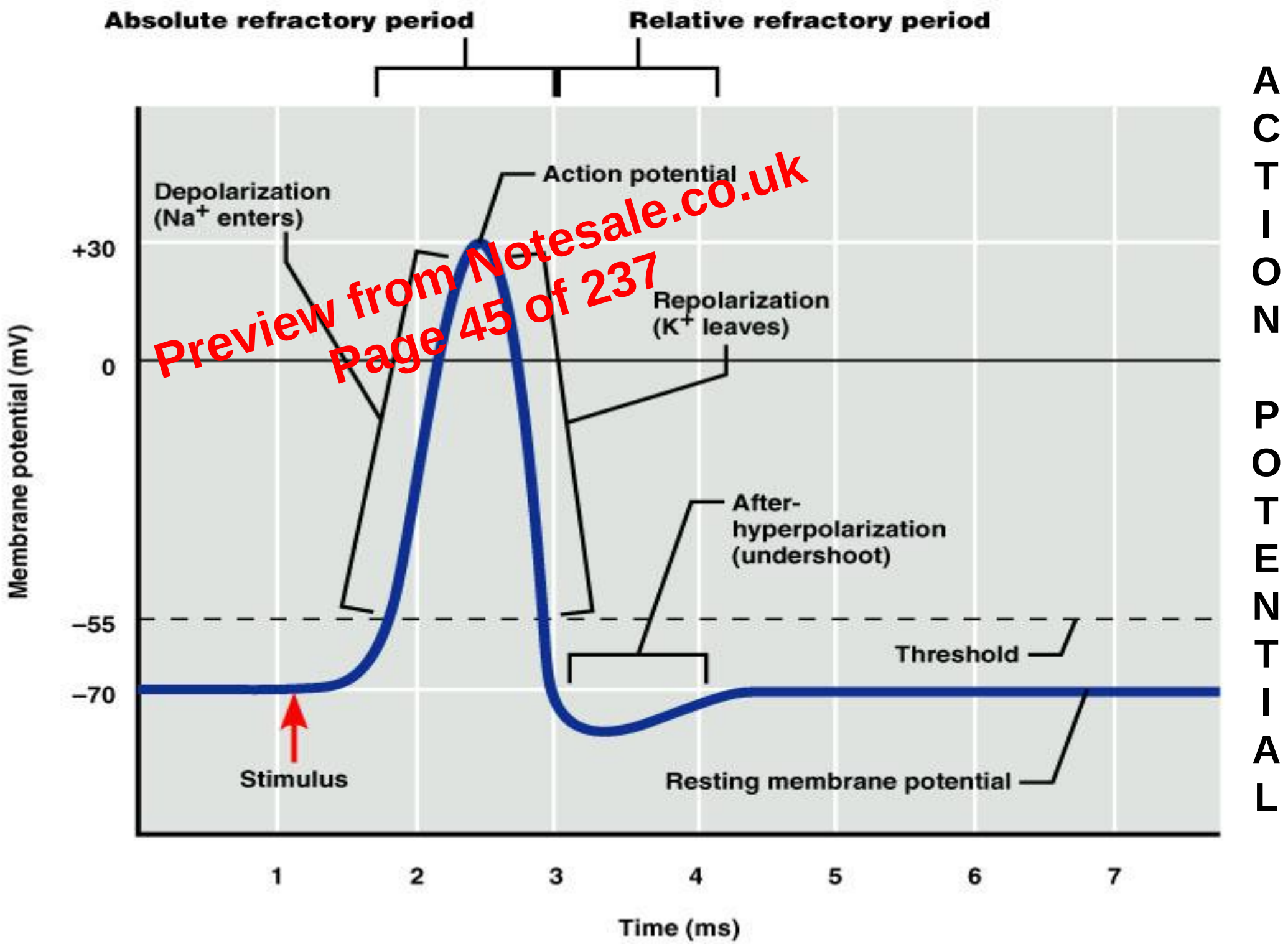
- **Dendrites**
  - **Receive impulse** from the axon of other neurons through **synaptic** connection.
  - Conduct impulse **towards** the cell body
- **Axon**
  - Conduct impulses away from cell body
  - Impulses arise from initial segment (trigger zone)
  - End in fine processes called **axon terminals**
  - Swollen tips- synaptic end bulbs - contain vesicles filled with neurotransmitters.

Functional Classification of Neurons

- **Sensory (afferent) neurons**
  - transport sensory information from skin, muscles, joints, sense organs & viscera **to CNS**
- **Motor (efferent) neurons**
  - send motor nerve impulses **to muscles & glands**
- **Interneurons (association) neurons**
  - **connect** sensory to motor neurons
  - 90% of neurons in the body

SUPPORTING CELLS

- Known as **neuroglial** or glial **cells**
  - The **majority** cells of the CNS
  - Smaller cells than neurons
  - Cells can **divide**
  - 4 cell types in CNS
    - **astrocytes,** oligodendrocytes, microglia & **ependymal**
  - 2 cell types in **PNS**
    - **schwann and satellite cells**



Hyperpolarization

- **Excessive** movement of K^+ (to inside cell) occurs
- This causes **hyper**polarization of the membrane (undershoot)
  - i. e. the potential becomes **more negative** than the resting potential

The Action Potential: SUMMARY

- Resting membrane potential is -70mV
- Depolarization is the change from -70mV to +30 mV
- Repolarization is the reversal from +30 mV back to -70 mV)
- Hyperpolarization – The reversal continues slightly before attaining the resting potential.

PROPOGATION OF AP

- An action potential **spreads (propagates)** over the surface of the **axon** membrane
  - The changes in the process of **depolarization and repolarization** occurs (**repeats**) along the axon towards the axon terminal.
  - The traveling action potential is called a nerve **impulse**

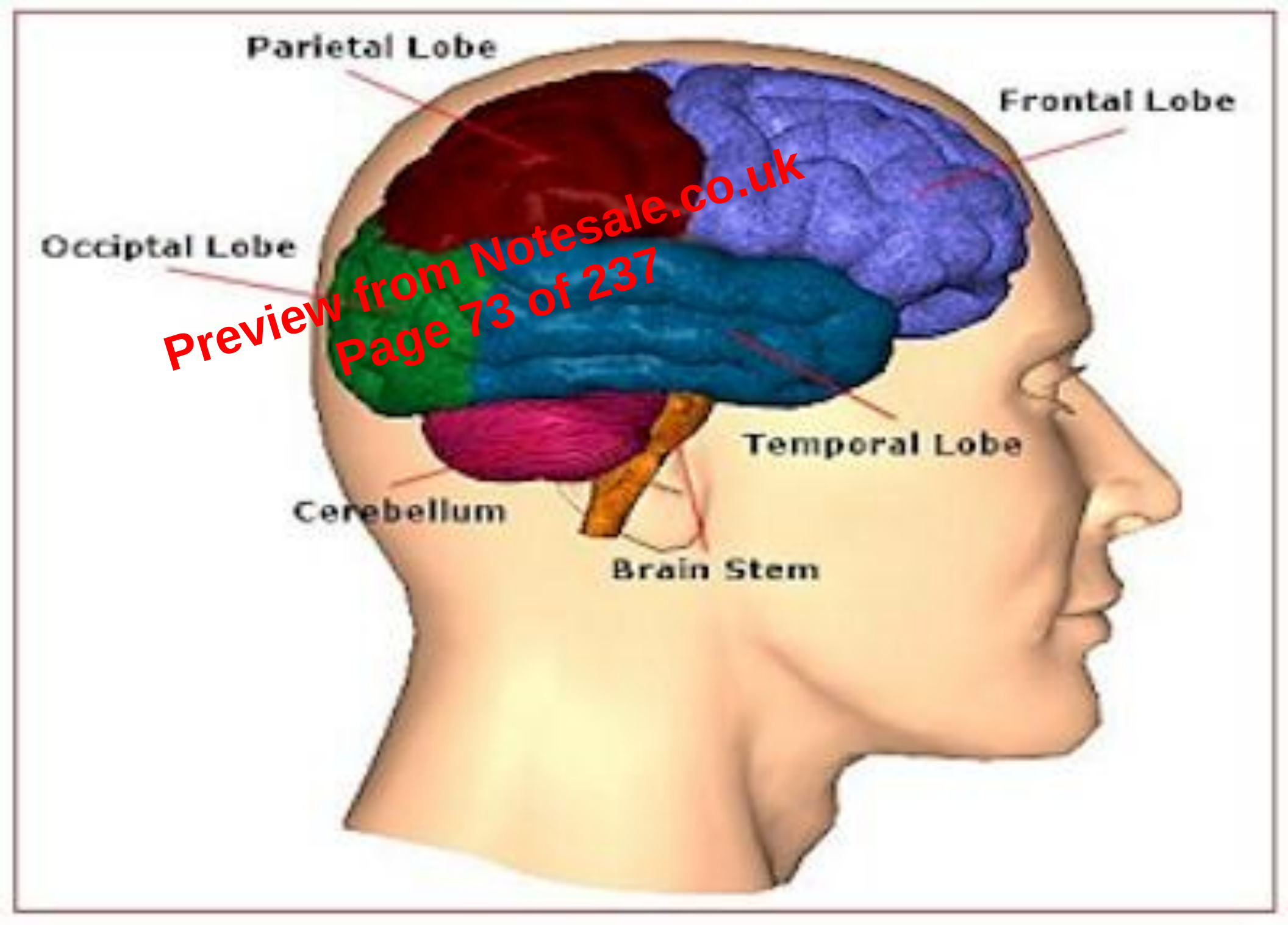
Propagation of action potential

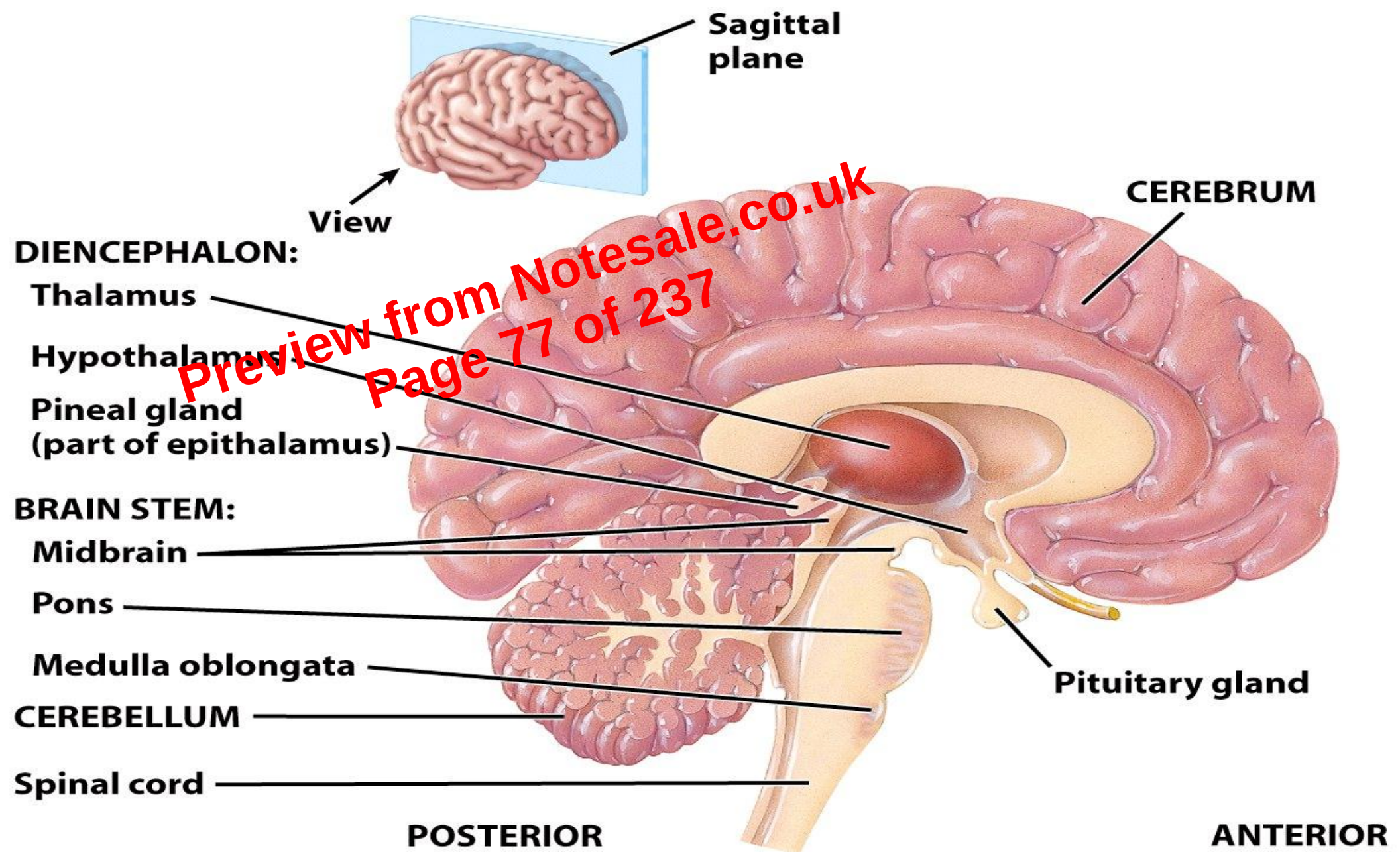
AP or impulse moves along the axon as:

- **Contiguous** conduction (along **un**myelinated fibers (axons))
  - Nerve impulse travels **continuosly** along the axon.
- **Saltatory** conduction (**Myelinated** nerve)
  - Nerve impulse **jumps** from one node of **Ranvier** to another.

NEUROTRANSMITTERS

- A chemical substance which when released, **transmits** nerve impulses across a synapse.
- Excitatory and inhibitory neurotransmitters
- Important neurotransmitters include **acetylcholine,, noradrenalin, adrenalin, and dopamine**, glutamate, aspartate, gamma aminobutyric acid, glycine, **nitric oxide (NO)**





Sagittal section, medial view

Figure 14-1a Principles of Anatomy and Physiology, 11/e

CEREBRUM

- **Folds** (gyri)
- **Grooves** (sulci or fissures)
  - **Longitudinal fissure** separates left & right cerebral hemispheres
- Each hemisphere is subdivided into **4** lobes:
  - ***frontal, parietal, temporal*, and *occipital***.
- Contain the higher brain centres.

FUNCTIONAL AREAS OF THE BRAIN

Motor areas

- Located in the precentral gyrus
- Conscious control of **voluntary (muscular) movements**

Sensory areas

- Located in the postcentral gyrus
- Involves in **conscious awareness of sensation**

Association areas

- **Integrate** diverse information

Sensory Areas

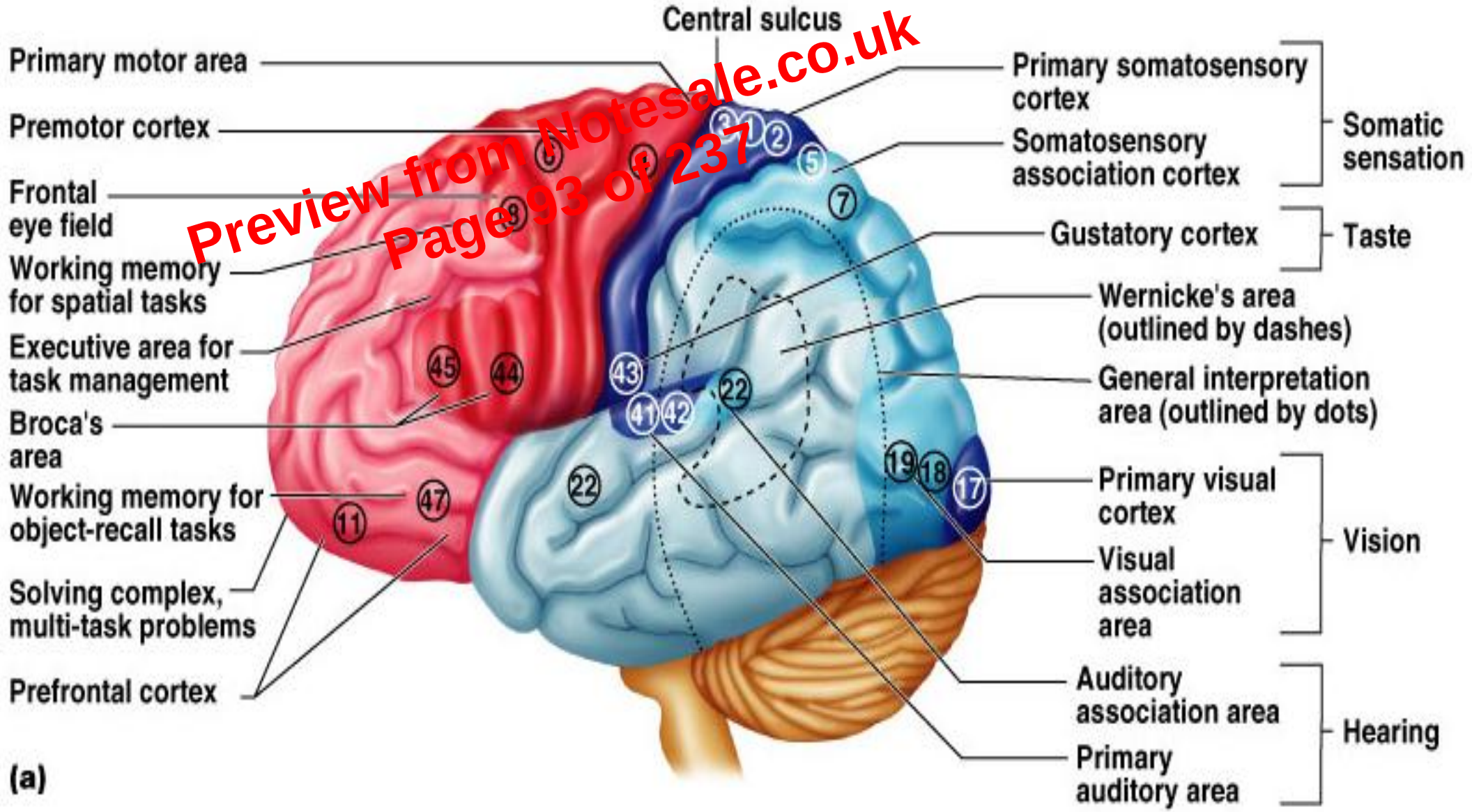
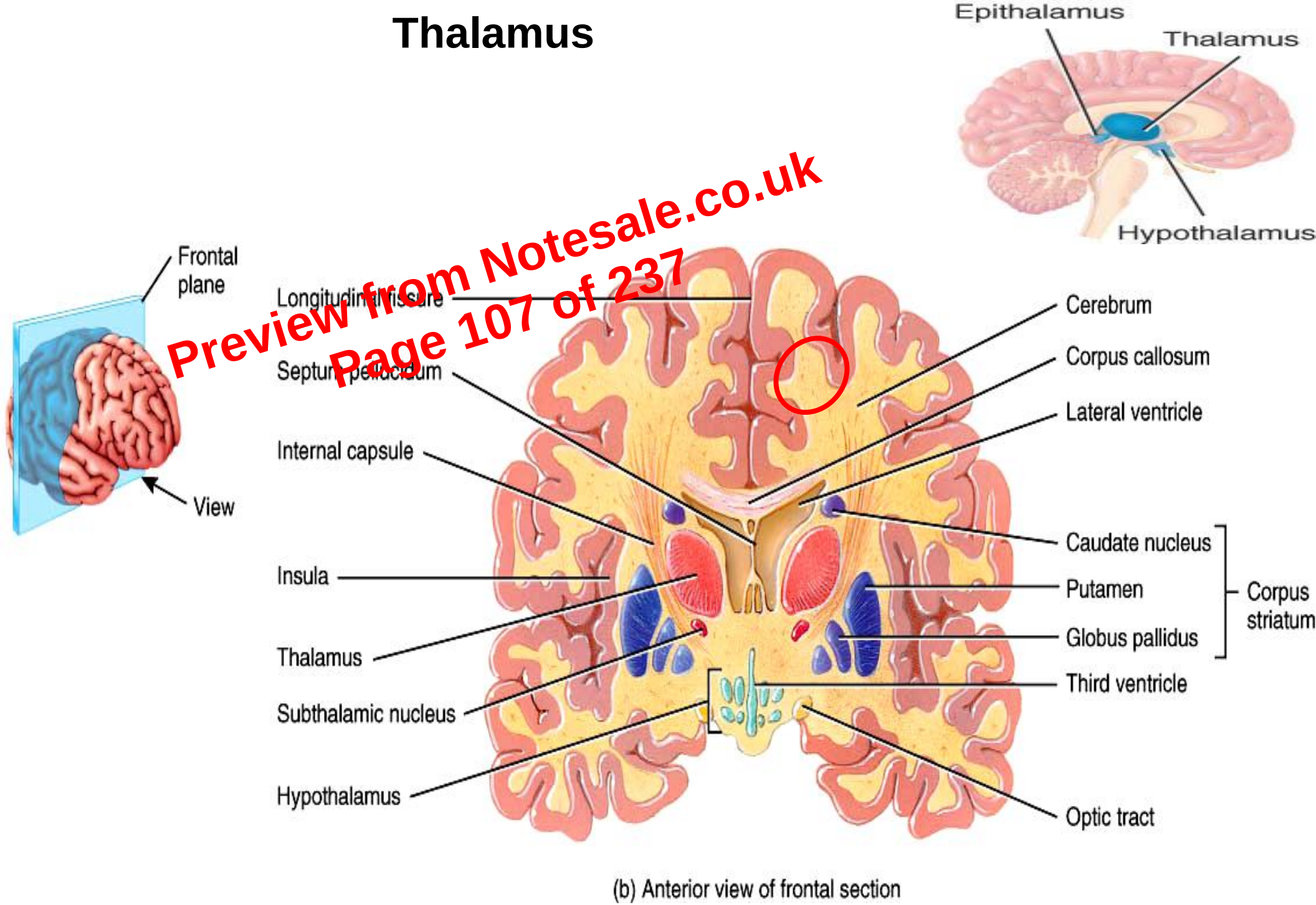


Figure 12.8a

Basal Nuclei

- Masses of **gray matter** found deep **within** the cortical white matter
- Specific functions

Thalamus

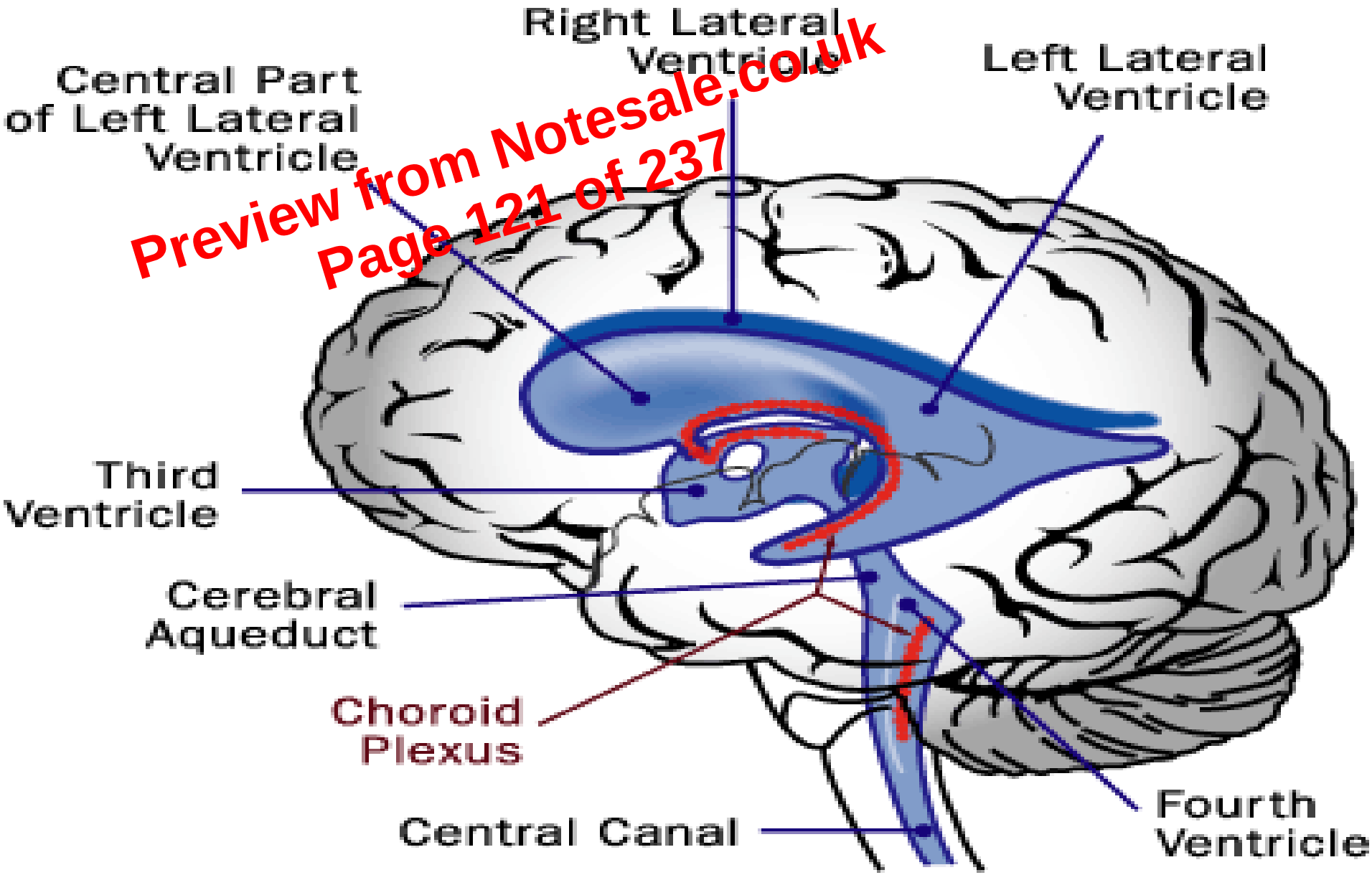


(b) Anterior view of frontal section

Protection of the Brain

- The brain is protected by the:
  - Cranial **bones**
  - Cranial **meninges** (**membranes/coverings**)
- The cranial meninges are **continuous** with the spinal meninges and are named:
  - dura mater, arachnoid, and pia mater.

The Ventricular System of the Human Brain



Hydrocephalus

- **Accumulation** of CSF in the brain **ventricles**
- Due to **blockage** of drainage of CSF)
  - **Continued (excessive)** production causes an increase in pressure - hydrocephalus
  - In **newborn** causes expansion of the skull and damage to the brain tissue

Brain Waves

- Normal brain function involves continuous **electrical activity**
- An **electroencephalogram (EEG)** records this activity
- Patterns of neuronal electrical activity recorded are called **brain waves**
- Each person's brain waves are unique
- Continuous train of peaks and troughs
- Wave frequency is expressed in Hertz (Hz)

- **Cerebrum**
  - **Higher** brain centres
  - Cerebral Cortex
    - Specialized parts - Frontal Lobe, Parietal, Occipital Lobe, Temporal Lobe
    - **Motor** cortex
    - **Sensory** cortex

Spinal cord - Gray Matter

- **Dorsal** half – **sensory** roots and **ganglia**
- **Ventral** half – **motor** roots
- Dorsal and ventral roots **fuse** laterally to form spinal **nerves**

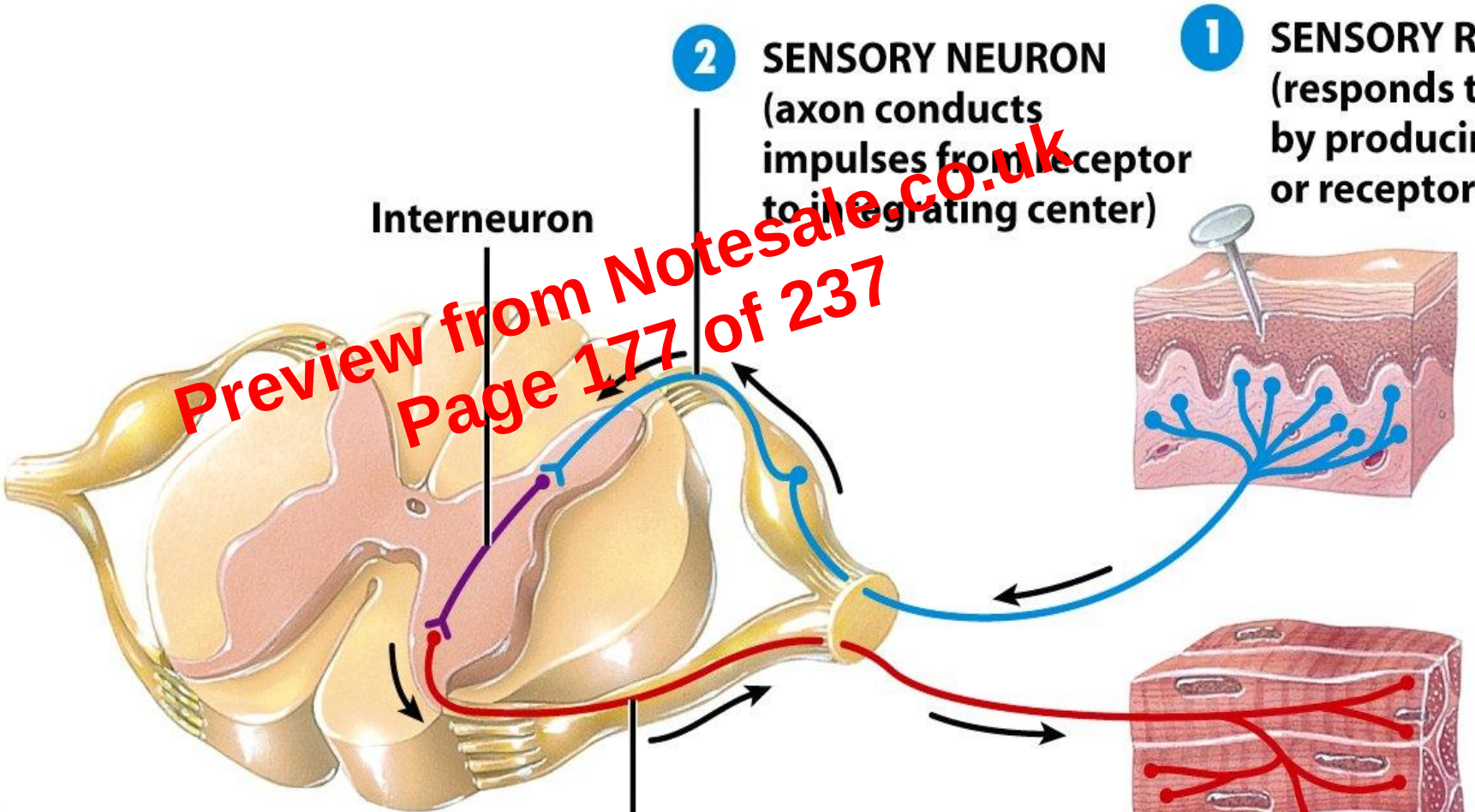
Nerve tracts (Pathways)

- Represent passage in which nerve impulse travels **from** outside to CNS and **vice versa**.
- **Ascending** tracts
- **Descending** tracts

Ascending (Sensory) Pathways

- Sensory impulse is carried **from** the **sensory receptors** through the afferent nerve into the spinal cord (white matter)
- Ascend to the sensory cortex of the **opposite** side of the brain

Components of reflex arc



1 SENSORY RECEPTOR
(responds to a stimulus by producing a generator or receptor potential)

2 SENSORY NEURON
(axon conducts impulses from receptor to integrating center)

Interneuron

3 INTEGRATING CENTER
(one or more regions within the CNS that relay impulses from sensory to motor neurons)

4 MOTOR NEURON
(axon conducts impulses from integrating center to effector)

5 EFFECTOR
(muscle or gland that responds to motor nerve impulses)

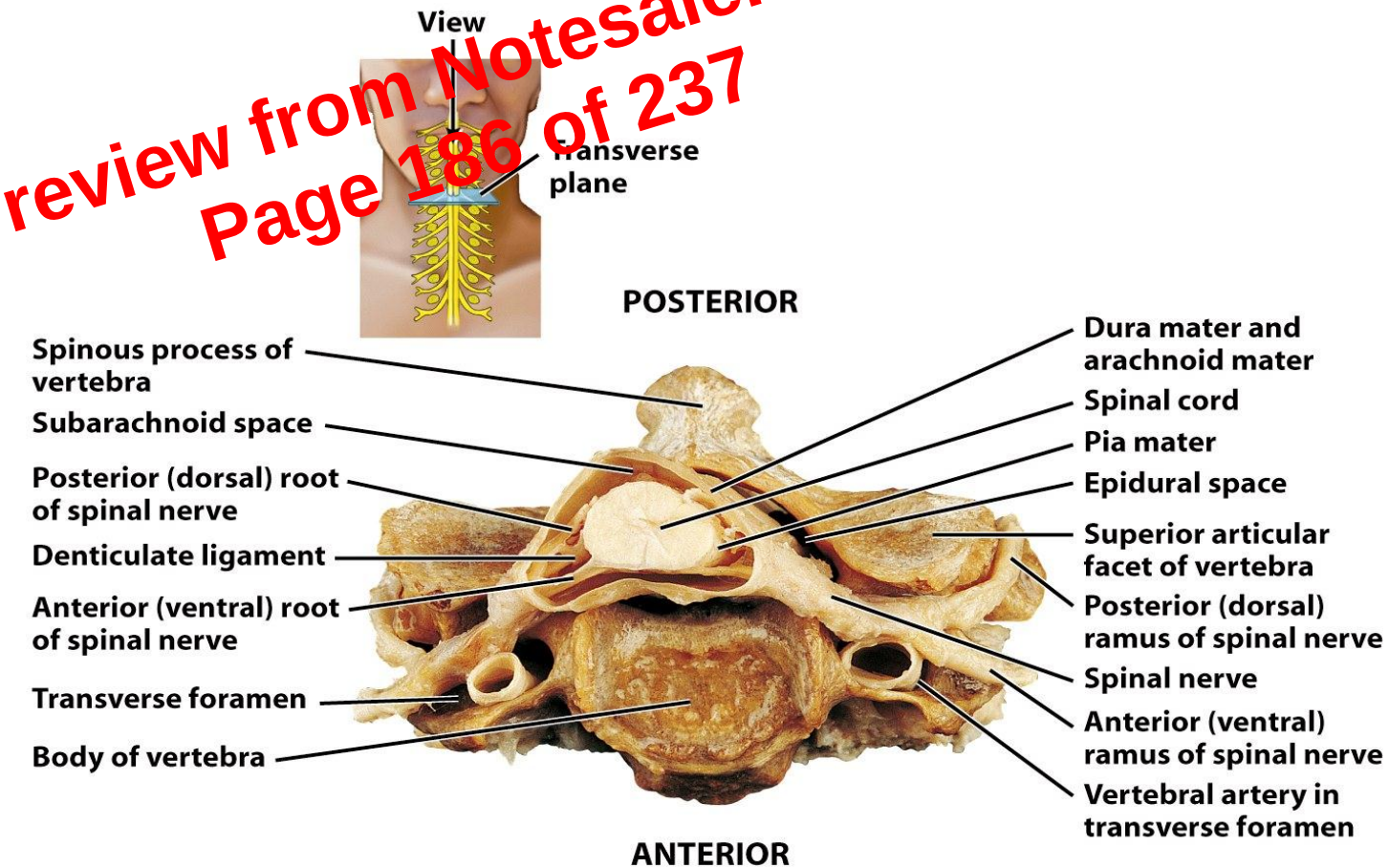
Figure 13-13 Principles of Anatomy and Physiology, 11/e

Knee jerk reflex

- A sudden **involuntary** forward movement of the **lower leg** that can be produced by a firm tap to the patellar tendon located just below the kneecap.
- Tapping on the tendon stretches the quadriceps muscle. This stimulates the sensory receptor (muscle spindle) to produce nerve impulse

Knee jerk reflex

- Sensory receptor → afferent (sensory) neuron → integrating centre in the spinal cord → efferent (motor) neuron → effector → contraction of quadriceps muscle the → knee jerks forward involunatrily



Transverse section of the spinal cord within a cervical vertebra

Figure 13-1c Principles of Anatomy and Physiology, 11/e

SYNAPTIC TRANSFER OF IMPULSE

- Impulse is transferred from neuron to neuron via synapse (no direct connection).

- **Synapse**
  - Is the functional **junction** between one neuron and another
  - Or between a neuron and an effector such as a muscle (neuromuscular junction) or gland.

TOPICS

- Peripheral nervous system
- Receptor physiology
- Reflex action

Receptor Class by **Location**:

2. Intero**ceptors:**

- Respond to stimuli arising **within** the body
- Found in internal **viscera** and **blood** vessels
- Sensitive to **chemical changes, stretch, and temperature changes**

Receptor Classification by **Structural Complexity**

- Receptors are structurally classified as either **simple** or **complex**
- **Most receptors are simple** and include encapsulated and unencapsulated varieties
- Complex receptors are **special sense organs**

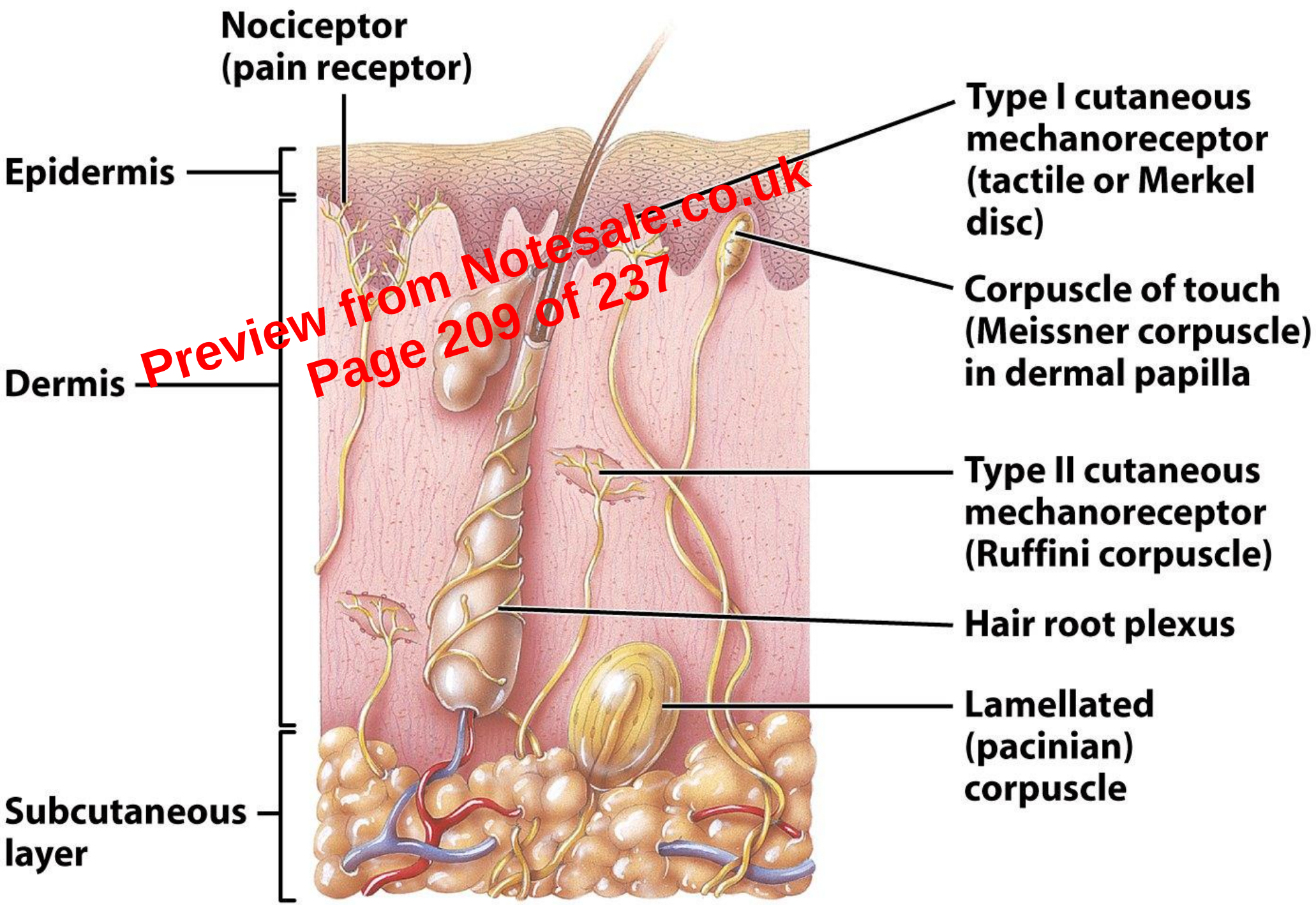


Figure 16-2 Principles of Anatomy and Physiology, 11/e

Simple Receptors: Encapsulated

TABLE 13.1 General Sensory Receptors Classified by Structure and Function (continued)

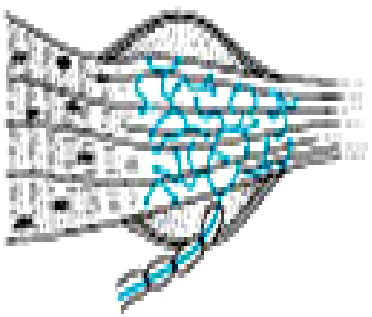
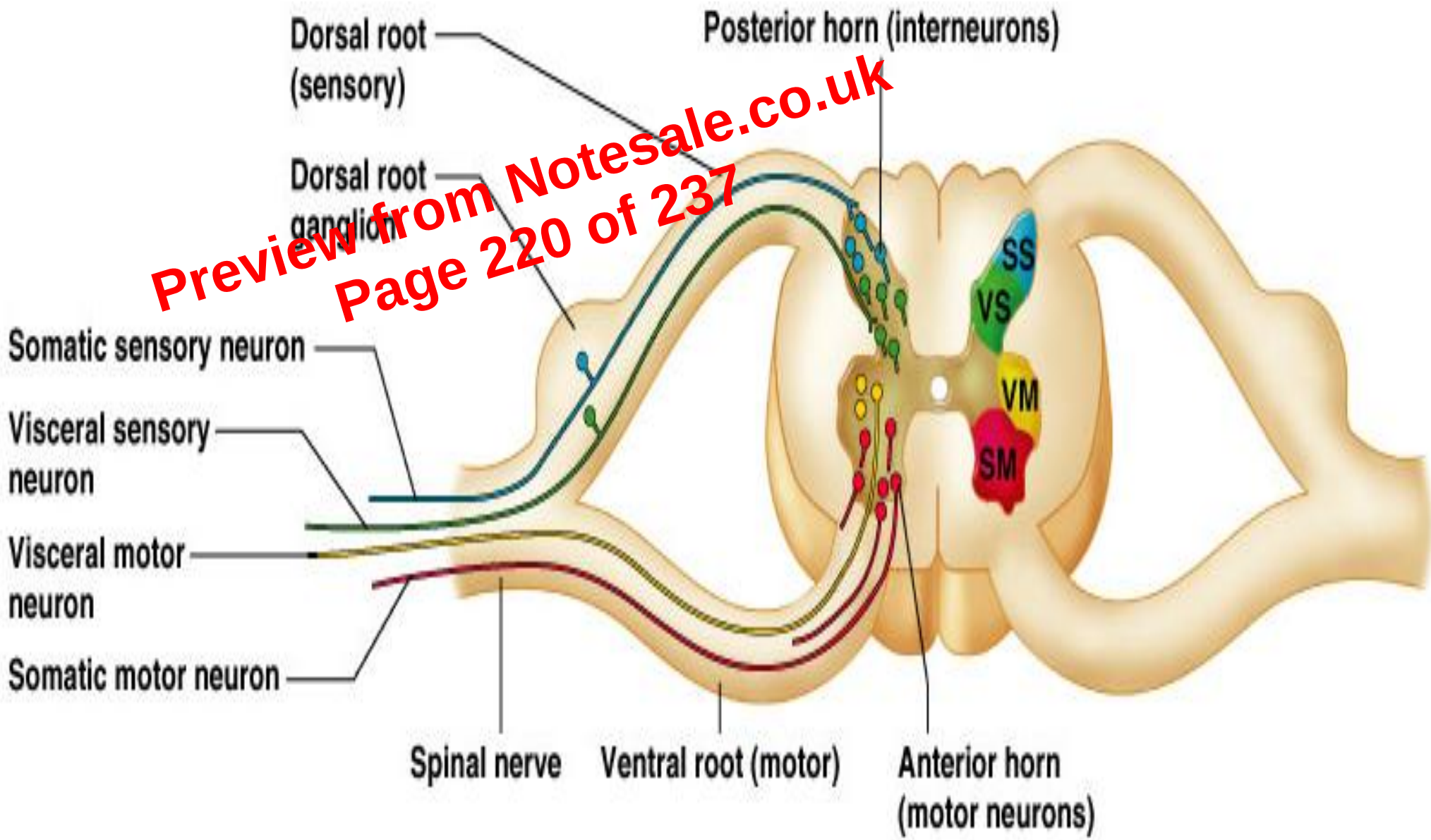
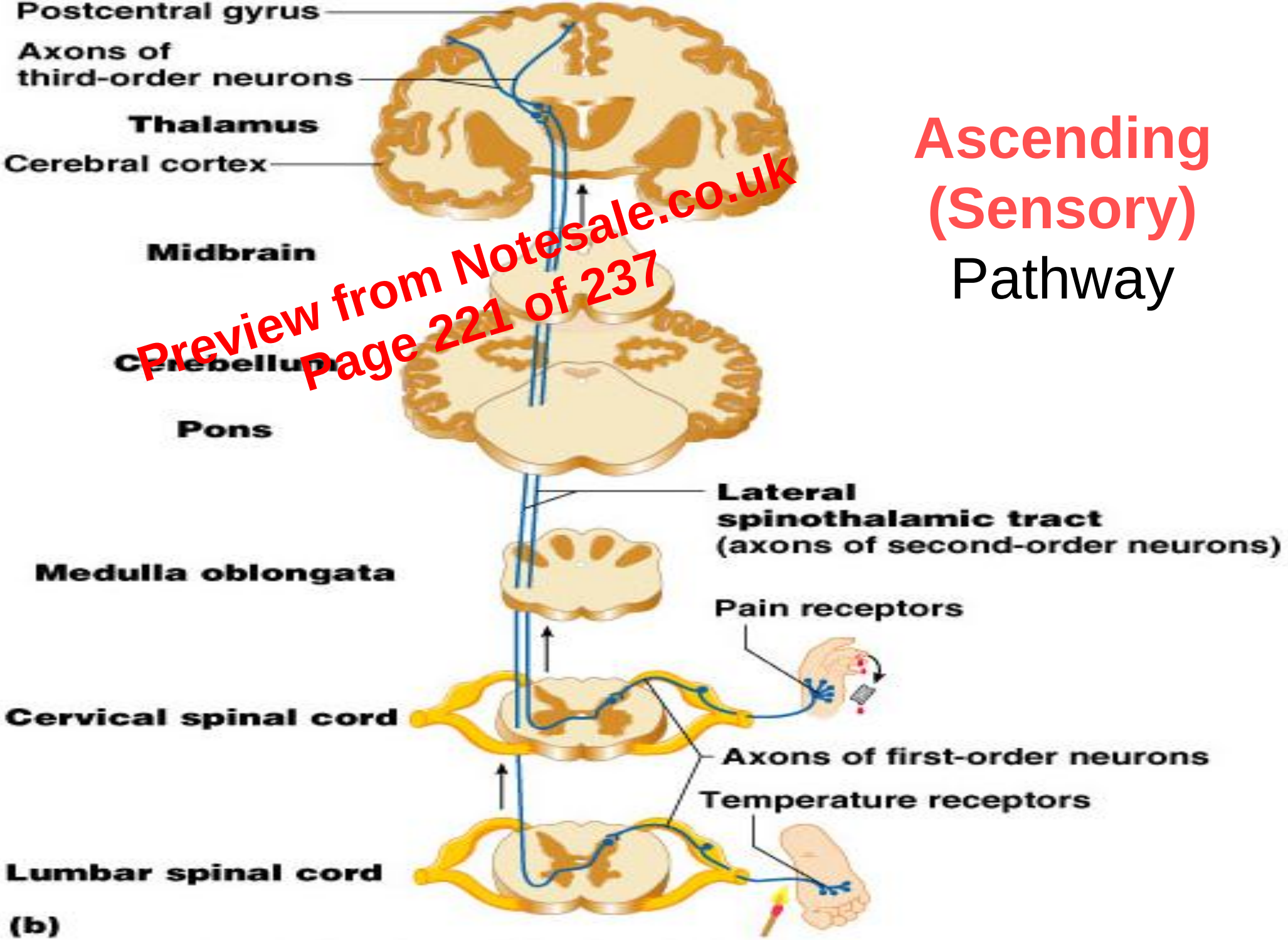
Structural Class	Illustration	Functional Classes According to Location (L) and Stimulus Type (S)	Body Location
Golgi tendon organs		L: Proprioceptors S: Mechanoreceptors (tendon stretch)	Tendons
Joint kinesthetic receptors		L: Proprioceptors S: Mechanoreceptors and nociceptors	Joint capsules of synovial joints

Table 13.1.4



Ascending (Sensory) Pathway



Classification of Nerves

- Sensory and motor divisions
  - **Sensory (afferent)** – carry impulse **to** the CNS
  - **Motor (efferent)** – carry impulses **from** CNS
- **Mixed** – sensory and motor fibers carry impulses to and from CNS; most **common** type of nerve

Knee jerk reflex

- Sensory receptor → afferent (sensory) neuron → integrating centre in the spinal cord → efferent (motor) neuron → effector → contraction of quadriceps muscle the → knee jerks forward involunatrily

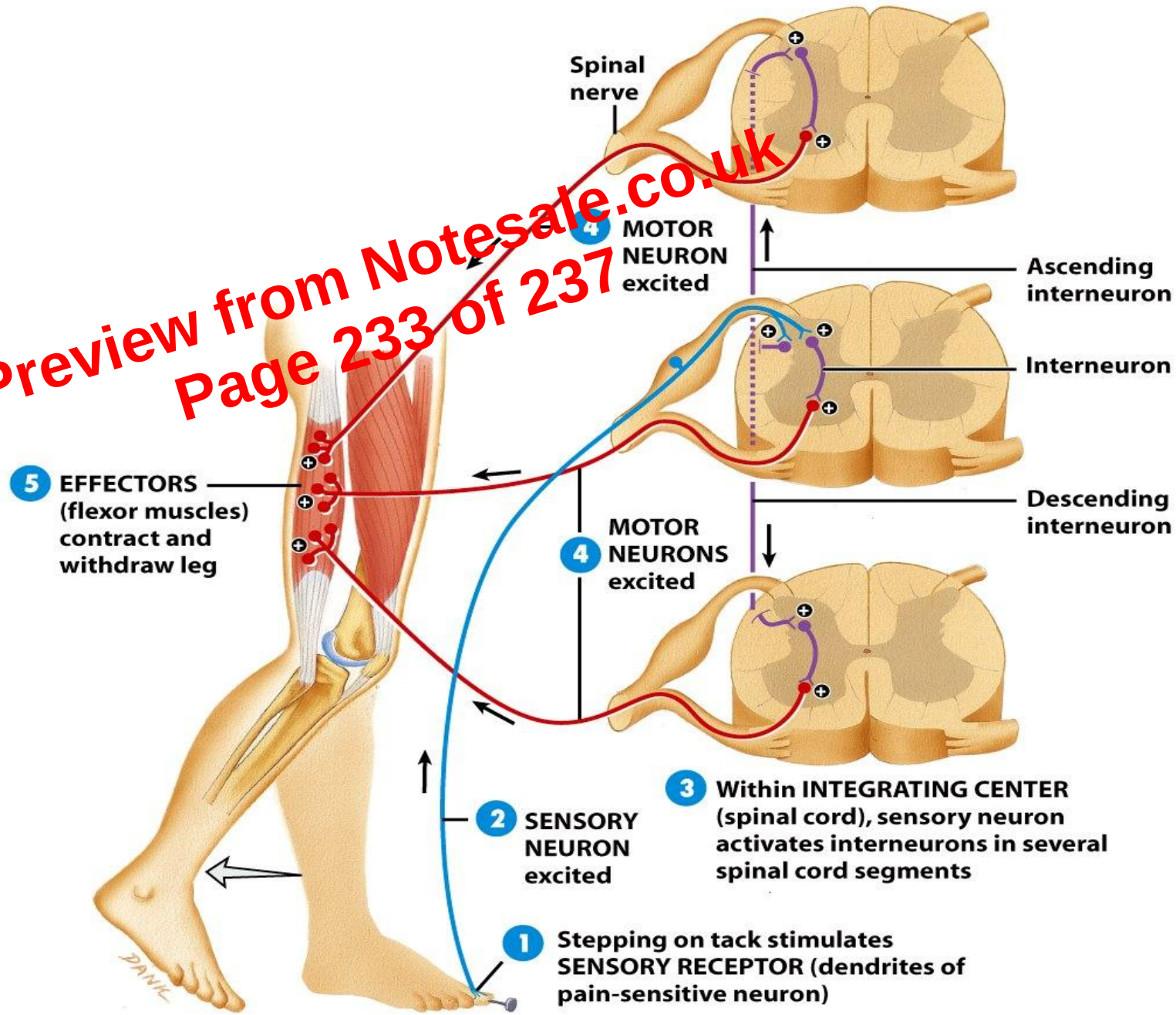


Figure 13-16 Principles of Anatomy and Physiology, 11/e