PHTY209: Week 1

- Define neuroplasticity
  - Plasticity: The brain's capacity to be shaped by experience. Any change in neuron structure or function that is observed either directly from measures of individual neurones or inferred from measures taken across populations of neurons.
  - Can be observed as changes in the number or strength of synapses
  - Systems level – alterations in neural networks and reorganisation of representational maps.
  - Behavioural changes – not measures of plasticity – where plasticity becomes functionally relevant.
  - Is involved in learning and rehabilitation
  - cortical maps are not static, but can be modified by behaviourally important experience
  - within limits, the cortical area is allocated in a use-dependent manner
  - Can be favourable or unfavourable (e.g. learning to play an instrument versus learned non-use in stroke).

- Describe how the principles of neuroplasticity translate to physiotherapy clinical practice - Rehabilitation is the process of maximising functional learning.
  - The integration of basic neuroscience into clinical practice is critical for guiding the questioning of researchers and maximising the recovery of patients.
  - Concepts from neuroscience underpin approaches to rehabilitation across the fields of musculoskeletal, sports, paediatric, geriatric and neurological physiotherapy: ○ Timing of rehabilitation ○ Task Specific Training ○ Dose Response ○ Intensity of Practice ○ Active learning in context ○ Habituation ○ Overcoming learned non-use

Neuroplasticity is influenced by the following principles:

1. Use it or lose it
2. Use it and improve it
3. Specificity
4. Repetition
5. Intensity
6. Time
7. Salience
8. Age
9. Transference
10. Inference

Lecture 2: Application of the ICF framework to clinical reasoning

- Describe the ICF framework
  - A conceptual framework is a logical structure that helps organise clinical practices into a cohesive and comprehensive plan
  - Components: clinical reasoning process, models of disablement

Models of Disablement

- Physiotherapists work within a Rehabilitation Framework based on a model of disablement.
- There are several models of disablement
- All models provide a framework for analysing the effects of acute / chronic conditions on the systems of the body, during performance of tasks and while executing roles in society.

1. Traditional medical model: The focus is on treating the impairment affecting body structures and functions.
2. Social Model: Offers a more holistic approach where there is a focus on the psychological and social implications of disability.
3. ICF (Environmental and Biopsychosocial model): Addresses the environment and not just the disability.

Define core ICF terminology

- International Classification of Functioning, Disability and Health (ICF)
- A model developed by the World Health Organisation (WHO) to describe functioning, disability and health
- Defines functioning and disability as multi-dimensional concepts relating to the:
    - ○ Body functions and structures of people ○ The activities people do and the life areas in which they participate ○ The factors in their environment that affect these experiences
- ICF is: A classification system for describing health. A common framework and language. The bio-psycho-social model = integration of the 'medical' and 'social' models of disability and health. A significant departure from previous models of disablement, which propose a causal relationship between disease, functional limitations and disability.

- Use the ICF framework to guide clinical reasoning in your assessments and treatment

ICF Terminology

Health-is a state of complete physical, social and mental well-being, not just the absence of disease.

Health Condition- is an umbrella term for acute or chronic disease, disorder, injury or trauma. It may also include circumstances such as pregnancy, ageing, stress, congenital anomaly, genetic predisposition.

Body Functions- are the physiological functions of body systems (including psychological functions).

Body Structures- are anatomical parts of the body, such as organs, limbs and their components.

Impairments- are problems in body function and structure such as:

- Reduction or loss
- Addition or excess
- Deviation

Represents a deviation from generally accepted population standards in the biomedical status of the body and its functions.

Impairments can be:

- Temporary/permanent, progressive/regressive, static, intermittent/ continuous. Is part of a health condition but does not necessarily indicate that a disease is present and that an individual should be regarded as sick.
- Primary Impairment: a manifestation of the underlying pathology - Secondary Impairment: results from other impairments.

Activity- Is the execution of a task or action by an individual.

- Activity limitations: are difficulties an individual may have in performing activities. N.B.
  "Activity Limitation" replaces the term "Disability" used in the 1980 version of the ICIDH.
- Range from slight to severe deviation in terms of quality or quantity in executing the activity in a manner or to the extent that is expected of people without the health condition.

Participation- Is involvement in a life situation

- are problems an individual may experience in involvement in life situations.
- Participation restrictions: The presence of a participation restriction is determined by comparing an individual's participation to that which is expected of an individual without disability in that culture or society. The presence of a participation restriction is determined by comparing an individual's participation to that which is expected of an individual without disability in that culture or society.

Classification of Activity and Participation

- Learning and applying knowledge
- General tasks and demands (single task or multiple tasks)
- Communication
- Mobility
- Self-care
- Domestic life
- Interpersonal interactions and relationships
- Major life areas: education, employment, basic economic self-sufficiency
- Community, social and civic life

Disability- an "umbrella" term for impairments, activity limitations and participation restrictions. Denotes the NEGATIVE aspects of the interaction between

an individual (with a health condition) and that individual's contextual factors (environmental and personal factors).

Functioning- an "umbrella" term for body functions, body structures, activities and participation. Denotes the POSITIVE aspects of the interaction between an individual (with a health condition) and that individual's contextual factors (environmental and personal factors).

Personal factors

- Age
- Gender
- Cultural background, social background
- Fitness, lifestyle habits
- Upbringing

Environmental factors

- Products and technology
- Attitudes of individuals in the environment
- Support and relationships
- Access to assistive devices

Facilitators: By their presence /absence improve functioning and reduce activity limitation. Can prevent an impairment or activity limitation from becoming a participation restriction, since the actual performance of an action is enhanced despite the person's problem with capacity.

They include:

- Accessible physical environment
- Availability of relevant assistive technology
- Positive attitudes of people towards disability
- Services, systems and policies that aim to increase the involvement of all people with a health condition in all areas of life
- Absence of stigma or negative attitudes

Barriers

- By their presence or absence limit functioning and create disability They include:
  - Physical environment that is inaccessible
  - Lack of relevant assistive technology
  - Negative attitudes of people towards disability
  - Services, systems and policies that are either non-existent or that hinder the involvement of all people with a health condition in all areas of life

The ICF as a framework for rehabilitation

Rehabilitation aims:

- To reduce impairment of body structures and functions.
- To reduce activity limitations
- To maximise participation
- The desired outcome of rehabilitation is full participation of the person at an individual and at a societal level
- This can be achieved in the presence of significant permanent impairment and significant activity limitations, provided the contextual factors are satisfactorily addressed
- If rehabilitation interventions address only the health condition, then the job is only partly done

The physiotherapist as a team member within the ICF model

- Interdisciplinary team
- Each team member may not work across all domains
- Effective teamwork allows a composite picture to be developed which facilitates appropriate holistic goals to be set.

Role of the physio within the ICF model

- To perform an assessment
- Identification of client's goals and of barriers/facilitators to achieving those goals
- Turn these goals into SMART goals (Specific, Measurable, Attainable, Realistic, Timed)
- Liaise with the Interdisciplinary Team
- To develop a treatment, progression and discharge plan
- The physiotherapist has a major role in addressing/treating impairments and minimising the functional activity limitations that are restricting participation in life situations.

WEEK 2: Disorders of Transmission

Recall the meaning of the following terms:

- Neurons (including motor neurons, sensory neurons and interneurons) and Glial (neuroglia) cells (notably astrocytes, oligodendrocytes (CNS) and Schwann cells (PNS) and understand the basic arrangement of these cells found in the central and peripheral nervous systems;

Neurons: Basic functional unit, generating and conducting electrical impulses. Neurons communicate with one another at synapses.

- Motor Neurons: A nerve cell forming part of a pathway along which impulses pass from the brain or spinal cord to a muscle or gland. Multipolar neuron.
- Sensory Neurons: Nerve cells within the nervous system responsible for converting external stimuli from the organism's environment into internal electrical impulses. Bipolar/ Unipolar Neuron.

- Interneurons: A neuron which transmits impulses between other neurons, especially as part of a reflex arc.

  Glial (neuroglia) Cells: Connective tissue which contribute to the NS function by insulating, supporting and nourishing adjacent neurons.

- Astrocytes: Surround blood vessels in NS and provide structural support, cover the exterior surface of the brain and spinal cord. They can also multiply and play a role in healing damaged neural tissue.
- Oligodendrocytes: Produce insulating myelin.
- Schwann's Cell: A cell of the peripheral nervous system that wraps around a nerve fibre, jelly-roll fashion, forming the myelin sheath.

- Nucleus: collections of cell bodies within the CNS
  Ganglion: a nerve cell cluster or a group of nerve cell bodies located in the autonomic nervous system.
  Grey Matter: the darker tissue of the brain and spinal cord, consisting mainly of nerve cell bodies and branching dendrites.
  White matter: Part of the brain that contains myelinated fibers.

- Myelin: Name the cells that produce myelin. Describe the process, location of and benefits of myelination.
  - Myelin is an insulator that increases the speed of conduction along the axon. - In the PNS→Schwann's cells produce and maintain myelin.
  - In the CNS→Glial cells called oligodendrocytes produce and maintain myelin.
    Process:
  - axon (blue) is embedded into the wall of the myelinating cell (yellow).
  - The cell membrane of the myelinating cell wraps around the axon – surrounding the axon (2) and then continuing to wind around the axon (3) until there are multiple layers of cell membrane covering the axon (4).

    Benefits:
  - Increased conduction speed increases the nervous system's information processing speed→Saltatory Conduction→the propagation of action potentials along myelinated axons from one node of Ranvier to the next node, increasing the conduction velocity of action potentials.
  - Decreases reaction times to stimuli promoting the ability to escape from sudden predatory attack.

- Action potential: describe how action potentials are initiated and propagated
  - Electrical signals that propagate along axons. AP are rapid, transient depolarisation of the cell membrane. sodium channels in the membrane open and sodium flows into the cell, bringing positive electrical charge and

so reducing the resting membrane potential. If the reduction of the RMP reaches threshold an AP will result.

- Classification of fibre types of the nervous system on the basis of conduction velocity and size; demonstrate an understanding the relationships between fibre size and conduction velocity, and between myelination and conduction velocity

Fibre type	Diameter (µm)	Myelin?	CV (m/s)	Function
Aα	12 - 20	yes	70 - 120	proprioception, motor
Aβ	5 - 12	yes	30 - 70	touch
Aγ	3 - 6	yes	15 - 30	motor (mm spindles)
Aδ	2 - 5	yes, but thin	12 - 30	pain, temp, touch
B	<3	yes	3 - 15	autonomic NS
C	0.3 - 1.3	no	0.5 - 2.3	pain, autonomic NS