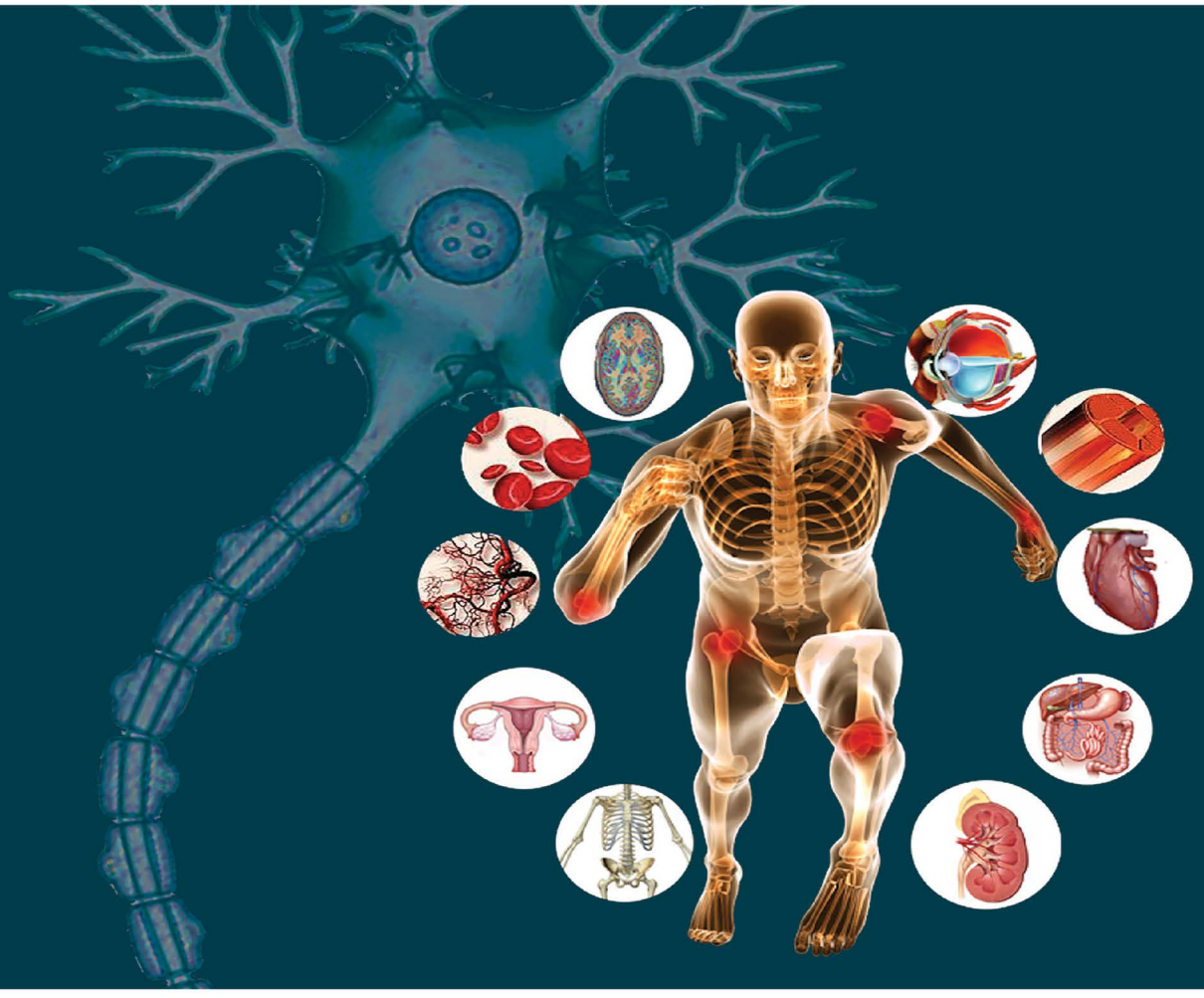
ed information on physiology books, visit our website **www.jaypeebrothers.com,** for detailed information on physiology books, visit our website **www.jaypeebrothers.com**

Human Physiology

Practical Workbook of Human Physiology



K Sri Nageswari
Rajeev Sharma

2nd Edition

JAYPEE

CONTENTS

	Page No.	Date	Signature
Chapter 1: RESPIRATORY SYSTEM	**1**		
Experiments			
• To Examine the Respiratory System of the Subject	1		
• To Record the Vital Capacity and the Effect of Posture on Vital Capacity	7		
• To Record Lung Volumes and Capacities Using Closed Circuit Spirometry with Benedict-Roth Apparatus	11		
• To Record Respiratory Movements by Stethography	15		
Demonstration Experiments			
• To Record Pulmonary Function Tests with Computerised Spirometer	19		
• To Determine Basal Metabolic Rate in a Subject	23		
• To Demonstrate the Procedure of Cardiopulmonary Resuscitation on a Subject	27		
Chapter 2: CARDIOVASCULAR SYSTEM	**31**		
Experiments			
• To Examine the Cardiovascular System	31		
• To Examine the Jugular Venous Pressure/Jugular Venous Pulse	37		
• Measurement of Arterial Blood Pressure Using Sphygmomanometer	41		
• To Study the Effect of Posture and Exercise on Blood Pressure	47		
• Clinical Examination of Pulse	51		
• To Perform Cardiovascular Endurance Tests	55		
Demonstration Experiments			
• To Obtain Pulse Tracing Using Student's Physiograph	61		
• To Record Electrocardiogram Using Portable ECG Machine	63		
• To Calculate Systolic Time Intervals from Simultaneously Recorded Tracings of ECG, Carotid Artery Pulse and Heart Sounds	67		
Chapter 3: CENTRAL NERVOUS SYSTEM	**71**		
• To Perform General Neurological Examination and Examination of Higher Functions	71		
• Examination of Cranial Nerves I–VI	79		
• Examination of Cranial Nerves VII– XII	85		
• To Elicit Superficial Reflexes	91		
• To Elicit Deep Reflexes	95		
• To Perform Examination of the Motor System	99		
• To Examine the Sensory System of a Subject	107		
• To Record Visual Acuity of the Subject	111		
• To Test Colour Vision	115		
• To Perform Perimetry	119		
• To Perform Hearing Tests	123		
• To Determine Visual and Auditory Reaction Time	127		

	Page No.	Date	Signature
Demonstration Experiments			
• To Record EEG Using Data Acquisition and Analysis System	129		
• To Record Galvanic Skin Response Using Data Acquisition and Analysis System	133		
• To Record Visual-evoked Potentials Using Data Acquisition and Analysis System	137		
• To Record Brainstem Auditory-evoked Potentials Using Data Acquisition and Analysis System	141		
• To Perform Autonomic Function Tests	145		
• To Perform Ophthalmoscopy	149		
Chapter 4: NERVE MUSCLE PHYSIOLOGY EXPERIMENTS	**153**		
Experiments			
• To Study the Phenomenon of Fatigue Using Mosso's Ergograph	153		
Demonstration Experiments			
• To Record EMG Using Data Acquisition and Analysis System	157		
• To Record Nerve Conduction Velocity Using Data Acquisition and Analysis System	161		
Chapter 5: REPRODUCTIVE SYSTEM	**167**		
Demonstration Experiments			
• To Perform Pregnancy Test	167		
Chapter 6: MAMMALIAN EXPERIMENTS	**171**		
Demonstration Experiments			
• To Record Blood Pressure and Respiration in Mammalian (Rabbit) Preparation and to Study the Effect of (A) Carotid Occlusion (B) Vagus Stimulation and (C) Drugs	171		
• To Perform the Perfusion of Isolated Mammalian Heart and to Study the Effect of Drugs and Ions	179		
• To Record the Movements of Isolated Mammalian Intestine and to Study the Effect of Drugs and Ions	183		
Chapter 7: HAEMATOLOGY EXPERIMENTS	**187**		
Experiments			
• Study of Compound Microscope	189		
• Collection of Blood Sample	199		
• Preparation and Staining of Peripheral Blood Smear	205		
• Differential Leucocyte Count	211		
• To Prepare a Peripheral Blood Smear and Perform Cooke-Arneth Count	219		
• Estimation of Haemoglobin Using Sahli's Method	223		
• Total Leucocyte Count	229		
• Total Red Blood Cell Count	237		
• Determination of Blood Groups	243		
• To Determine Bleeding Time and Clotting Time	249		
• Determination of Absolute Values	257		

	Page No.	Date	Signature
Demonstration Experiments			
• Determination of Erythrocyte Sedimentation Rate	261		
• To Determine the Packed Cell Volume	267		
• To Determine Osmotic Fragility of Red Blood Cells	271		
• To Perform Platelet Count	275		
• To Perform Total Reticulocyte Count	281		
Chapter 8: VERTICAL ORIENTATION PROGRAMME	**285**		
• Visit to Department of Medicine	285		
• Visit to Department of Pulmonary Medicine	287		
• Visit to Department of Otorhinolaryngology (ENT)	289		
• Visit to Dietetics Department	291		
• Visit to Department of Transfusion Medicine	293		
Bibliography	*295*		

Chapter

3

Central Nervous System

EXPERIMENT NO. 1

AIM: TO PERFORM GENERAL NEUROLOGICAL EXAMINATION AND EXAMINATION OF HIGHER FUNCTIONS

Introduction

A routine examination of the whole nervous system is carried out in a sequential manner in order to exclude any major neurological disability. The nervous system examination is divided into following parts:

1. Examination of higher mental functions
2. Motor system examination
3. Sensory system examination
4. Examination of cranial nerves.

Brain is basically an input–output device. It receives its input via sensory system and produces action or output via motor system. These two systems are separately tested as defect in any modality can produce serious disease.

Examination of higher mental functions is performed to evaluate the intellect and cognition of the subject.

- In sensory system examination, we test for the sensation of touch, pressure, temperature, pain, stereognosis, vibration and proprioception.
- In motor system examination, the movement and strength, tone and bulk of muscles, reflexes, gait and involuntary movements of any group of muscles in the body are tested.
- In cranial nerve examination, 12 pairs of cranial nerves serving important sensory and motor functions essential for survival are tested bilaterally.

Examination of Higher Mental Functions

1. Consciousness
2. Orientation
3. General behaviour
4. Mood/affect

JAYPEE BROTHERS

5. Delusion and hallucinations
6. Memory
7. Speech
8. General awareness and logical reasoning
9. Sleep and other normal daily functions.

Consciousness

Consciousness is a state of awareness of one's own self and one's environment. With altered states of consciousness ranging from stupor, semicoma and coma, the subject does not respond to various stimuli like visual, tactile, thermal and painful stimuli. Consciousness can be classified under various subheadings:

a. Awake/alert: Subject is conscious, active, awake and alert.

b. Somnolence: Subject can be awakened from his sleep by various stimuli and will make appropriate motor and verbal responses.

c. Stupor: Subject is aroused by painful and repeated stimuli and may respond to simple commands only for short periods. Restlessness and spontaneous movements might occur.

d. Semi coma: Painful stimuli cause withdrawal or other adaptive movements. Disorientation occurs.

e. Coma: Subject is deeply unconscious and does not respond to any kind of external stimulus or to inner need.

However, the Glasgow Coma Scale (GCS) is more specific in defining the altered states of consciousness (score of 3 represents worst and 15 represents the best score).

Orientation

Subject should be asked questions about time or day, date, month, year, the place where he is from, whom he is talking to and for how many days he has been in (if admitted). This elicits the orientation in time, person and place.

General Behaviour

The attire/dress of the subject, personal hygiene, the general attitude and cooperation with the examiner should be observed. It is noted whether he is evasive or hostile or shy or over frank. Note for any mannerisms or nervous behaviour.

Mood/Affect

The present mood of the subject is noted whether he is happy, euphoric, ecstatic, depressed, angry, having suicidal tendencies. Note whether the subject's mood is congruent with his speech and his general behaviour e.g. A subject describing the death of his mother in a euphoric mood suggests mental disease.

Delusions/Hallucinations

Delusions are false fixed beliefs, which cannot be changed despite evidence to the contrary. Hallucinations are false impressions from the organs of special senses (aural, visual and olfactory), for which no cause is found. The subject is asked whether he is having any hallucination and judge whether he is having any delusions.

JAYPEE BROTHERS

Memory

Memory is defined as the retention and storage of acquired information in various areas of brain. The ability of the subject to recall various events is tested for the following three types of memory :

- Immediate
- Recent or short term memory
- Remote or long term memory.

The subject is asked to repeat a 7-digit number to test his immediate memory. For recent memory, the subject is asked to enumerate the contents of his breakfast or the news he has read in the morning.
To test for remote memory, the subject is asked about the date of his marriage or some significant life event in the past.

Speech

Speech abnormalities can be of two types:

a. Difficulty in articulation i.e. *dysarthria*
b. Disability in production of speech i.e. *aphasia*

In dysarthria, the speech can be *stammering/lalling* speech
In aphasia, there is disturbance of the ability to use language in speaking, writing or comprehending. It is further of three types:

a. *Fluent aphasia*
b. *Anomic aphasia*
c. *Non-fluent aphasia*

The classification of aphasias given above is based upon the site of lesion i.e.

- Wernicke's area or in arcuate fasciculus or in area 40, 41, 42 of auditory cortex (fluent aphasia)
- Broca's area (non-fluent aphasia)
- Angular gyrus (anomic aphasia).

Tests of Aphasia

Fluent Aphasia

- Lesion in Wernicke's area: The subject is asked or is presented with written words. He is unable to comprehend the meaning of spoken or written words. His speech is fluent but full of jargon or neologisms.
- Lesion in arcuate fasciculus: Also known as "*conduction aphasia*". The subject is asked about his name. He hears and understands and has good auditory comprehension but cannot put parts of the words together and thus cannot reply.

Anomic Aphasia

- Lesion in angular gyrus: Lesion in the angular gyrus in the categorical hemisphere leads to "*anomic aphasia*". The subject cannot understand written language or pictures as the visual information is not processed and transmitted to Wernicke's area.

JAYPEE BROTHERS

Non-fluent Aphasia

- Lesion in Broca's area: The speech of the subject is slow and words are hard to come by. His speech is limited only to two or three words to express the whole range of meaning and emotion.
  1. *Spoken*: Patients is asked about his name. He hears and understands and knows what to reply but is unable to plan the precise order in which muscles have to be employed and thus cannot reply though he can give affirmation by nodding.
  2. *Written*: In a similar way, when a question is written, the subject can see and interpret it but fails to write a reply. But if a leading question is put, he can write yes or no correctly.
     In *motor aphasia*, the subject can comprehend the speech but cannot speak because of defect in productive mechanism i.e. Broca's area.

General Awareness and Logical Reasoning

The subject is asked some important questions about general awareness like who is the Prime Minister of our country. The subject is asked to repetitively subtract 5 from 100 to note his logical reasoning.

Sleep

The subject is asked about his sleep hours, any waking up during night, any desire to sleep in daytime or other problems. Sleep is disturbed in states of anxiety and some sleep disorders.

Questions

1. Define different types of memory.
2. What are the various altered states of consciousness?

JAYPEE BROTHERS

EXPERIMENT NO. 2

AIM: EXAMINATION OF CRANIAL NERVES I-VI

Ist (Olfactory) Nerve

It is a pure sensory nerve concerned with olfaction. The subject is asked to find out by smelling only (keeping the eyes closed), familiar substances like clove oil, oil of peppermint, asafoetida or common bed side substances like soap, fruit, etc. put in small test tubes. Substances like ammonia should be avoided, as it irritates Vth cranial nerve also. The testing should be done in both nostrils separately (when testing through right nostril the subject is asked to block the left nostril and vice versa).

The complaints of any cough, cold or nasal blockage should be ruled out.

Observation

The subject should be able to identify the normal smell.

Anosmia (complete absence of smell), *parosmia* (alteration in the character of smell) or *hyposmia* (reduction in the sense of smell) should be looked for.

IInd (Optic) Nerve

It is a pure sensory nerve, subserving vision in all its faculties like light, form and colour sense. Each eye is separately tested for the following:

1. Visual acuity (Experiment no. 8)
2. Colour vision (Experiment no. 9)
3. Field of vision (Experiment no. 10).

IIIrd (Oculomotor) Nerve

It supplies

i. Ciliary muscle (helps in accommodation)
ii. Sphincter pupillae (helps in papillary constriction)
iii. Levator palpebrae superioris (elevation of upper eyelid)
iv. Extraocular muscles except superior oblique and lateral rectus.

IVth (Trochlear) Nerve

It supplies superior oblique muscle.

VIth (Abducens) Nerve

It supplies lateral rectus muscle.

Cranial nerves III, IV and VI are mixed nerves and are tested together as they innervate the extra ocular muscles which are responsible for the movements of the eyeball.

Examination of III, IV and VI Nerves:

1. The subject is made to sit comfortably. The eyes are observed for the following :
   a. Presence of ptosis—Drooping of upper eyelid.
   b. Lid lag in either eye—When patient is asked to look downward; the upper eyelid lags behind the eyeball.

JAYPEE BROTHERS

c. Presence of any squint or strabismus—An abnormality of ocular movements in which the visual axes do not meet at the point of fixation leading to *diplopia* or *double vision*.
d. Presence of nystagmus—The involuntary rhythmic oscillations of eyeballs, when gaze is fixed in one direction.

2. *Examination of the eye movements in all directions:* Eye movements are tested by asking the subject to follow the movements of examiner's finger in upward, downward, medial, lateral and oblique directions. Following movements are looked for:
   a. Abduction—A function of lateral rectus.
   b. Adduction—A function of medial rectus.
   c. Elevation in full abduction—A function of superior rectus.
   d. Elevation in full adduction—A function of inferior oblique (rotates the eyeball outwards and pulls it upwards.
   e. Depression in full abduction—A function of inferior rectus.
   f. Depression in full adduction—A function of superior oblique (rotates the eyeball inwards and pulls it downwards).
3. *Examination of pupil*
   a. Size of pupil: Size of both the pupils is compared
   b. Shape of pupil: The shape of the pupil is noted, whether circular in outline (normal) or irregular
   c. Pupillary reflexes:
      i. *Light reflex*
         - *Direct light reflex*: Each eye is separately examined with the subject seated in shade or indirectly illuminated place with the other eye covered. He is asked to look at a distant object so that the accommodation is relaxed. A bright light is brought from the side and is shone into the eye to be tested.
           Observations: Immediate constriction of the pupil in the same eye.
         - *Indirect/consensual light reflex*: A hand is placed between the two eyes and light is thrown into one eye while the effect is observed on the other eye.
           Observations: Pupillary constriction in the unstimulated eye.
      ii. *Accommodation reflex*:
         The examiner's index finger is kept close to the subject's nose while the subject is asked to look at a distant object. Then the subject is asked to look at examiner's index finger quickly.

   The accommodation reflex comprises of three events:
   a. Constriction of pupil
   b. Convergence of the eyes
   c. Increase in the convexity (anterior curvature) of the lens.

Vth (Trigeminal) Nerve

It is a mixed nerve with sensory and motor functions. It is formed by three divisions:
1. Ophthalmic
2. Maxillary
3. Mandibular.

JAYPEE BROTHERS

Testing of Motor Functions

a. The subject is asked to clench the teeth tightly and the hardness of *masseter* and *temporalis muscle* is tested on either side.
   Observations: The muscle on affected side fails to become prominent.
b. The subject is asked to open the mouth and jaw symmetry is noted.
   Observations: Any deviation of jaw indicates weakness of that part.

Testing of Sensory Functions

a. Touch, pressure, pain and temperature sensations are tested over the skin and mucous membrane of the face supplied by the three branches of trigeminal nerve.
b. Corneal reflex is tested by touching the lateral edge of cornea at its conjunctival margin with a wisp of cotton wool and reflex blinking of the eye is noted.

Questions

1. Comment briefly upon the following:
   a. Accommodation reflex
   b. Light reflex
   c. Argyll-Robertson pupil.

JAYPEE BROTHERS

EXPERIMENT NO. 3

AIM: EXAMINATION OF CRANIAL NERVES VII – XII

VIIth (Facial) Nerve

It is a mixed nerve and consists of motor and sensory fibres.

Testing of Facial Nerve

1. The subject is seated comfortably and the face is observed for the following features:
   a. Expression of the face
   b. Depth of nasolabial folds
   c. Furrows on forehead
   d. Width of palpebral fissure
   e. Symmetry of angles of mouth.
2. *Testing of upper face:*
   i. The subject is asked to frown or look upwards and normal symmetrical wrinkling of the forehead is noted.
   ii. The subject is asked to shut his eyes as tightly as he can and normal descent of upper lids and rolling in of eye lashes is looked for.
   iii. The subject is asked to shut his eyes tightly and examiner tries to open them. Normally eyes cannot be opened while resistance is being applied by the subject.

   Bells's phenomenon: Rolling of eyeballs upwards during attempted forced eye closure. It is a normal phenomenon but is more obvious when eye closure is not possible in facial nerve palsy.
3. *Testing of lower face*:
   i. The subject is asked to whistle which is not possible in facial nerve palsy.
   ii. The subject is asked to show his teeth and the position of angle of mouth is noted. The mouth is deviated to a healthy side in facial nerve palsy because of unopposed action of muscle on healthy side.
   iii. The subject is asked to inflate his mouth with air and blow out his cheeks. Now, either side of cheek is gently tapped with a finger. The air leaks out from the affected side in facial nerve palsy.
   iv. The taste sensation from anterior two-third of the tongue is tested for sweet, salt and sour preparation.

   Facial nerve palsy can be divided into supranuclear and infranuclear palsy.

Supranuclear palsy: Lesion is above the facial nerve nucleus. Lower part of the face is mainly affected because the parts of the facial nuclei innervating the upper face are bilaterally innervated and therefore only partial paralysis of upper part of the face occurs. Taste sensation is spared.

Infranuclear palsy: Lesion is at the level or below the level of facial nerve nucleus. Both the upper and lower part of the face is affected because of damage to final common path i.e. facial nerve. There is loss of taste sensation from anterior 2/3rd of the tongue and *"hyperacusis*" (sounds on the side of the facial nerve palsy may seem unusually loud) because of the paralysis of stapedius muscle on the affected side.

VIIIth (Vestibulocochlear) Nerve

It is a pure sensory nerve and has two sets of fibres performing auditory and vestibular functions

JAYPEE BROTHERS

1. Auditory Functions

a. Hearing tests or tuning fork tests (Experiment no. 11)
b. Audiometry.

2. Vestibular functions:

a. The subject is asked about any complaints of giddiness/dizziness and vertigo (external objects seem to move around the subject).
b. The subject is enquired for any history of *nystagmus* (involuntary rhythmic jerky movements of the eyeball).
c. *Romberg's sign*—This is a test for loss of position sense (sensory ataxia). The subject is asked to stand with his feet close together and is then asked to close his eyes. Romberg's sign is positive if he sways about or falls to either side on closing his eyes.

IXth (Glossopharyngeal) Nerve

It is a mixed nerve consisting of motor and sensory fibres.
1. *Taste sensation:* Sensation of taste on posterior one-third of tongue is tested
2. *Palatal reflex:* The back of pharynx is tickled with a cotton wick and reflex contraction of pharynx is noted.

Xth (Vagus) Nerve

1. Tests for the palate

a. The subject is asked about any history of *regurgitation* of fluids through the nose during swallowing
b. Any nasal twang is noted
c. Palatal reflex is tested
d. The subject is asked to say 'Ah' and movement of both sides of palatal arch is observed.

2. Tests for the Larynx

Laryngoscopy i.e. direct visualization of vocal cords is done .

XIth (Accessory) Nerve

The size, shape and strength of trapezius and sternocleidomastoid muscles are evaluated.

Testing of trapezius muscle: The subject is asked to shrug his shoulders while the examiner presses them downwards.

Testing of sternocleidomastoid muscle: The subject is asked to rotate his head to one side, against the resistance applied by the examiner from contralateral side.

XIIth (Hypoglossal) Nerve

The tongue of the subject is inspected while at rest and while protruding from the mouth
1. Fasciculation/tremor is observed in relaxed tongue.
2. The subject is asked to protrude his tongue as far as possible and any deviation from midline is looked for.

JAYPEE BROTHERS

3. To test the strength of muscles of the tongue of the subject is asked to push the tongue against the cheek as the resistance is applied with an index finger by the examiner.

Questions

1. Differentiate between Supranuclear and Infranuclear lesions of facial nerve.
2. What is the sensory innervation of the tongue?
3. What are the different modalities of taste and how do you test them? Which are the different areas of the tongue representing different modalities of taste?

JAYPEE BROTHERS

EXPERIMENT NO. 4

AIM: TO ELICIT SUPERFICIAL REFLEXES

Definition

Superficial reflexes are the reflex contractions of the underlying muscles when superficial structures of body like skin and mucous membrane are stimulated. These are the polysynaptic reflexes.

Following superficial reflexes can be elicited

1. Plantar reflex
2. Abdominal reflex
3. Cremasteric reflex
4. Corneal reflex
5. Conjunctival reflex
6. Scapular reflex.

Plantar Reflex (L_5, S_1)

The outer edge of the sole of the foot is stimulated with a key or a stick by gentle scratching starting from the heel and moving towards the little toe along the lateral border of heel and then medially towards the great toe.

Normal response: Plantar flexion of toes.

Babinski's response/sign: Dorsiflexion of great toe and fanning of other toes.

Cause/reason: Occurs in upper motor neuron lesions.

Babinski's response occurs normally also in infants and in deep sleep.

Abdominal Reflex (T_7–T_{12})

The abdominal wall is stimulated with the help of a key or a wooden stick which is passed across the abdominal skin from the outer aspect towards midline in the plane of the dermatome.

Normal response: Contraction of underlying abdominal musculature.

This reflex is difficult to observe in obese/anxious persons.

Cremasteric Reflex (L_1, L_2)

The upper and inner aspect of thigh is gently stroked from above downwards with a blunt object.

Normal response: Elevation of testicles on the side of stimulation due to contraction of cremasteric muscle.

Corneal Reflex (Cranial Nerve V and VII)

The lateral edge of cornea is touched at its conjunctival margin with the wisp of cotton wool from the lateral side of the eye (outer canthus) while the subject is asked to look directly in front.

Normal response: Blinking (Bilateral).

Conjunctival Reflex (Cranial Nerve V and VII)

The bulbar conjunctiva is touched with the wisp of cotton wool.

Normal response: Blinking (Bilateral).

JAYPEE BROTHERS

EXPERIMENT NO. 5

AIM: TO ELICIT DEEP REFLEXES

Definition

Reflex is an involuntary response to adequate sensory stimulus and depends upon the integrity of reflex arc.

Deep reflexes can be elicited by providing a stimulus, which is, sudden stretching due to single sharp tap on the tendon of a lightly stretched muscle. The reflex is integrated at the spinal cord level but is modified by the activity of the higher centres through descending pathways.

The following deep reflexes are elicited:

1. Knee jerk
2. Ankle jerk
3. Biceps jerk
4. Triceps jerk
5. Supinator jerk
6. Jaw jerk.

Gradation of response: The muscle contraction or movement of the joint is noted and the response is graded as follows:

0. Absent
1. Present
2. Brisk
3. Very brisk
4. Clonus.

Jendrassik's Manoeuvre

When reflexes are feeble reinforcement can be done by asking the subject to make a strong voluntary effort by hooking the fingers of two hands together and then pulling them apart as hard as possible or to make a fist with the ipsilateral hand. The reinforcement helps by increasing the γ-discharge thereby increasing the sensitivity of muscle spindle to stretch.

Knee Jerk (L_2–L_4)

This can be elicited in two positions

- Sitting.
- Supine.
- *Knee jerk in sitting position:* When the subject is sitting at the edge of the bed or chair with legs hanging freely over the edge, he is asked to cross one leg over other. Then a sharp tap is given on the patellar tendon after palpating it.
- *Knee jerk in supine position:* The patient's legs are kept in semiflexed position and the hand is placed underneath the knee to be tested so as to raise it off the bed and let it completely rest on the examiner's arm. The patellar tendon is struck with the hammer.

Observation

Extension of the knee due to contraction of the quadriceps femoris muscle.

JAYPEE BROTHERS

for detailed information on physiology books, visit our website **www.jaypeebrothers.com,** for detailed information on physiology books, visit our website **www.jaypeebro**

Practical Workbook of Human Physiology

Practical Workbook of Human Physiology is specially meant for the first year MBBS students as well as undergraduate students of allied disciplines. The workbook is concise, handy and economical to which the students can carry easily in the laboratory and note down their observations on the blank sheets provided in it. Thus, it replaces the unprinted blank practical files in which they have to write down the whole experimental procedure on their own within the limited time available during practical hours.

The undergraduate medical students are supposed to deposit the practical manual with the department during the final professional examination. This workbook is light weight and fulfills easily the purpose, unlike the printed practical books available in the market. The workbook serves the function of a manual as well as a practical textbook where all the pertinent text material is given at one place.

K Sri Nageswari MD FABMS IFME is Professor in the Department of Physiology at Dr VRK Women's Medical College Hyderabad, Telangana, India. She has also served as Professor and Head, Department of Physiology, Government Medical College, Chandigarh, from 1998 to 2006 and as Reader at the same college from 1992 to 1996. She was also the Professor in charge of Academics and in charge of undergraduate medical curriculum. Since her superannuation in 2006, she has been serving as Professor and Head in the Department of Physiology at various private medical institutes.



She has around 35 years of teaching and research experience. She bagged into her credit 24 full-length national and international research papers and 43 abstracts (presented at national and international conferences), five technical reports, two chapters in books and four books on physiology written for undergraduate medical students. She also served as reviewer and examiner for a number of MD and PhD theses and served as reviewer for various prestigious journals and projects. She was a resource person at national and international conferences and symposia conducted on medical education. She is an International Fellow in Medical Education (ECFMG, now known as FAIMER, USA) and worked in the Department of Physiology and Biophysics at UIC, Chicago, USA, for five months in 2001. In March 2012, she conducted an IUPS workshop for medical teachers at College of Medicine, Arabian Gulf University, Kingdom of Bahrain. She is member of American Physiological Society since 2001 and an Emeritus member since 2014. She is also member of the Physiological Society, UK. She is Fellow of Indian Association of Biomedical Scientists since 2003. She taught physiology and conducted research on Biological Effects of Electromagnetic Radiation at various prestigious institutions like IIT, Kanpur and Defence Institute of Physiology and Allied Sciences. She completed various research projects successfully as principal investigator and coinvestigator. Her research interests include biological and immunological effects of electromagnetic radiation, medical education, and obesity. She had introduced a number of innovative teaching-learning strategies into the course curriculum of physiology for medical students, and the work was published in the American Physiology Society Journal, Advances in Physiology Education. She is recipient of Professor Puthuraya award for best teacher in physiology, Dev Raj Bajaj Research award for invention of new research technique/instrumentation in the field of physiology and ML Gupta award for her significant contribution in the field of medical education by Association of Physiologists and Pharmacologists of India, a National body, in the years 2009, 2006 and 2005, respectively.

Rajeev Sharma MD is serving as Professor and Head, Department of Physiology at Guru Gobind Singh Medical College, Faridkot, Punjab, India. He has also been In-charge of Academics and Research in the institute. Previously, he served in Government Medical College, Chandigarh from 2002 to 2010. He has more than 18 years of experience in teaching physiology to various undergraduate and postgraduate students. He has many research papers published in national and international journals and has been a guest speaker in various conferences. He has just completed the Advance Course in Medical Education (ACME). He worked with Dr K Sri Nageswari to develop a simulation software for amphibian experiments which has been published as a book and CD. He is the member of executive body of Association of Physiologists of India (ASSOPI). His key areas of interest are medical education and intraoperative neuromonitoring.



Available at all medical bookstores or buy online at www.jaypeebrothers.com

JAYPEE BROTHERS
Medical Publishers (P) Ltd.
www.jaypeebrothers.com

Join us on facebook.com/JaypeeMedicalPublishers

Shelving Recommendation
PHYSIOLOGY

ISBN 978-93-5270-145-2