

It is a conglomeration of billions of cells forming nerves that are specifically designed to provide a communication network within the human body

The Nervous System



What are the three primary functions of the nervous system?

Sensory, Integrative and Motor function



The ability of the nervous system to sense changes in either the internal or external environment.

Sensory Function



The ability of the nervous system to analyze and interpret the sensory information to allow for proper decision making and produce the appropriate response.

Integrative Function



The neuromuscular response to the sensory information, such as causing the muscle to initially contract when stretched.

Motor Function



The functional unit of the nervous system

The Neuron



The three main parts of the neuron

- Cell Body
- Axon
- Dendrites



The three main functional classifications of neurons

- Sensory (Afferent)
- Interneurons
- Motor (Efferent)



Transmit nerve impulses from effector sites via receptors to the brain and spinal cord.

Sensory Neurons



Transmit nerve impulses from one neuron to another.

Interneurons



Transmit nerve impulses from the brain and spinal cord to the effector sites such as muscles or glands.

Motor Neurons



Consistes of the brain and the spinal cord.Serves mainly to interpret information.

Central Nervous System



Consists of 12 cranial nerves, 31 pairs of spinal nerves and sensory receptors.

Peripheral Nervous System



Two Functions of peripheral nerves

1. They provide a connection for the nervous system to activate different effector sites such as muscles.
2. Relay information from the effector sites back to the brain via sensory receptors providing a constant update on the relationship between body and environment.



Specialized structures that are designed to transform environmental stimuli (heat, light, sound, taste, motion) into sensory information that the brain and spinal cord can interpret and produce a response.

Sensory Receptors



Specialized structures that are responsible for sensing distortion in tissues.

Mechano Receptors



The major sensory organs of the muscle and sit parallel to the muscles fibers. They are sensitive to change in length and rate of length change.

Muscle Spindles



At the point where the muscle and tendon meet and are sensitive to changes in muscular tension and rate of the tension change.

Golgi Tendon Organs



Made up of three systems. The Muscular, Nervous and Skeletal systems.

Kenetic Chain



A framework for our structure and movement.

The Skeletal System



Form junctions that are connected by muscles and connective tissue.

Bones



Sites where movement occurs as a result of muscle contraction.

Joints



Made up of the skull, the rib cage, and the vertebral column. 80 Bones

Axial Skeleton



The upper and lower extremities as well as the shoulder and pelvic girdles. 126 Bones

Appendicular Skeleton



The number of joints in the body

300



Flattened or indented portions of the bone that are attachment sites for the supraspinatus and infraspinatus muscles, respectively.

Bone Depressions



Projections protruding from the bone to which muscles, tendons, and ligaments can attach.

Bone Processes



Joint motion with three major motion types. Roll, slide and spin.

Arthrokinematics



Classifications of Joints

Synovial and Nonsynovial



Comprising 80% of the joints in the body and are most associated with movement and have the greatest capacity for movement. (The Knee)

Synovial Joints



No joint cavity and fibrous connective tissue; Little or no movement.

Nonsynovial Joints



No axis of rotation; Moves by sliding side-to-side or back and forth. (Carpals of the hand)

Gliding Joint



Formed by fitting of condyles of one bone into elliptical cavities of another; moves predominantly in one plane. (Knee)

Condloid Joint



Uniaxial; moves in one plane of motion - sagittal (Elbow)

Hinge



One bone fits like a saddle on another bone; moves predominantly in two planes - sagittal frontal (Joint of the thumb)

Saddle



Only one axis; moves in one plane of motion - transverse (radioulnar)

Pivot



Most mobile of joints; Moves in all three planes of motion (Shoulder)

Ball-and-socket

Made up of collagen and is the primary connective tissue for a joint. Connect bone to bone and provide static and dynamic stability.

Ligament

Muscles generate internal tension that, under the control of the nervous system, manipulates the bones of our body to produce movements.

The Muscular System

Structures that attach muscles to bone and provide the anchor from which the muscle can exert force.

Tendons

The wrapped outer layer of the muscle

The Epimysium

Structures that attach muscle to bone and provide the anchor from which the muscle can exert force.

The Tendons

A plasma membrane that encases muscle fibers.

The Sarcolemma

The functional unit of muscle that produces muscular contraction and consists of repeating sections of actin and myosin.

Sarcomere

The contraction of a muscle generated by neural stimulation

Neural Activation

A motor neuron and all the muscle fibers it innervates

Motor Unit

Chemical messengers that cross synapses to transmit electrical impulses from the nerve to the muscle.

Neurotransmitter

Muscle Fiber Types

Type 1 (Slow Twitch)

Type 2 (Fast Twitch)

Muscle fiber with;

- More Capillaries, mitochondria and myoglobin
- Increased Oxygen delivery
- Smaller in size
- Less force produced
- Slow to fatigue

Type I (Slow Twitch)



Muscle Fiber:

- Fewer capillaries, mitochondria, and myoglobin
- Decreased oxygen delivery
- Larger in size
- More force produced
- Quick to fatigue

Type II (Fast Twitch)



Four Muscle Types

- Agonist
- Synergist
- Stabilizer
- Antagonist



Muscles that are the primary movers in a joint motion. Also known as Prime Movers.

Agonists



Muscles that act in direct opposition to agonists

Antagonist



Muscles that assist Prime Movers (agonists) during functional movement patterns

Synergists



Muscles that support or stabilize the body while the prime movers and the synergists perform the movement patterns.

Stabilizers

Cranial and spinal nerves that spread throughout the body and serve to relay information from bodily organs to the brain and from the brain to bodily organs

Peripheral nervous system



Neurons that transmit nerve impulses from effector sites to the brain or spinal cord.

Sensory (afferent) neurons



Organs sensitive to change in tension of the muscle and the rate of that change.

Golgi tendon organs



The neuromuscular response to sensory information

Motor function



The combination and interrelation of the nervous, skeletal, and muscular systems.

Kinetic chain



The functional unit of the nervous system

Neuron



Large groups of cells that form nerves, which provide a communication network within the body.

Nervous system



The ability of the nervous system to sense changes in either internal or external environments

Sensory function



Neurons that transmit impulses from one neuron to another

Interneurons



Consists of the brain and spinal cord and serves mainly to interpret information

Central nervous system



The ability of the nervous system to analyze and interpret sensory information to allow for proper decision making, which produces the appropriate response

Integrative function



Neurons that transmit nerve impulses from the brain or spinal cord to the effector sites.

Motor (efferent) neurons



Sensory receptors responsible for sensing distortion in bodily tissues

Mechanoreceptors



Receptors sensitive to pressure, acceleration, and deceleration in the joint

Joint receptors



Fibers sensitive to change in length of the muscles and the rate of that change

Muscle spindles



_____ attach muscles to bone and provide the anchor from which the muscle can exert force and control the bone and joint

Tendons



_____ is tissue consisting of long cells that contract when stimulated to produce motion

Muscle



_____ are chemical messengers that transmit electrical impulses from the nerve to the muscle

Neurotransmitters



The _____ is a series of muscles that the nervous system commands to move the skeletal system

Muscular system



The functional unit of muscle that produces muscular contraction (which consists of repeating sections of actin and myosin) is called the _____.

Sarcomere



_____ is the contraction of a muscle generated by the communication between the nervous system and muscular system.

Neural activation



The movable places where two or more bones meet

Joints



Portion of the skeletal system that includes the upper and lower extremities

Appendicular skeleton



Projection protruding from the bone where muscles, tendons, and ligaments are attached.

Process



The body's frame, which is comprised of bones and joints

Skeletal system



Portion of the skeletal system that consists of the skull, rib cage, and vertebral column

Axial skeleton



The movements of the joints

Arthrokinematics



Connective tissue that connects bone to bone

Ligament



Joints that are held together by a joint capsule and ligaments and are most associated with movement in the body

Synovial joints

Hard connective tissues that connect to create a skeletal framework.

Bones

Flattened or indented portion of bone, which can be a muscle attachment site

Depression

Joints that do not have a joint cavity, connective tissue, or cartilage

Nonsynovial joints

Lower in capillaries, mitochondria, and myoglobin_____

Type II

Is this a characteristic of Type I or Type II Muscle Fiber?

Smaller in size_____

Type I

Is this a characteristic of Type I or Type II Muscle Fiber?

Produce less force_____

Type I

Is this a characteristic of Type I or Type II Muscle Fiber?

Slow in fatigue_____

Type I

Is this a characteristic of Type I or Type II Muscle Fiber?

Long-term contractions_____

Type I

Is this a characteristic of Type I or Type II Muscle Fiber?

Produce more force_____

Type II

Is this a characteristic of Type I or Type II Muscle Fiber?

Quick to fatigue_____

Type II

Is this a characteristic of Type I or Type II Muscle Fiber?

Short-term contractions (force and power)_____

Type II

Is this a characteristic of Type I or Type II Muscle Fiber?

Three primary functions of the nervous system
sensory, integrative, and motor functions

Sensory Functions

ability of the nervous system to sense changes in either internal or external environment

Integrative function

ability of the nervous system to analyze and interpret the sensory information to allow for proper decision making, which produced the appropriate response

Motor Function

the neuromuscular response to the sensory information

Neuron

Functional unit of the nervous system

Neurons are composed of three main parts: ...
cell body, axon and dendrites

List the three main classifications of neurons

Sensory (afferent) neurons

Interneurons

Motor (efferent) neurons

Sensory Neurons

transmit nerve impulses from effector sites to the brain or spinal cord

Interneurons

Transmit nerve impulses from one neuron to another

Motor Neurons

Transmit nerve impulses from the brain and spinal cord to effector sites

Central Nervous system

Composed of the brain and spinal cord
serves mainly to interpret information

Peripheral nervous system

Cranial and spinal nerves that spread throughout the body

provides a connections for the nervous system to activate different effector sites and to relay information to the brain from the sensory receptors

contain 12 cranial nerves, 31 pairs of spinal nerves

Four major categories of sensory receptors

Mechanoreceptor- touch and pressure

chemoreceptors- taste and smell

photoreceptors- light

mechanoreceptors

receptor responsible for sensing distortions in body tissues

located in muscles, tendons, ligaments, and joint capsules

Muscle spindles

Receptors sensitive to change in length and rate of change

Golgi Tendon Organ

Receptors sensitive to change in tension of the muscle and the rate of that change.

They are at the point where muscle and tendon meet.

When excited they will cause the muscle to relax

Joint Receptors

Located in and around the joint capsule. They respond to pressure, acceleration, and deceleration in the joint

Skeletal system

the bodys framework, composed of bones and joint

Bones

provide a resting ground for muscles and protection of vital organs

Joint

the movable junction where two or more bones meet

Axial Skeleton

Skull, rib cage, and vertebral column

80 bones

Appendicular Skeleton

upper and lower extremities as well as the shoulder and pelvic girdle

126 bones

There are ____ bones in the body. ____ contribute to voluntary movement.

there are more than ____ joints

roughly 206

177 voluntary movement

more than 300 joints

The two main functions of bone are

to act as levers and provide support

Depressions

Flattened or indented portion of bone which can be a muscle attachment site.

ex. supraspinus fossa, intertubercular sulcus

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Process

Projections protruding from the bone where tendons, muscles, and ligaments can attach

Common processes

Condyle- located on the inner and outer portion of the femur and the top of the tibia

Epicondyle- located on the inner and outer portion on the humerus to help form the elbow joint

tubercle- located at the top of the humerus at the glenohumeral joint

trochanter- located at the top of the femur and are attachment site for hip musculature

arthrokinematics

joint motion. Three major motion types are roll, slide, and spin

Example of joint roll

the femoral condyles moving over the tibial condyles during a squat

example of joint slide

tibial condyles moving across femoral condyles during and knee extensions

example of joint spin

radio-ulnar rotation

synovial joints

joints that are held together by a joint capsule and ligaments and are move associated with movement in the body

types of synovial joints in the body

Gliding

Condyloid

Hinge

Saddle

Pivot

ball and Socket

Gliding joint

moves back and forth or side to side.

example: carpals in the hand

Condyloid joint

one bone fits into the elliptical cavity of another bone for form the joint. movement in one plane with minimal movement in others.ex: in wrist between radius and capals and in the knee joint

Hinge joint

uniaxial joint allowing movement in only one plane of motion

ex. elbow, interphalangeal, ankle

Saddle Joint

One bone looks like a saddle with the articulating bone straddling it

ex: only in the thumb

pivot joint

allow movement in predominantly one plane of motion (rotation, pronation and supination in transverse)

ball and socket

most mobile, movement in all three planes

hip, shoulder

Nonsynovial joints

joints that do not have a joint cavity, connective tissue, or cartilage.

little to no movement

ex: skull, distal joint of tibia and fibia, and symphysis pubis

muscle is wrapped by a connective tissue call_____and an inner layer immediately surrounding the tissue call

fascia

Epimysium

The bundle of muscle fibers with in a muscle is called a _____. Each of these bundles is wrapped in a connective tissue called _____.

fascicle

perimysium

Individual muscle fibers are wrapped with a connective tissue called _____.

endomysium

Tendons

Connective tissues that attache muscle to bone and provide an anchor for the muscles to produce force.

Muscle fibers are encased by a plasma membrane known as a _____

sarcolema

Sarcomere

The functional unit of muscle that produces muscular contraction and consists of repeating section of actin and myosin. It lies in the space between to z lines. Sarcomeres compose the myofibril

Tropomyosin

located on the actin filament and block myosin binding sites located on the actin filament, keeping myosin from attaching to actin while the muscle is relaxed.

neural activation

the contraction of a muscle generated by neural stimulation

Motor Unit

A motor neuron and the muscle fibers it innervates

neuromuscular junction

the point where the neuron meet and individual muscle fiber. the junction is actually an small gap between the nerve and muscle fiber often called a synapse

Neurotransmitter

Chemical messengers that cross synapses to transmit electrical impulses from the nerve to the muscle

☐

Acetylcholine

ACh- the neurotransmitter used by the neuromuscular system. One attached to the receptor site ACh stimulates the muscle fiber to go through a series of steps that produce muscle contractions

☐

steps in sliding filament theory

1. A sarcomere shortens as a result of the Z lines moving closer together.
2. The Z lines converge as the result of myosin heads attaching to the actin filament and asynchronously pulling (power strokes) the actin filament across the myosin, resulting in shortening of muscle fiber

☐

Type 1 muscle fibers

slow twitch

higher number of capillaries, mitochondria and myoglobin which allows for improved delivery of oxygen.

smaller in size

slower to produce maximal tension

more resistant to fatigue

important to stabilization

"red fibers"

☐

Type Two muscle fibers

fast twitch

contain fewer capillaries, mitochondria, and myoglobin.

larger in size

quick to produce maximal tension

fatigue more quickly

"white fibers"

Type IIa have higher oxidative capacity and fatigue more slowly than type IIb

Type IIb have a low oxidative capacity and fatigue quickly

☐

Agonist in:

Chest Press

Overhead Press

Row

Squat

Hip extension

prime mover:

Pectoralis major

Deltoid

Latissimus dorsi

Gluteus maximus, quadriceps
gluteus maximus



Synergist in:

Chest Press

Overhead Press

Row

Squat

Hip extension

assist prime mover:

Anterior deltoid, triceps

Triceps

Posterior deltoid, biceps

hamstrings

hamstring and erector spinae



Stabilizer in:

Chest Press

Overhead Press

Row

Squat

Hip extension

Stabilize while primer mover and synergist work;

rotator cuff

rotator cuff

rotator cuff

transverse abdominis

transverse abdominis



Antagonist in:

Chest Press

Overhead Press

Row

Squat

Hip extension

Oppose prime mover:

Posterior deltoid

Latissimus dorsi

Pectoralis major

Psoas

psoas



When the neuromuscular system responds to stimulus it is called?

Motor Function



The combination and interrelation of nervous, skeletal and muscular systems is known as

...

THE KINETIC CHAIN

p. 16 (NASM)

Match the following terms of the nervous system with their respective functions:

1. Sensory function
2. Integrative function
3. Motor function

- A. Sense changes
- B. Respond to changes
- C. Analyze & interpret

1. SENSORY FUNCTION - sense changes in either the internal or external environment

2. INTEGRATIVE FUNCTION - analyze and interpret sensory information

3. MOTOR FUNCTION - neuromuscular response to sensory information

p. 16 (NASM)

The Central Nervous System (CNS) consists of ...

THE BRAIN & SPINAL CORD

p. 17 (NASM)

The Peripheral Nervous System consists of ...

CRANIAL/SPINAL NERVES AND SENSORY RECEPTORS

p. 17 (NASM)

It becomes important to train the nervous system efficiently to ensure that _____, which enhances performance and decreases the risk of injuries.

PROPER MOVEMENT PATTERNS ARE BEING DEVELOPED

p. 16 (NASM)

The function of the Peripheral Nervous System is to ...

- PROVIDE A CONNECTION FOR THE NERVOUS SYSTEM TO ACTIVATE DIFFERENT EFFECTOR SITES (e.g., muscles)

- RELAY INFORMATION FROM EFFECTOR SITES BACK TO THE BRAIN VIA SENSORY RECEPTORS

pp. 17, 19 (NASM)



What are the 3 main functions of the nervous system?

- SENSE CHANGES IN EITHER INTERNAL OR EXTERNAL ENVIRONMENT (SENSORY)

- ANALYZE & INTERPRET SENSORY INFORMATION (INTEGRATIVE)

- PROVIDE THE NEUROMUSCULAR RESPONSE TO THE SENSORY INFORMATION (MOTOR)

p. 16 (NASM)



Transmit nerve impulses from effector sites (e.g., hand) to the brain/spinal cord.
SENSORY (AFFERENT) NEURONS

p. 17 (NASM)



Transmit nerve impulses from one neuron to another.
INTERNEURONS

p. 17 (NASM)



Transmit nerve impulses from the brain/spinal cord to various effector sites (e.g., muscles, glands).

MOTOR (EFFECTOR) NEURONS

p. 17 (NASM)



Sensory receptors are specialized structures located throughout the body that are designed to transform _____ into _____ that the brain & spinal cord can then interpret to produce _____.

- ENVIRONMENTAL STIMULI (heat, light, sound, taste, motion)

- SENSORY INFORMATION

- A RESPONSE

There are 4 types of sensory receptors:

- mechano-receptors

- noci-receptors

- chemo-receptors

- photo-receptors

p. 19 (NASM)



Mechano-receptors are responsible for sensing _____ in body tissues.

DISTORTION

p. 19 (NASM)

What are the three types of mechano-receptors, and to what are they sensitive?

- MUSCLE SPINDLES: sense changes in muscle length and rate of length change

- GOLGI TENDON ORGANS (GTO): sense changes in tension and rate of tension change

- JOINT RECEPTORS: sense pressure and acceleration/deceleration of the joint
pp. 19-20 (NASM)

LOCATION:

Located in or around the joint capsule

JOINT RECEPTORS

p. 20 (NASM)

LOCATION:

Located where the muscle and tendon meet (musculotendinous junction)

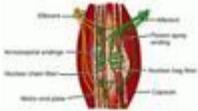


GOLGI TENDON ORGAN (GTO)

p. 19 (NASM)

LOCATION:

Are parallel to a muscle's fibers



MUSCLE SPINDLES

p. 19 (NASM)

If one system of the _____ is not working properly, it will affect the other systems and ultimately affect _____.

- KINETIC CHAIN

- MOVEMENT

p. 16 (NASM)

Name the parts of a neuron.



- CELL BODY
- AXON
- DENDRITES

p. 17 (NASM)



The framework for both structure and _____ is called:

- MOVEMENT
- SKELETAL SYSTEM

p. 21 (NASM)



Growth, maturation and functionality of the skeletal system are greatly affected by ...

- POSTURE
- ACTIVITY
- NUTRITION

p. 21 (NASM)



The _____ junction where 2 or more bones meet is called a ...

- MOVABLE
- JOINT

Movement occurs here as a result of muscle contraction.

p. 21 (NASM)



What causes movement at a joint?



MUSCLE CONTRACTION

p. 21 (NASM)



This consists of some 80 bones in the skull, rib cage and vertebral column.

AXIAL SKELETON

p. 22 (NASM)



This consists of some 126 bones in the upper/lower extremities as well as the shoulder and pelvic girdles.

APPENDICULAR SKELETON

p. 22 (NASM)





What does this image depict?

THE APPENDICULAR SKELETON

p. 22 (NASM)



How many joints are there in the body?

> 300

There are closer to 230 to 250 movable or semi-movable joints. This does not include non-movable joints in the skull.

p. 22 (NASM)



Why do bones have surface markings?

TO PROVIDE INCREASED STABILITY AND ATTACHMENT SITES FOR MUSCLES

There are 2 types of surface marking: depressions and processes.

p. 22 (NASM)



What is the purpose of bone depressions?

- PROVIDE SITES FOR ATTACHMENT OF MUSCLES (fossa)

- ALLOW SOFT TISSUE TO PASS THROUGH (sulcus)

Examples:

- Fossa - supraspinous and infraspinous fossa on the scapula (shoulder) - to attach the supraspinatus and infraspinatus muscles respectively

p. 22 (NASM)



What type of process is located above a condyle, such as in the humerus to form the elbow joint or in the femur to form the knee joint?



EPICONDYLE

p. 23 (NASM)



Condyles are _____ projections at a joint that usually articulate with a another bone, such as in ... (provide example)

- LARGE ROUNDED
- THE BOTTOM (INSIDE/OUTSIDE) OF THE FEMUR & TOP OF THE TIBIA TO FORM THE KNEE JOINT

p. 23 (NASM)



_____ are large rounded projections at a joint that usually articulate with another bones, such as in ... (provide example)



- CONDYLES
- THE BOTTOM (INSIDE/OUTSIDE) OF THE FEMUR & TOP OF THE TIBIA TO FORM THE KNEE JOINT

p. 23 (NASM)



These joint types comprise about 80% of all joints in the body, are most associated with movement, and have the greatest capacity for motion.



SYNOVIAL JOINTS

p. 25 (NASM)



What are the 3 major motion types?

- ROLL

- SLIDE

- SPIN

Arthrokinematics = joint motion

p. 24 (NASM)



What is arthrokinematics?

- JOINT MOTION

p. 24 (NASM)





During a squat, what major type of joint motion is exhibited as the femoral condyles move over the tibial condyles?

ROLL MOVEMENT

p. 24 (NASM)



During a knee extension, what major type of joint motion is exhibited as the tibial condyles move across the femoral condyles?

SLIDE MOVEMENT

p. 24 (NASM)



During pronation and supination of the forearm, what major type of joint motion is exhibited as the head of the radius moves on the end of the humerus?

SPIN MOVEMENT

p. 24 (NASM)



What type of joint is exhibited by the following?

- Simplest movement of all joints
- back & forth/side-to-side movement
- Example: carpals of the hand



GLIDING (plane) JOINT

Also see "The Anatomy Lesson" at <http://home.comcast.net/~wnor/>

p. 25 (NASM)



What type of joint is exhibited by the following?

- Fitting of the condyle of one bone into the elliptical cavity of another to form the joint
- Movement occurs mostly in 1 plane: flexion/extension in the sagittal plane
- Movement occurs minimally in the transverse plane (rotation) and frontal plane (adduction/abduction)
- Example: in the wrist between the radius and carpals and in the knee joint

CONDYLOID (ellipsoidal) JOINT

Also see "The Anatomy Lesson" at <http://home.comcast.net/~wnor/>

p. 25 (NASM)



What type of joint is exhibited by the following?

- uni-axial
- movement mostly in the sagittal plane
- Examples: elbow, ankle



HINGE JOINT

Also see "The Anatomy Lesson" at <http://home.comcast.net/~wnor/>

p. 26 (NASM)



What type of joint is exhibited by the following?

- an articulating bone straddling another
- movement mostly in 2 planes: sagittal plane (flexion/extension) and frontal plane

(adduction/abduction)

- Example: only found in the carometacarpal joint of the thumb



SADDLE JOINT

Also see "The Anatomy Lesson" at <http://home.comcast.net/~wnor/>

p. 26 (NASM)



What type of joint is exhibited by the following?

- movement mostly in one plane (transverse plane - rotation, pronation and supination)

- Example: radioulnar joint (at the elbow)



PIVOT JOINT

Also see "The Anatomy Lesson" at <http://home.comcast.net/~wnor/>

p. 26 (NASM)



What type of joint is exhibited by the following?

-movement in all 3 planes

- Examples: shoulder (humerus/scapula), hip



BALL & SOCKET JOINT

Also see "The Anatomy Lesson" at <http://home.comcast.net/~wnor/>

p. 26 (NASM)

What are the characteristics of a non-synovial joint? Give one example.

- IN THE UNITING STRUCTURE, THERE IS:

- * NO JOINT CAVITY
- * NO FIBROUS CONNECTIVE TISSUE
- * NO CARTILAGE

- EXHIBIT LITTLE OR NO MOVEMENT

EXAMPLES:

- SUTURES OF THE SKULL

- DISTAL JOINT OF THE TIBIA & FIBULA (ANKLE)

p. 26 (NASM)

_____ provide stability, allowing for movement to take place without unwanted movement.

JOINTS

p. 27 (NASM)

Why is it important that the fitness professional understands that one joint affects the motion of others?

- IT CREATES AWARENESS OF BODY FUNCTIONALITY

- IT IS THE PREMISE BEHIND KINETIC CHAIN MOVEMENT

- IT INFLUENCES FITNESS MOVEMENT ASSESSMENTS, DESIGNING FITNESS PROGRAMS, AND MONITORING EXERCISE TECHNIQUE

p. 27 (NASM)

WHAT IS THE PRIMARY CONNECTIVE TISSUE FOR A JOINT?

LIGAMENTS

p. 28 (NASM)

Joints _____ bones, provide _____ and input to _____, are made of _____ and _____.

- CONNECT

- DYNAMIC STABILITY

- NERVOUS SYSTEM

- COLLAGEN & ELASTIN

p. 28 (NASM)

Collagen fibers provide ligaments with the ability to ...

WITHSTAND TENSION

p. 28 (NASM)

Elastin gives a ligament some _____ to withstand

- FLEXIBILITY
- BENDING & TWISTING

p. 29 (NASM)



Ligaments are characterized by _____, which means that ligaments do not

- POOR VASCULARITY
- HEAL/REPAIR WELL

p. 29 (NASM)



The actual muscle itself is wrapped by an outer layer called _____ and an inner layer immediately surrounding the muscle called the _____.

- FASCIA
- EPIMYSIUM

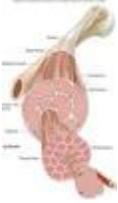
The fascia and epimysium are intimately connected with the bone and help to form the muscle's tendon.

p. 30 (NASM)



From the outermost layer surrounding each muscle to the innermost layer of tissue, place the following the correct order:

- Sarcolemma
- Epimysium
- Fascia
- Sarcoplasm
- Perimysium
- Fascicle
- Muscle fiber
- Endomysium
- Myofibril
- Sarcomere
- Muscle belly



1. FASCIA (outer layer surrounding entire muscle bundle)
2. EPIMYSIUM (immediately surrounds muscle belly)
3. MUSCLE BELLY
4. PERIMYSIUM (surrounds each fascicle)
5. FASCICLE (bundle of muscle fiber)
6. ENDOMYSIUM (surrounds individual muscle fibers)
7. MUSCLE FIBER
8. SARCOLEMMA (surrounds each individual muscle fiber)
9. SARCOPLASM
10. MYOFIBRIL
11. SARCOMMERE

See www.getbodysmart.com for more information.

p. 30 (NASM)



What role do tendons play in movement?

- ALLOW FORCES TO BE TRANSFERRED FROM MUSCLE TO BONE
- ATTACH MUSCLE TO BONE, PROVIDING ANCHORS FROM WHICH MUSCLES CAN CONTROL THE JOINT/BONE.

p. 31 (NASM)



Like ligaments, why are tendons susceptible to slow repair and adaptation?

POOR VASCULARITY (BLOOD SUPPLY)

p. 31 (NASM)



What is the function of the mitochondria?

TRANSFORM ENERGY FROM FOOD INTO ENERGY FOR CELLS

p. 31 (NASM)



Which are the actual contractile components of muscle tissue?

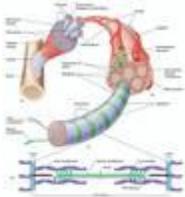


MYOFILAMENTS

p. 31 (NASM)



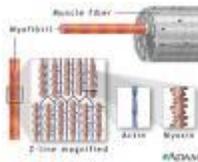
_____ and _____ form repeating sections within a myofibril called _____.



- ACTIN
- MYOSIN
- SARCOMERES

A sarcomere is the functional unit of the muscle, like the neuron is the functional unit for the nervous system.

p. 31 (NASM)

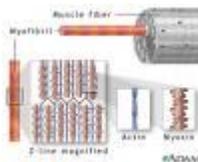


Two protein structures important to muscle contractions are _____ and _____. Located on the actin filament, _____ blocks myosin (thick filament) binding sites on the actin (thin) filament while the muscle is relaxed.

- TROPOMYOSIN (keeps muscles relaxed)
- TROPONIN (aids in/causes muscle contraction)

- TROPOMYOSIN

p. 31 (NASM)



Two protein structures important to muscle contractions are _____ and _____. Located on the actin filament, _____ provides binding

sites on the actin (thin) filament for both calcium and tropomyosin when a muscle needs to contract.

- TROPOMYOSIN (keeps muscles relaxed)
- TROPONIN (aids in/causes muscle contraction)

- TROPONIN
p. 32 (NASM)



What 3 methods are involved in muscle contraction?

- NEURAL ACTIVATION
- SLIDING FILAMENT THEORY
- EXCITATION-CONTRACTION-COUPLING MECHANISM

p. 32 (NASM)

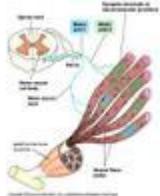


When a muscle contracts from neural stimulation, this is called ...
NEURAL ACTIVATION

p. 32 (NASM)

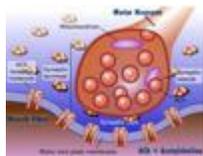


A motor neuron and all of the muscle fibers it stimulates is called a ...



MOTOR UNIT

p. 32 (NASM)

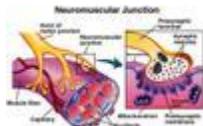


Existing as a small gap called a "synapse" at which a neuron meets an individual muscle fiber, the _____ is where neurotransmitters transmit electrical impulses from nerve to muscle.

NEUROMUSCULAR JUNCTION

These electrical impulses are called "action potentials."

p. 32 (NASM)



What happens at the neuromuscular junction?

NEUROTRANSMITTERS TRANSPORT ELECTRICAL IMPULSES FROM NERVE TO MUSCLE.

p. 32 (NASM)



Neurotransmitters are _____ that cross the neuromuscular junction (synapse), transporting _____ from the nerve to the muscle.

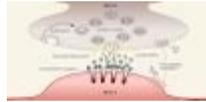
- CHEMICAL MESSENGERS

- ELECTRICAL IMPULSES

p. 32 (NASM)



What is the name of the neurotransmitter used by the neuromuscular system to stimulate muscle fibers to produce contractions?



ACETYLCHOLINE (ACh)

p. 32 (NASM)



A protein that forms the thin filaments is called ...

ACTIN

p. 31 (NASM)



A protein that forms the thick filaments is called ...

MYOSIN

p. 31 (NASM)



What is the functional unit of the muscle that produces contractions, consisting of repeating sections of actin and myosin?

SARCOMERE

p. 31 (NASM)



A protein that binds oxygen in muscle allowing for improved oxygen delivery is called ...

MYOGLOBIN

p. 33 (NASM)



What is the following muscle fiber type:

- slow twitch

- higher # of capillaries, mitochondria, and myoglobin

- often referred to as "red fibers"

- less force produced

- slow to fatigue

- used for aerobic activity

- long-term contractions (stabilization)

TYPE I

Type I, slow oxidative, slow twitch, or "red" muscle is dense with capillaries and is rich in mitochondria and myoglobin, giving the muscle tissue its characteristic red color. It can carry more oxygen and sustain aerobic activity.

From <http://en.wikipedia.org/wiki/Muscle>

p. 33 (NASM)



What is the following muscle fiber type:

- fast twitch
- larger in size
- often referred to as "white fibers"
- quick to fatigue
- produce more force
- short-term contractions (force & power)

TYPE II

Type II is further broken down into 3 sub-categories:

- Type IIa
- Type IIx (or IId)
- Type IIb

Type II, fast twitch muscle, has three major kinds that are, in order of increasing contractile speed:

* Type IIa, which, like slow muscle, is aerobic, rich in mitochondria and capillaries and appears red.

* Type IIx (also known as type IId), which is less dense in mitochondria and myoglobin. This is the fastest muscle type in humans. It can contract more quickly and with a greater amount of force than oxidative muscle, but can sustain only short, anaerobic bursts of activity before muscle contraction becomes painful (often incorrectly attributed to a build-up of lactic acid). N.B. in some books and articles this muscle in humans was, confusingly, called type IIB.

* Type IIb, which is anaerobic, glycolytic, "white" muscle that is even less dense in mitochondria and myoglobin. In small animals like rodents this is the major fast muscle type, explaining the pale color of their flesh.

From <http://en.wikipedia.org/wiki/Muscle>

p. 33 (NASM)



Which muscle type functions as a prime mover?

AGONIST

For an agonist to be effective as a mover in the skeletal system it must actually cross one or more structure(s) that can move. This is typically where the muscle crosses a joint by way of a connecting tendon. As the myofibrils of a muscle are excited into action and then contract, they will create tension and pull through the tendon and pulling the lever arm of bone on the opposite side of the joint closer to the muscles origin.

from [http://en.wikipedia.org/wiki/Agonist_\(muscle\)](http://en.wikipedia.org/wiki/Agonist_(muscle))

p. 35 (NASM)



An agonist acts as a ...

PRIME MOVER

For an agonist to be effective as a mover in the skeletal system it must actually cross one or more structure(s) that can move. This is typically where the muscle crosses a joint by way of a connecting tendon. As the myofibrils of a muscle are excited into action and then contract, they will create tension and pull through the tendon and pulling the lever arm of bone on the opposite side of the joint closer to the muscles origin.

from [http://en.wikipedia.org/wiki/Agonist_\(muscle\)](http://en.wikipedia.org/wiki/Agonist_(muscle))

p. 35 (NASM)



A synergist acts as to ...

ASSIST A PRIMER MOVER

Synergist is a kind of muscle which performs, or assist in performing, the same set of joint motion as the agonists. Synergists are muscles that act on movable joints . Synergists are sometimes referred to as "neutralizers" because they help cancel out, or neutralize, extra motion from the agonists to make sure that the force generated works within the desired plane of motion.

from <http://en.wikipedia.org/wiki/Synergist>

p. 35 (NASM)



Which muscle type functions to assist a prime mover?

SYNERGIST

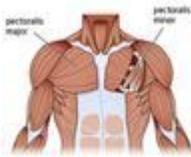
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from <http://en.wikipedia.org/wiki/Synergist>

p. 35 (NASM)



During a chest press, which muscle acts as a prime mover?



PECTORALIS MAJOR

p. 35 (NASM)



During the squat, which muscle acts as the synergist?



HAMSTRINGS

p. 35 (NASM)



During the overhead press, which muscle acts as a stabilizer?

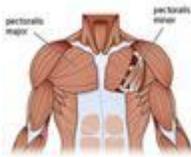


TRANSVERSUS ABDOMINIS

p. 35 (NASM)



During the row, which muscle acts as the antagonist?



PECTORALIS MAJOR

p. 35 (NASM)



During the chest press, name which muscles act as:

- Agonist
- Synergist
- Stabilizer
- Antagonist

Agonist - PECTORALIS MAJOR

Synergist - ANTERIOR DELTOID, TRICEPS

Stabilizer - ROTATOR CUFF

Antagonist - POSTERIOR DELTOID

p. 35 (NASM)

During the overhead press, name which muscles act as:

- Agonist
- Synergist
- Stabilizer
- Antagonist

Agonist - DELTOID

Synergist - TRICEPS

Stabilizer - ROTATOR CUFF

Antagonist - LATISSIMUS DORSI

p. 35 (NASM)

During the row, name which muscles act as:

- Agonist
- Synergist
- Stabilizer
- Antagonist

Agonist - LATISSIMUS DORSI

Synergist - POSTERIOR DELTOID, BICEPS

Stabilizer - ROTATOR CUFF

Antagonist - PECTORALIS MAJOR

p. 35 (NASM)

During the squat, name which muscles act as:

- Agonist
- Synergist
- Stabilizer
- Antagonist

Agonist - GLUTEUS MAXIMUS, QUADRICEPS

Synergist - HAMSTRINGS

Stabilizer - TRANSVERSUS ABDOMINIS

Antagonist - PSOAS

p. 35 (NASM)

Which muscle type functions to support while agonist and synergist work?

STABILIZERS

- Chest press: rotator cuff
- Overhead press: rotator cuff
- Row: rotator cuff
- Squat: transversus abdominis

p. 35 (NASM)

Which muscle type functions to oppose the prime mover?

ANTAGONIST

- Chest press: posterior deltoid
- Overhead press: latissimus dorsi
- Row: pectoralis major
- Squat: psoas

p. 35 (NASM)



A stabilizer acts to ...

SUPPORT WHILE AGONIST AND SYNERGIST WORK

The muscles that stabilize one joint so a desired movement can be performed in another joint.

<http://exercise.about.com/library/Glossary/More%20Definitions%202/bldef-stabilizers.htm>

p. 35 (NASM)



An antagonist acts to ...

OPPOSE THE PRIME MOVER

An "antagonist" is a classification used to describe a muscle that acts in opposition to the specific movement generated by the agonist and is responsible for returning a limb to its initial position.

[http://en.wikipedia.org/wiki/Antagonist_\(muscle\)](http://en.wikipedia.org/wiki/Antagonist_(muscle))

p. 35 (NASM)



What is the functional unit of the muscle that produces contraction, consisting of repeating sections of actin and myosin?

SARCOMERE

p. (NASM)



What is the protein that forms thin filaments within each segment of sarcomere?

ACTIN

p. (NASM)



What is the protein that forms thick filaments within each segment of sarcomere?

MYOSIN

p. (NASM)

In humans what are the components that make up the human movement system?

1. nervous system
2. skeletal system

3. muscular system



Kinetic chain:

the combination and interrelation of the nervous, muscular, and skeletal systems.



nervous system:

the communication network within the body.

- consist of billions of cells

- central command center that allows us to gather info. about our internal and external environments, process and interpret the info. and then responds to it.



what are the 3 primary functions of the nervous system?

1. sensory function

2. integrative function

3. motor function



sensory function:

the ability of the nervous system to sense change in either the internal or external environment.

ex:

- stretch placed on a muscle

- change from walking on the sidewalk to walking on sand.



integrative function:

the ability of the nervous system to analyze and interpret sensory info. to allow for proper decision making, which produces the appropriate response.



motor function

the neuromuscular (nervous & muscular system) response to the sensory info.

- causes muscle to initially contract when stretched

- changing walking patterns on different surfaces...

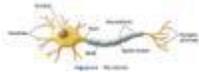


all movement is directly dictated by what system?

nervous system



neuron



the functional unit of the nervous system



what are the three main parts that a neuron is composed of?

1. the cell body (soma)

2. axon

3. dendrites



what does the soma (cell body) contain?

a nucleus and other organelles such as lysosomes, mitochondria, and a golgi complex



what are axons?

- cylindrical projection from the cell body that transmits nervous impulses to other neurons or effector sites (muscles, organs, and other neurons)

- provides communication from the brain and spinal cord to other parts of the body



what are dendrites?

responsible for gathering info. from other structures back into the neuron.



sensory (afferent) neurons:

transmit nerve impulses from effector sites (such as muscles or organs) to the brain or spinal cord.



interneurons:

transmit nerve impulses from one neuron to another.



motor (efferent) neurons:

transmit nerve impulses from the brain and spinal cord to effector sites (such as muscles or glands)



central nervous system:



composed of the brain and spinal cord

- serves mainly to interpret info.

☐

peripheral nervous system:

consist of cranial and spinal nerves that branch/ spread throughout the body.

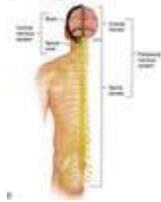
- provide a connection for the nervous system to activate different effector sites such as muscles (motor function)

- relay info. from the effector sites back to the brain via sensory receptors (sensory function)

providing constant updates on the relationship between the body and the environment.

☐

peripheral nervous system:



☐

sensory receptors:

specialized structures located throughout the body that are designed to transform environmental stimuli (heat, light, sound, taste, motion) into sensory info.

☐

4 major categories of sensory receptors and their response:

1. mechanoreceptors

- respond to mechanical force (touch pressure)

2. Nociceptors:

- respond to pain (pain receptors)

3. chemoreceptors:

- respond to chemical interaction (smell and taste)

4. Photoreceptors:

- respond to light (vision)

☐

Muscles spindles:

receptors sensitive to change in length of the muscle and the rate of the change.

- major organ of the muscles

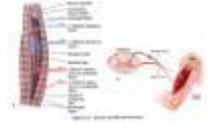
- sits parallel to the muscle's fibers

- sensitive to change in length and rate of length change

- prevents muscles from stretching too far or too fast (avoid injury)



picture of muscle spindle:



Golgi tendon organs (GTO):

receptors sensitive to change in tension of the muscle and the rate of that change.

- located where the muscle and tendon meet and are sensitive to changes in muscular tension and rate of the tension change

- will cause muscles to relax when excited.

- prevent muscles from being placed under excessive stress and sustaining injury.



Golgi tendon organs (GTO):



Joint receptors:

receptors that respond to pressure, acceleration, and deceleration in the joints.

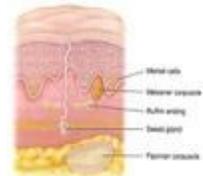
- located around the joint capsule

- act to signal extreme joint positions and thus help to prevent injury

- act to initiate a reflexive inhibitory response in the surrounding muscles if there is too much stress placed on the joint.



joint receptors:

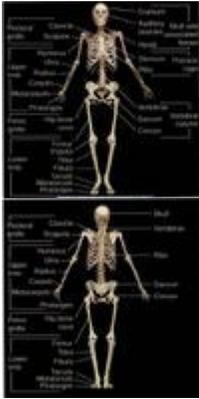


skeletal system:

the body's framework, composed of bones and joints.

- framework for outer structure and movements

- resting ground for the muscles of our body



bones:

provide a resting ground for muscles and protection of vital organs.



joints:

the movable junction where two or more bones meet.

- site where movement occurs as a result of muscle contraction.



axial skeleton:

portion of the skeletal system that consist of the skull, rib cage, and vertebral column.

- aprox. 80 bones.



appendicular skeleton:

portion of the skeleton system that includes the upper and lower extremities.

- approx. 126 bones



how many bones in the body?

roughly 206 bones.



how many joints in the body

more than 300.



what are the two main functions bones provide?

1. leverage:

act and perform as levers when acted on by muscles

2. provide support:

this translates into posture, which is necessary for the efficient distribution of forces acting on the body.



depressions:

flattened or indented portion of bone, which can be a muscle attachment site



fossa:



a common depression



sulcus

[suhl-kuhs



another form of a depression.

- a groove in a bone that allows soft tissue to pass through.



Process:

projection protruding from the bone where muscles, tendons, and ligaments can attach.



most common processes are?

- process

- condyle

- epicondyle

- tubercle [too-ber-kuhl]

- trochanters [troh-kan-ter]





trochanters [troh-kan-ter]

located at the top of the femur and are attachment sites for the hip musculature

greater trochanter = "hipbone"

how are joints formed?

by one bone that articulates with another bone.

arthrokinematics

joint movement

what are the three major motion types?

- roll

- slide

- spin

describe roll motion?



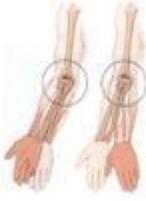
one joint rolls across the surface of another

describe slide motion?



one joint slides across the surface of another

describe spin motion?



one joint surface rotates on another



synovial joints:

joints that are held together by a joint capsule and ligaments and are more associated with movement in the body.

- produce synovial fluid which lubricates joint surfaces to reduce excessive wear and to nourish the cartilage cells



what are the several types of synovial joints?

- gliding (plane)

- Condylloid (condylar or ellipsoidal)

- hinge

- saddle

- pivot

- ball and socket



gliding joint?

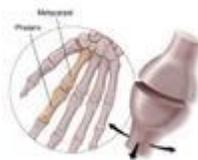


a nonaxial joint that has the simplest movement of all joints

- moves either back and forth or side to side.



Condylloid (condylar or ellipsoidal joint):

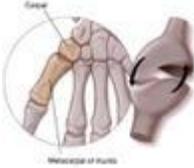


called because the condyle of one bone fits into the elliptical cavity of another bone to form joint.

- movement predominately occurs in one plane (flexion and extension in the sagittal plane) with minimal movement in the others.



saddle joint:



- only found in the carpometacarpal joint in the thumb

- allows movement predominantly in 2 planes of motion (flexion & extension in the sagittal plane; adduction and abduction in the frontal plane)



Pivot joint:



- allows movement predominantly in one plane of motion (rotation, pronation, supination in the transverse plane)

- found in the atlantoaxial joint at the base of the skull (top of spine) and between radius and ulna joint.



ball and socket joint:



- most mobile joint

- allow movement in all 3 planes

ex:

shoulder

hips



what are some functions of joints?

- joints provide the bones a means to be manipulated, allowing for movement throughout segments of the body.

- provide stability, allowing for movement to take place without unwanted movement

- all joints are linked together meaning that movement of one joint directly affects movement of the others.



nonsynovial joints:



- have no joint cavity, fibrous connective tissue, or cartilage in the uniting structure.

- can be structured in either a fibrous/cartilaginous manner

- exhibit little/ no movement.

ex:

- sutures of the skull

- distal joint of tibia & fibula

- symphysis pubis



ligaments:



- primary connective tissue that connects bone together and provides stability, input to the nervous system, guidance, and the limitation of improper joint movement.



what are ligaments made out of?

- primarily collagen and elastin (protein)



collagen fibers:

situated in a more parallel fashion providing ligaments to withstand tension.



elastin fibers:

gives ligaments some flexibility to withstand bending and twisting



ligaments are characterized by poor vascularity (or blood supply), they do not heal or repair very well and may be slower to adapt.

skeletal system:

body's framework and is made up of bone and joints in two divisions:

- axial

- appendicular

4 main types of bone?

- long

- short

- flat

- irregular

(all have markings of depressions/ processes)

how are bones connected?

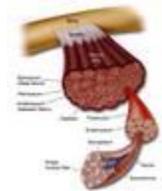
(via ligaments) by either synovial/ nonsynovial joints which provide movement as well as stability

muscular system:

series of muscles that moves the skeleton.

muscles are the _____ & _____ of our body
movers, stabilizers

structure of the skeletal muscle



what does connective tissues within muscle allow?

- allow the forces generated by the muscle to be transmitted from the contractive components of the muscle to the bones. (creating motion)

tendons:

connective tissues that attach muscle to bone and provide an anchor for muscles to produce force.

action potentials:

electrical impulses which are transported from the central nervous system down the axon of the neuron



neurotransmitter:

chemical messengers that cross synapses to transmit electrical impulses from the nerve to the muscle.

- activate a series of steps that produce muscle contraction.



sliding filament theory:



Excitation-contraction coupling:

the process of neural stimulation creating muscle contraction.



what are the main group of muscle fibers?

- type I (slow twitch)

- type II (fast twitch)

- type IIa

- type IIb



type I muscle fibers?

- slow twitch

- contain a high # of capillaires, mitochondria, and myoglobin (allows for improved delivery of oxygen)

- often referd to as red fibers

- smaller in size (diameter)

- slower to produce maximal tension and more resistant to fatigue

- important for muscles producing long-term contractions necessary for stabilization and postural control.



type II muscle fibers:

- fast twitch

- genreally contaill fewer capillaries, mitochondria, and myoglobin

- often referred to as white fibers
- larger in size
- quick to produce maximal tension, and fatigue more quickly
- important for muscle producing movements requiring force and power such as performing a sprint.



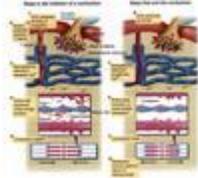
type IIa:
higher oxidative capacity and fatigue slower.



type IIb:
- low oxidative capacity and fatigue quickly



steps in the initial contraction and at the end:



Speed	Force	Endurance
Fast	High	Low
Slow	Low	High



agonist muscles:
muscles that act as prime movers
(they are muscles most responsible for a particular movement)



synergist muscle:
assist prime movers during movement

ex:
hamstring and erector spinae with gluteus max. during hip extension.



stabilizer muscles:
support/ stabilize the body while the prime movers and synergists perform movement patterns.

ex:

transversus abdominis, internal oblique, multifidus (deep back muscle) during hip extension.



antagonist muscle:

perform opposite action of the prime mover.

ex:

psoas (deep hip flexor) to gluteus max. during hip extension.