BACK TO BASICS:  
FUNCTIONAL KINESIOLOGY REVIEW

MIOTA CONFERENCE  
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Objectives:

1. Define Kinesiology.

2. Identify and understand the anatomical/structural, physiological/chemical, and psychological/emotional components of the Kinesiology Triad.

3. Understand and describe the role of biomechanics and the sensorimotor system in motor learning.

4. Apply the information learned to enhance clinical practice and understanding of how the skeletal muscle, integumentary, and neurological systems interact with one another through the practice of kinesiology in order to influence a patient’s functional, behavioral, and emotional responses to occupational therapy treatment.
Kinesiology: definition?
Kinesiology: The study of skeletal muscle and movement patterns?
Kinesiology:
The study of skeletal muscle movement to improve postural control and athletic performance?
Kinesiology:

The study of functional movement patterns needed for normal development and daily function?
Kinesiology: the true definition...

A complex triad of Anatomical, Physiological, & Psychological components that work together to impact functional movement

Harmony, Hitchin
Kinesiology Triad: ANATOMICAL / STRUCTURAL
Tissues of the body:

ANATOMICAL/STRUCTURAL COMPONENTS OF THE KINESIOLOGY TRIAD
1. Epithelial
2. Muscle
3. Nervous
4. Connective

A. Loose Connective
B. Bone
C. Cartilage
D. Blood

Four Basic Tissue Categories
Muscle tissues:

**Striated**: Can see alternative light and dark markings from the actin and myosin fibers

**Non-striated**: markings are not visible

**Voluntary**: You **CAN** control by conscious effort

**Involuntary**: YOU **CANNOT** control
Skeletal Muscle:

ANATOMICAL/STRUCTURAL COMPONENTS OF THE KINESIOLOGY TRIAD
Tendon
Fibrous connective tissue
Attaches muscle to bone

Fascia
Continuation of the tendon
Covers and separates muscles

Fascicle
A bundle of muscle fibers
Muscle fiber/cell
Has many bundles *myofibrils*

Myofibril
a bundle *myofilaments*

Myofilaments
chains of contractile proteins *Actin & Myosin*
Function of Skeletal Muscle:

1. Movement
2. Posture
3. Heat Production
**Terminology:**

**Origin:**
fixed end of the muscle; the attachment on the bone that **does not move.**

**Insertion:**
site of attachment of the muscle on the bone that **moves.**
**Terminology:**

**Prime mover/Agonist:**
primary muscle responsible for a movement

**Antagonist:**
performs the opposite action as the prime mover; can resist actions of the primary mover

**Synergist:**
muscle(s) that assists or helps
Phases of Movement:

1. Preparation
2. Initiation
3. Action
4. Follow through
Skeletal Joints:

ANATOMICAL/STRUCTURAL COMPONENTS OF THE KINESIOLOGY TRIAD
Skeletal Joints: articulation

An *articulation* is a joint or juncture between bones; includes the cartilage on the bones.

This juncture **allows** bone growth and **movement**
## Joint Classifications

<table>
<thead>
<tr>
<th>MOVEMENT</th>
<th>STRUCTURE</th>
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</thead>
<tbody>
<tr>
<td>1. <strong>Synarthrotic</strong> – NO movement</td>
<td>1. <strong>Fibrous</strong>: i.e. Skull sutures</td>
</tr>
<tr>
<td>2. <strong>Amphiarthrotic</strong> – Limited movement</td>
<td>2. <strong>Cartilaginous</strong>: i.e. pubic symphysis</td>
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<tr>
<td>3. <strong>Diarthrotic</strong> – Freely moveable</td>
<td>3. <strong>Synovial</strong>: i.e. shoulder joint</td>
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</table>
Types of Synovial Joints

Ball & socket

Saddle

Pivot

Condylar

Plane

Hinge
Levers:

HOW CENTER OF GRAVITY IMPACTS SKELETAL MUSCLE MOVEMENT
Levers: 4 basic components

1. Rigid bar (bone)
2. Fulcrum / pivot point where the bar turns (joint)
3. Object moved against resistance (muscle)
4. Energy force to move the bar (ATP)
Levers: 1\textsuperscript{st} Class

Examples:

a. Scissors
b. Seesaw
c. Hemostat

\textbf{Resistance}>\textbf{Fulcrum}>\textbf{Force}
Levers: 2nd class

Example:
wheelbarrow

Fulcrum > Resistance > Force
Levers: 3rd class

Examples
a. Eyebrow tweezers
b. Forceps

Resistance>Force>Fulcrum
Body Planes:

SKELETAL MUSCLE MOVEMENT THROUGH THE X3 PLANES
BODY PLANES:

1. Sagittal
2. Transverse
3. Frontal
Coronal
**X3 BODY PLANES:**

- **Sagittal**: Right & left portions
- **Coronal/Frontal**: Anterior & Posterior
- **Transverse**: Superior & inferior
Connective Tissues:

ANATOMICAL/STRUCTURAL COMPONENTS OF THE KINESIOLOGY TRIAD
CONNECTIVE Tissues:

1. Bone
2. Blood
3. Cartilage
4. Fibrous Connective Tissue
5. Adipose
**Collagen**: a *fibrous protein* that gives tissues **strength**

<table>
<thead>
<tr>
<th>Found In...</th>
<th>Also Found In...</th>
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<tbody>
<tr>
<td><strong>Dense Regular Connective Tissue</strong></td>
<td></td>
</tr>
<tr>
<td>✓ Ligaments</td>
<td>✓ Dermis</td>
</tr>
<tr>
<td>✓ Tendons</td>
<td></td>
</tr>
<tr>
<td>✓ Bone</td>
<td></td>
</tr>
<tr>
<td><strong>Dense Irregular Connective Tissue</strong></td>
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</tbody>
</table>
Integumentary System: Dermis

ANATOMICAL/STRUCTURAL COMPONENTS OF THE KINESIOLOGY TRIAD
Epidermis is the outermost layer of stratified squamous epithelium

Dermis is the thick inner layer of fibrous connective tissue

Subcutaneous layer is layer of areolar & adipose below the dermis; also called the hypodermis; not part of skin
The dermis: dense irregular connective tissue with elastin and collagen. Referred to as the “True skin”.

It contains:

- Receptors
- Nerves
- Blood vessels
- Muscle fibers & smooth muscle
- Oil and sweat Glands
- Hair roots and follicles
The dermis:

Nerves

Nerves send impulses in response to:

• temperature changes
• pain
• pressure
• touch
Kinesiology Triad:
PHYSIOLOGICAL / CHEMICAL
Q: Which neurotransmitter is responsible for skeletal muscle contraction?

A: ACETYLCHOLINE
Neurological Control:

PHYSIOLOGICAL/CHEMICAL COMPONENTS OF THE KINESIOLOGY TRIAD
Basal Ganglia (a.k.a. Basal Nuclei)

Interacts with other brain areas including the motor cortex, thalamus, and cerebellum to **facilitate voluntary movement**

- Filters out unwanted muscle activity
- Controls repetitive movement
- Maintains posture
- Produces dopamine
Cerebellum:

Integrates sensory information about areas of muscle memory including:

✓ position of body parts,
✓ posture, and
✓ voluntary muscle coordination
Midbrain (brainstem): Cerebral Peduncles:

x2 prominent bundles of nerve fibers on the underside of the midbrain.

They are the main motor pathways between the cerebrum and the lower parts of the nervous system.
Occipital Lobe: Visual Nerve Pathway

- Eye
- Fibers from nasal (medial) half of each retina crossing over
- Optic chiasma
- Optic tract
- Lateral geniculate body of thalamus
- Optic radiations
- Visual cortex of occipital lobe

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Stereoscopic Vision

- Provides perception of distance and depth
- Results from formation of two slightly different retinal images

![Stereoscopic Vision Diagram](Image)
Receptors:

PHYSIOLOGICAL/CHEMICAL COMPONENTS OF THE KINESIOLOGY TRIAD
Mechanoreceptors

A. Stretch receptors in the muscles and lungs

B. Baroreceptors (a.k.a. pressoreceptors) detect changes in blood pressure (BP)

C. Proprioceptors sense changes in tension in the muscles & tendons
Mechanoreceptors

- Provides biofeedback after detecting a change that deforms the receptor itself
  - A. Golgi tendon organ
  - B. Muscle spindle
  - C. Pacinian corpuscles
The dermis: Mechanoreceptors

1. **Pacinian corpuscles**
   - Lie deep within the dermis and detect pressure

2. **Meissner corpuscles**
   - Lie very close to the dermal papillae and detect light touch
Spinal tracts: carry information to and from the Central Nervous System (CNS)
Sensory [afferent] neurons

1. Bring sensory impulses to the CNS
2. Dendrites or specialized structures act as sensory receptors
3. Detect changes in the environment including detecting temperature, pain, touch, pressure, vision, hearing....
Motor [efferent] neurons

1. Take motor impulses from the CNS
2. Carry impulse to effectors [muscles and glands]
3. Respond to changes in the environment that are detected by sensory receptors
Reflexes:

Protective, automatic responses to change (stimuli) coming from inside or outside the body
Structure of a 3-neuron reflex arc

“Withdrawal Reflex”
Structure of the Simple Reflex arc: “monosynaptic”
Structure of the Cross Extensor Reflex Arc: 
“contralateral”
Kinesiology Triad: PSYCHOLOGICAL / EMOTIONAL
Age-Related Changes
Aging muscles:

**40’s**
- ATP, creatine phosphate & myoglobin start to decrease
- Muscles become drier, smaller, & weaker
- Connective tissue & adipose take the place of some muscle tissue

**80’s**
- Nearly 50% of muscle has atrophied
- Strength is significantly decreased
- Muscle reflexes slow down significantly
Age-related changes in Joints:

- **Stiff joints vs exercise**
- **Fibrous joints** strengthen over time
- **Cartilaginous joints:**
  - Epiphyseal (growth) plate disappears by age 25 (when growing stops)
  - Ligaments lose elasticity > stiff muscles and joints
  - Symphysis joints in Vertebrae become dehydrated & loses movement; discs “slip” or collapse, causing elderly persons’ height to decrease, spinal stiffness, and loss of ROM
- **Synovial Joints:**
  - Slow progression of loss, beginning in 30’s
  - Fewer capillaries = slower circulation of synovial fluid... joints stiffen, which leads to falls
Activity & Exercise = prolonged use of joints

Lack of activity & exercise = stiff joints

Disuse decreases nutrient supply to joints, which lead to more stiffness

More stiffness leads to less desire to be active or exercise

...and so on, and so on, and so on...
References:


