

the **BAD** series

basic academics for dance

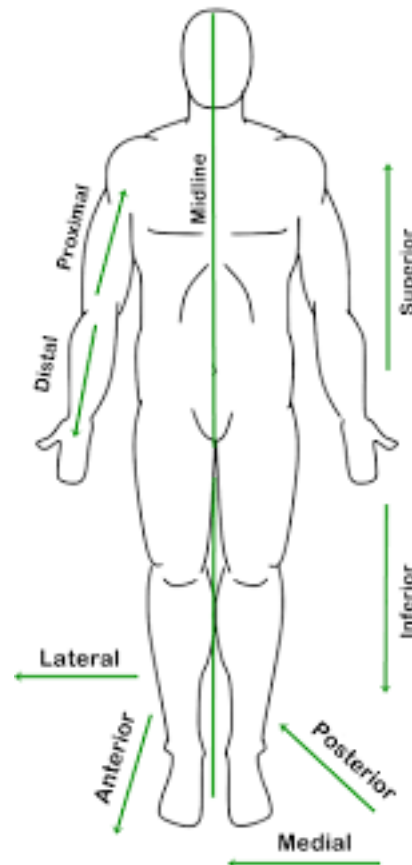
*Created by:  
Larisa Grohema*

# GLASS HOUSE DANCE

**BIOMECHANICS & KINESIOLOGY  
(FOR DANCERS)**

the **BAD** series  
basic academics for dance

# **ANATOMICAL TERMINOLOGY:**



→ **TERMS OF DIRECTION**

→ **TERMS OF MOTION**

→ **CONNECTIVE TISSUES**

→ **CARTILAGE**

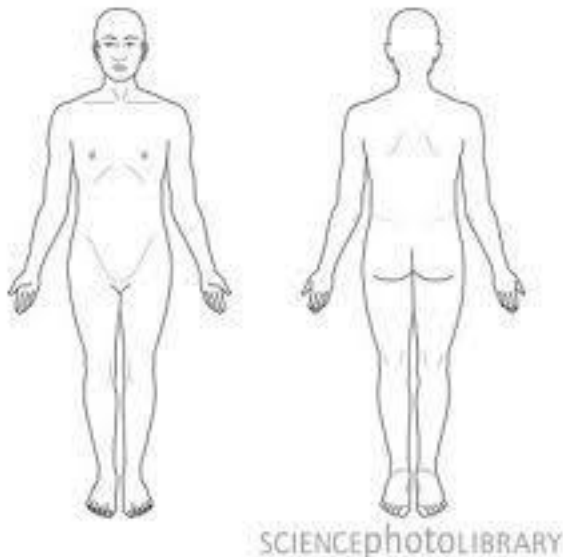
## ANATOMICAL TERMINOLOGY

**KINESIOLOGY** is the study of \_\_\_\_\_ and \_\_\_\_\_.

Kinesiology brings together the fields of anatomy, physiology, physics and geometry and relates them to human movement. Thus Kinesiology utilizes principles of mechanics, musculoskeletal anatomy and neuromuscular physiology.

The term \_\_\_\_\_ is frequently used interchangeably with Kinesiology. The differences between the two terms are based simply on research focus.

Mechanics is the branch of physics dealing with the study of forces and the motion produced by their actions. Biomechanics involves taking the principles and methods of mechanics and applying them to the structure and function of the human body.



\_\_\_\_\_ will be our point of reference when referring to terms of direction & motion.

We can use anatomical terminology for describing the

bodies \_\_\_\_\_,

\_\_\_\_\_ and

\_\_\_\_\_.

## TERMS OF DIRECTION

Superior: UP/ABOVE

Deep: DEEP/FARTHER FROM SURFACE

Inferior: \_\_\_\_\_

Superficial: \_\_\_\_\_  
(muscles usually)

Anterior: FRONT/FORWARDS  
Posterior: BACK/BACKWARDS

Plantar Surface: SOLES OF FEET  
Palmar Surface: PALMS OF HANDS

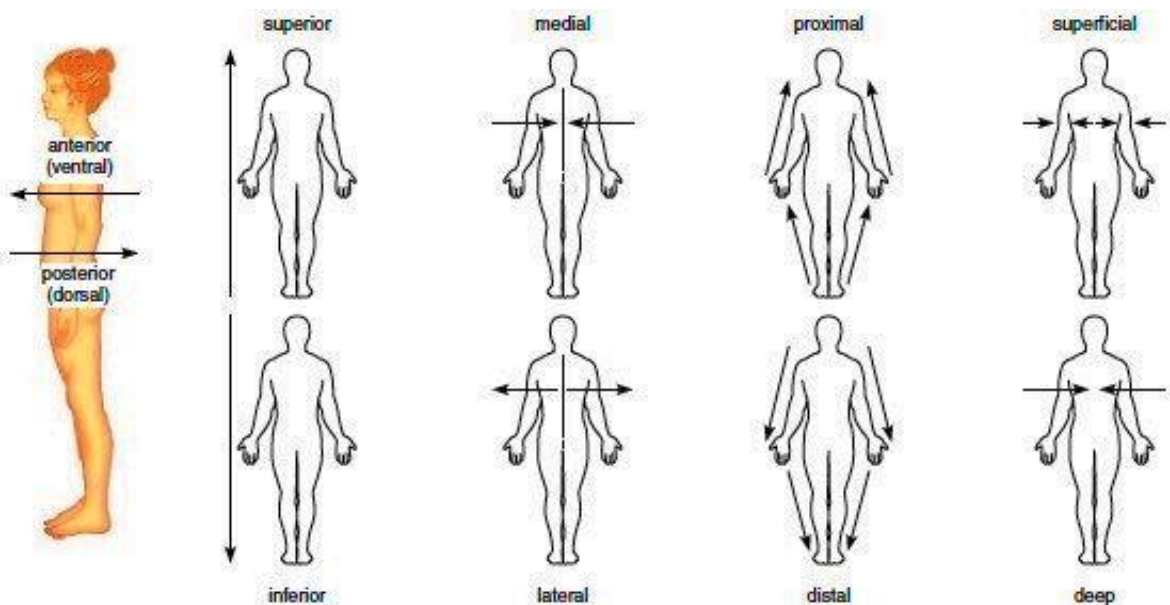
Medial: CLOSER TO THE MIDLINE

Prone Position: LYING FACE DOWN  
Supine Position: LYING FACE UP

Lateral: \_\_\_\_\_

Proximal: CLOSER TO THE TRUNK  
Distal: FARTHER AWAY FROM THE TRUNK (limbs usually/root of limb)

Ipsilateral: \_\_\_\_\_  
Contralateral: ON OPPOSITE SIDES



## TERMS OF MOTION/MOVEMENT



Flexion: TO BEND/BONES ARE BROUGHT CLOSER TOGETHER.  
Extension: TO RETURN FROM FLEXION TO ANATOMICAL POSITION.

Abduction: TO TAKE AWAY FROM THE MIDLINE.  
Adduction:

---

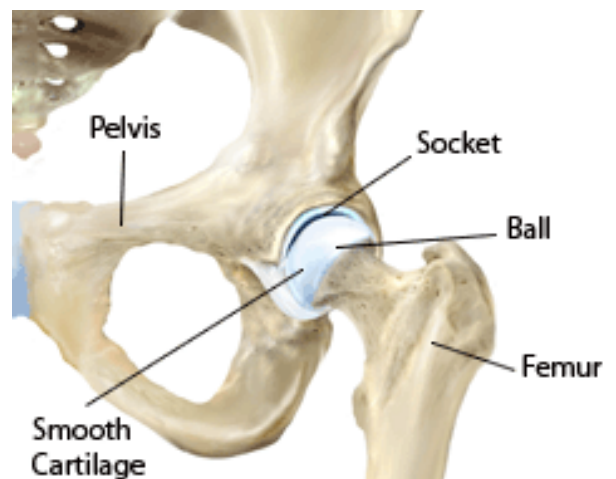
Rotation: BONES ROTATE AROUND AN AXIS. (BALL & SOCKET JOINTS).

Examples: \_\_\_\_\_ &

\_\_\_\_\_

Medial: INWARD

Lateral: OUTWARD

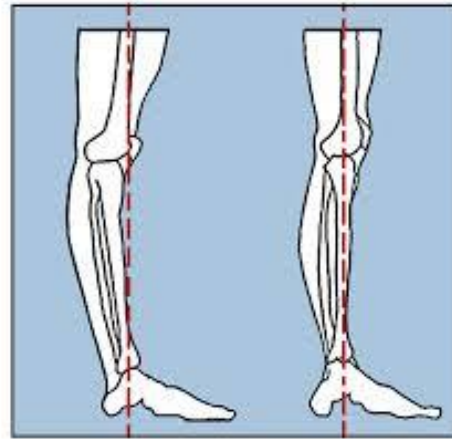


Dorsiflexion: TO FLEX (WRISTS & FEET/TOES & FINGERS)

Plantar Flexion: POINTING THE FEET/RELEVÉ.

Lateral Flexion: SIDE BEND.

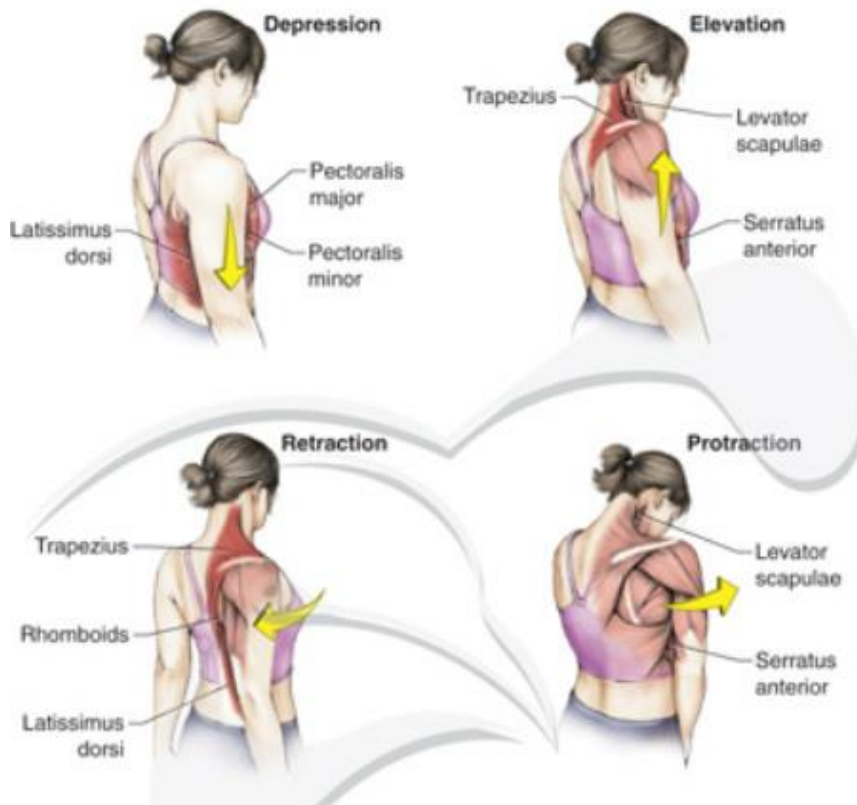
Hyperextension: \_\_\_\_\_



Pronation: ROLLING THE FOOT IN

Supination: \_\_\_\_\_

### SCAPULAR MOTIONS



## CONNECTIVE TISSUES

→ Function is to bind, support, insulate and protect structures.  
(includes bone)

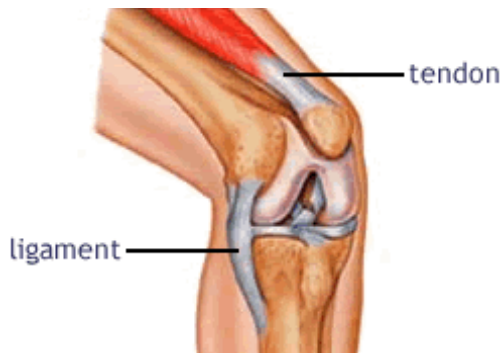
Connective Tissues Include:

1. **TENDONS**
2. **LIGAMENTS**
3. **CARTILAGE**
4. FASCIA
5. BONE

Types of Connective Tissue:

1. LOOSE CONNECTIVE TISSUE
2. **DENSE CONNECTIVE TISSUE**
3. **CARTILAGE**
4. BONE
5. LIQUID

### TENDONS VS LIGAMENTS:



**Tendons attach \_\_\_\_\_ to**

\_\_\_\_\_.

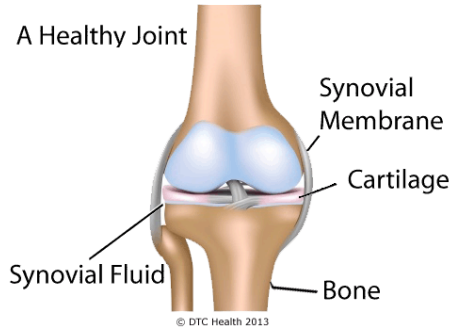
**Ligaments attach \_\_\_\_\_ to**

\_\_\_\_\_ and form joints.

\_\_\_\_\_ : Collagen and elastic fibers that can endure more stress than tendons and ligaments.

### 3 TYPES OF CARTILAGE:

#### **HYALINE CARTILAGE**

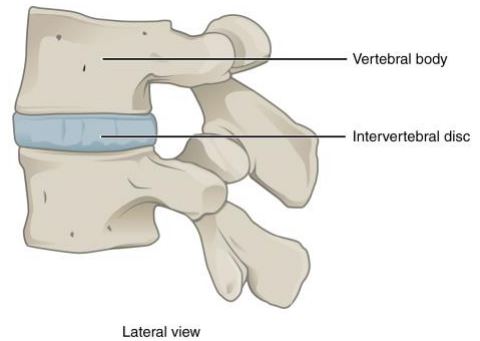


→ Most abundant in the body

→ At \_\_\_\_\_; reduces friction and absorbs shock

#### **FIBROCARTILAGE**

→ \_\_\_\_\_ type of cartilage  
→ *Ex: Intervertebral discs*



#### **ELASTIC**



→ Maintains the \_\_\_\_\_ of certain structures.

→ *Ex:* \_\_\_\_\_ & \_\_\_\_\_.



## REFLECT:

Pick 1-2 “terms of direction” & 1-2 “terms of movement”. Improvise for 30 seconds with focus on your selected terms. For a harder challenge, pick terms in which feel “unnatural” or repeat this activity with different terms each time.

Film your phrase, and send it to a friend who is also taking Bio/Kines. Can they guess your terms?

# **THE SKELETAL SYSTEM** **&** **THE MUSCULAR SYSTEM**



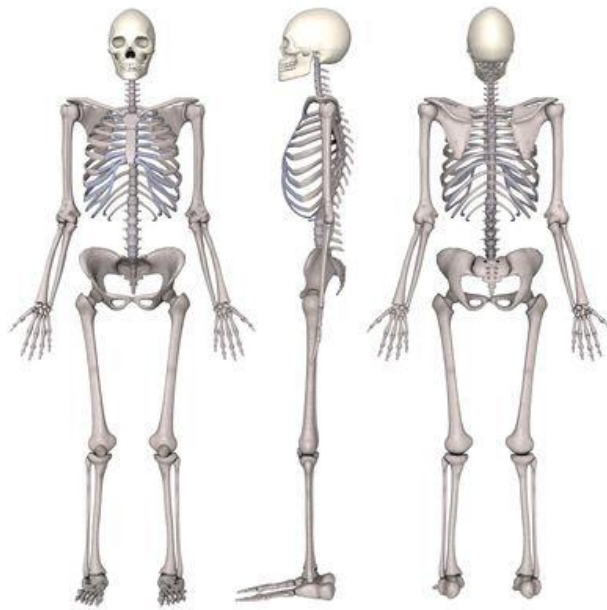
**→ BONES**

**→ MUSCLES**

**→ THE VERTEBRAL COLUMN**

**→ THE ABDOMINALS**

## The Skeletal System: BONES



1. There are \_\_\_\_\_ bones in the adult human body.
2. The entire framework of the bones including their \_\_\_\_\_, \_\_\_\_\_ & \_\_\_\_\_ comprise the skeletal system.

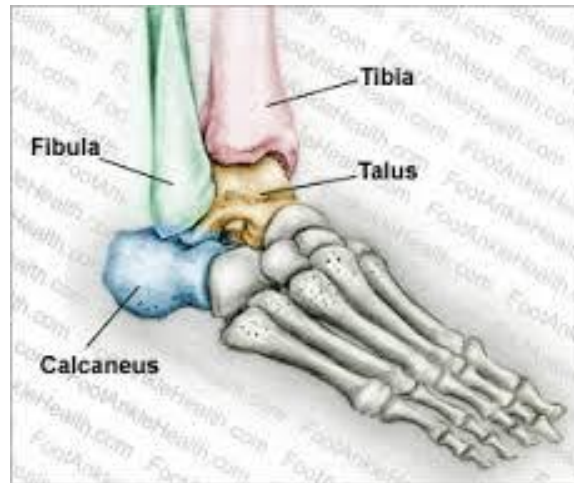
### Functions of the Bone:

1. Support: Serves as structural framework.
2. \_\_\_\_\_: Protects fragile organs from injury.

*Ex: The skull protects the \_\_\_\_\_ & the ribs protect the \_\_\_\_\_.*

3. MOVEMENT- muscles attach to bone and pull on them to produce movement.
4. BLOOD CELL PRODUCTION- within certain bones, red bone marrow produces red blood cells. Red blood cells are essential for the transport of \_\_\_\_\_ & \_\_\_\_\_.

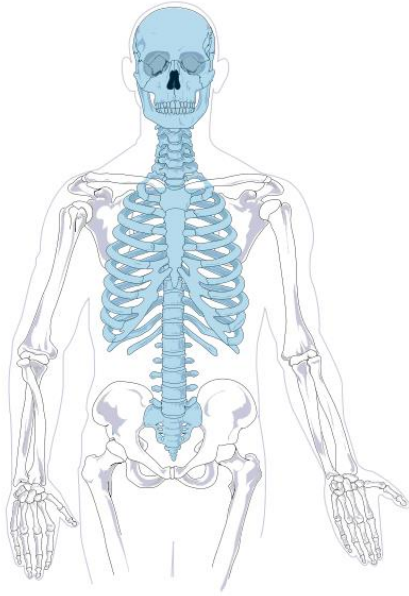
5. \_\_\_\_\_: Bones store calcium and phosphorus that contribute to strength of the bone.



Bone Remodeling is the ongoing replacement of old bone tissue by new bone tissue. It involves the balance between two processes

1. Bone Resorption- the \_\_\_\_\_ of mineral & collagen fibers.
2. Bone Deposition- the \_\_\_\_\_ of minerals & collagen fibers.

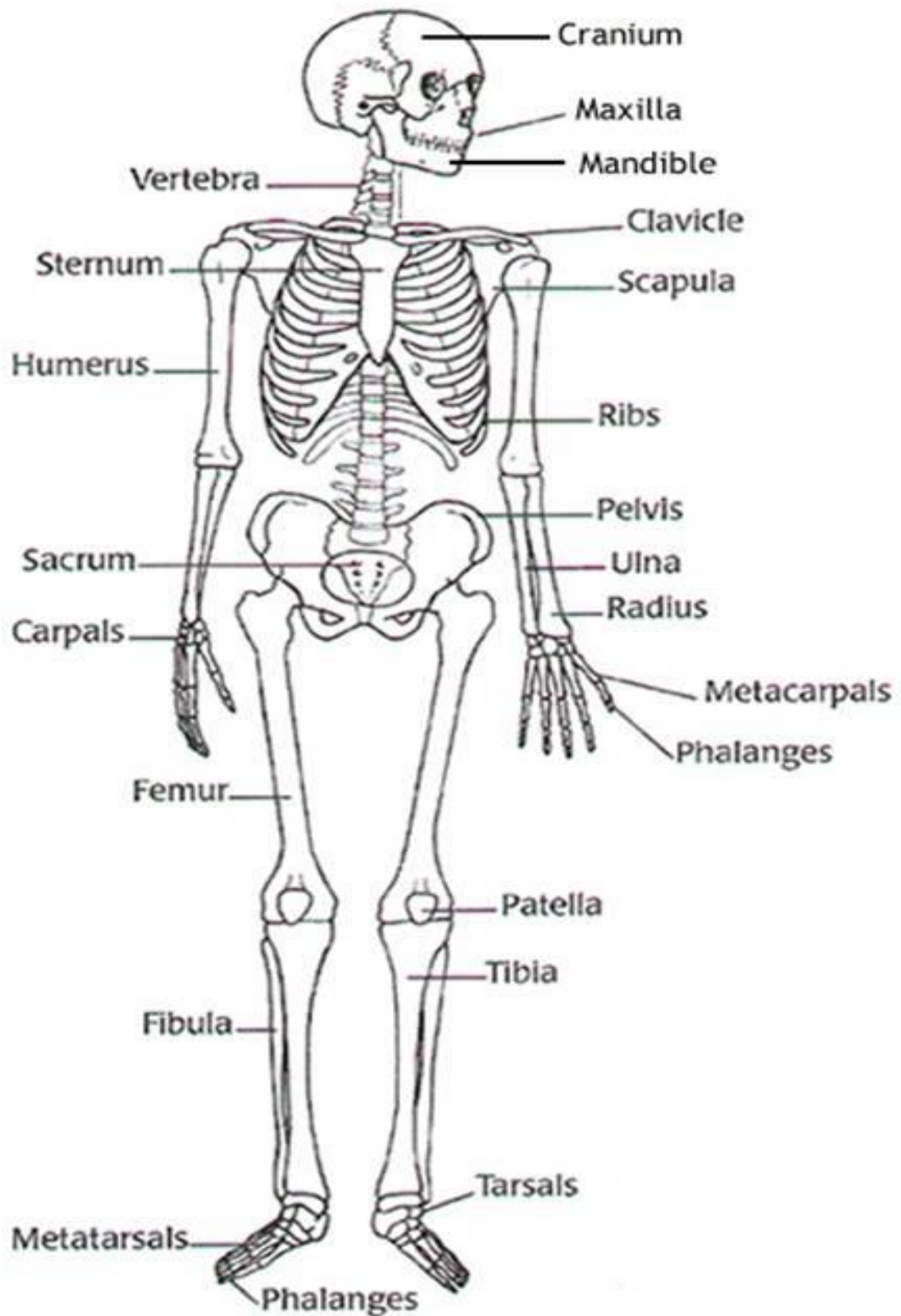
→ Bone remodeling allows for the removal of injured bone, alteration to account for patterns of stress, stronger bones.



THE AXIAL SKELETON



THE APPENDICULAR SKELETON



## THE 5 DIFFERENT TYPES OF BONES:

SHORT BONES: cube shaped, as wide as are long.

*Ex:* \_\_\_\_\_

LONG BONES: greater length than width

*Ex:* \_\_\_\_\_

FLAT BONES: expanded broad, flat plates. Usually to protect an organ & muscle attachment.

*Ex:* \_\_\_\_\_

IRREGULAR BONES: complex shape.

*Ex:* \_\_\_\_\_

SESAMOID BONES: develop in certain tendons where there is considerable friction, tension and stress

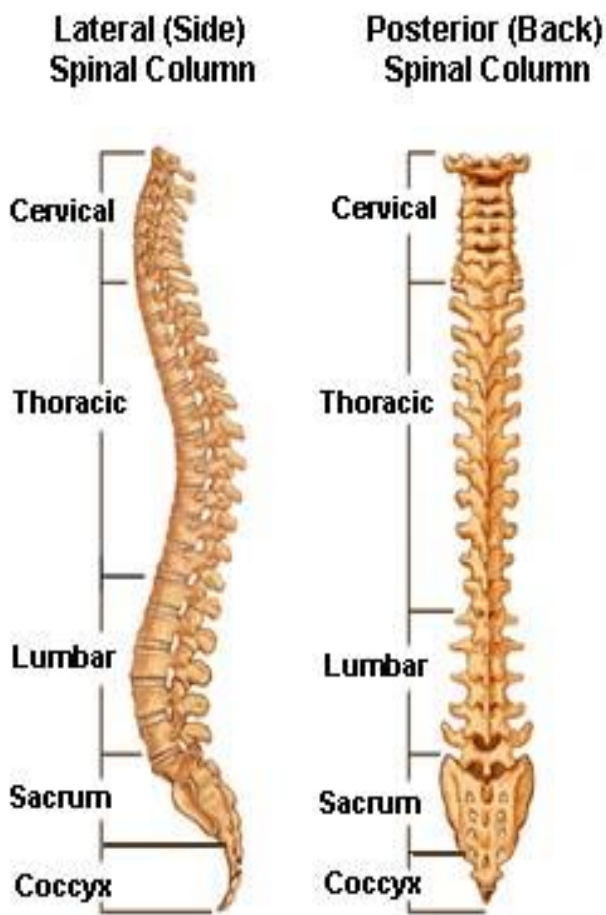
*Ex:* \_\_\_\_\_

### IN CLASS EXERCISE:

→ *In groups, identify a “color” to represent each TYPE OF BONE. Color the skeletons bones (page 5) by category of type of bone.*

## THE VERTEBRAL COLUMN

- The spine is composed of \_\_\_\_\_ separate bones called vertebrae.
- The vertebral column \_\_\_\_\_ the spinal cord and spinal nerve roots, in addition to providing \_\_\_\_\_ for the weight of the body.
- The vertebral column is the point of attachment for the muscles of the back.



→ The bones of the sacrum and coccyx are FUSED together, no movement.

→ Movement is the greatest in the \_\_\_\_\_ & \_\_\_\_\_ areas.



## THE MUSCULAR SYSTEM



- Muscles main purpose is to produce \_\_\_\_\_ & \_\_\_\_\_.
- Muscle makes up \_\_\_\_\_ of total human body weight.
- Muscle tissue is \_\_\_\_\_ denser than fat tissue.

### TYPES OF MUSCLE:

1. Skeletal-\_\_\_\_\_ muscles that control nearly every action a person INTENTIONALLY performs.
  - There are \_\_\_\_\_ skeletal muscles in the human body.
2. Cardiac- Involuntary muscle that is only found in the \_\_\_\_\_ and is responsible for keeping the heart pumping.

3. Smooth- Involuntary muscle that is not controlled by our conscious mind. It is found in the esophagus, stomach, intestines, etc. These muscles contract to move substances (such as food) through the organ.

**SKELETAL MUSCLE** is either:



1. **Fast Twitch** – whiter in color, contract quickly and powerfully; fatigue rapidly.

*Ex: sprinting & weightlifting*

2. **Slow Twitch**- red in color, uses fats, proteins & carbs as energy, contract over a long period of time.

*Ex: long distance running & cycling*

→ If muscle strength is regarded as the ability to use \_\_\_\_\_ on something, then the \_\_\_\_\_ muscle is the strongest in the body.

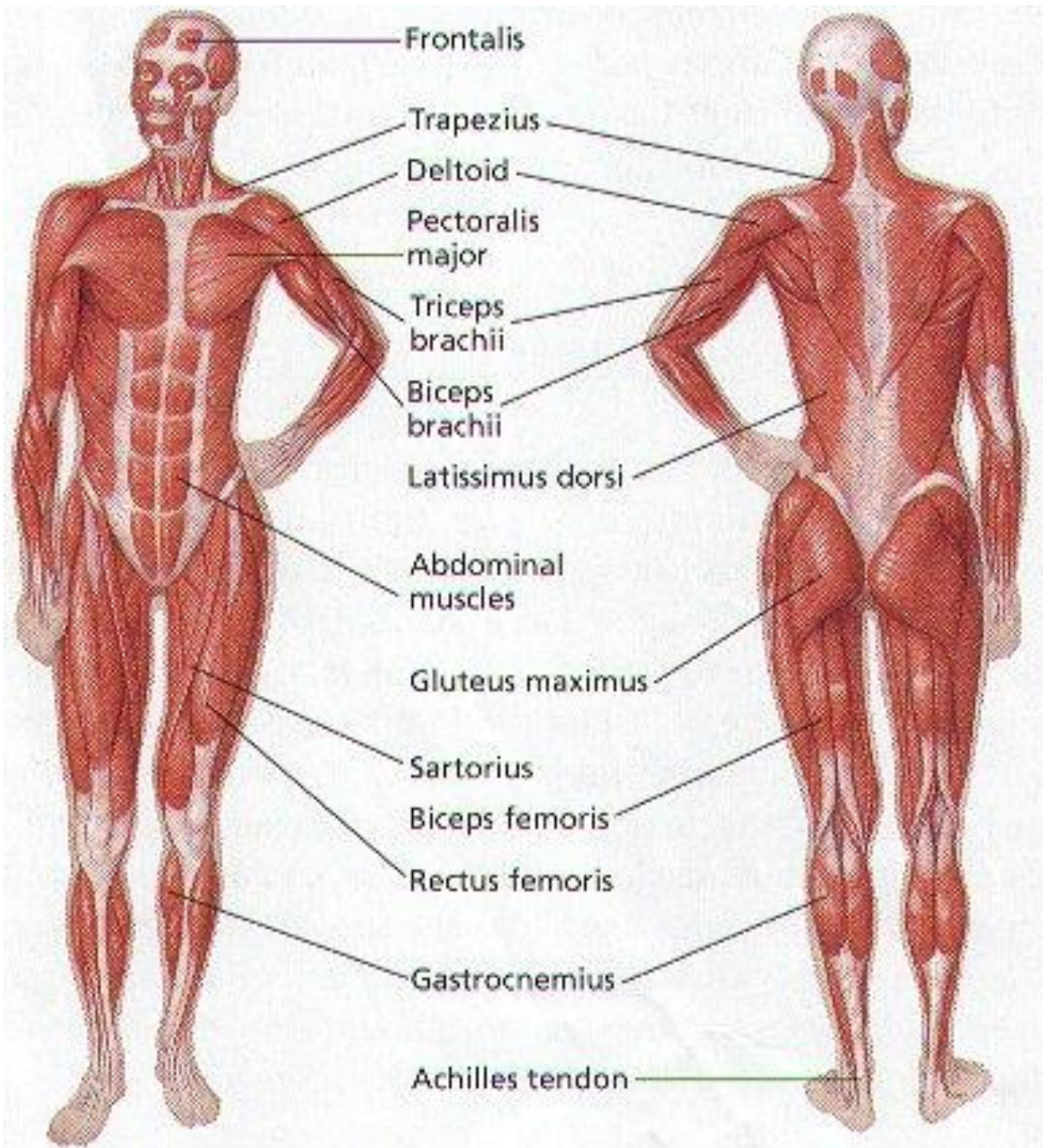
→ The strongest muscles in relation to the job they have to do is the external muscle of the \_\_\_\_\_ which are about 100x stronger than they need to be in relation to the small size and weight of the eyeball.

*Fun Fact: It takes \_\_\_\_\_ muscles in the face to smile and \_\_\_\_\_ muscles to frown.*

REPEATING AN ACTION OVER AND OVER AGAIN CREATES MUSCLE MEMORY. MUSCLES FINE TUNE THEMSELVES, BECOMING MORE AND MORE PRECISE AND EXACT IN WHAT THEY DO.

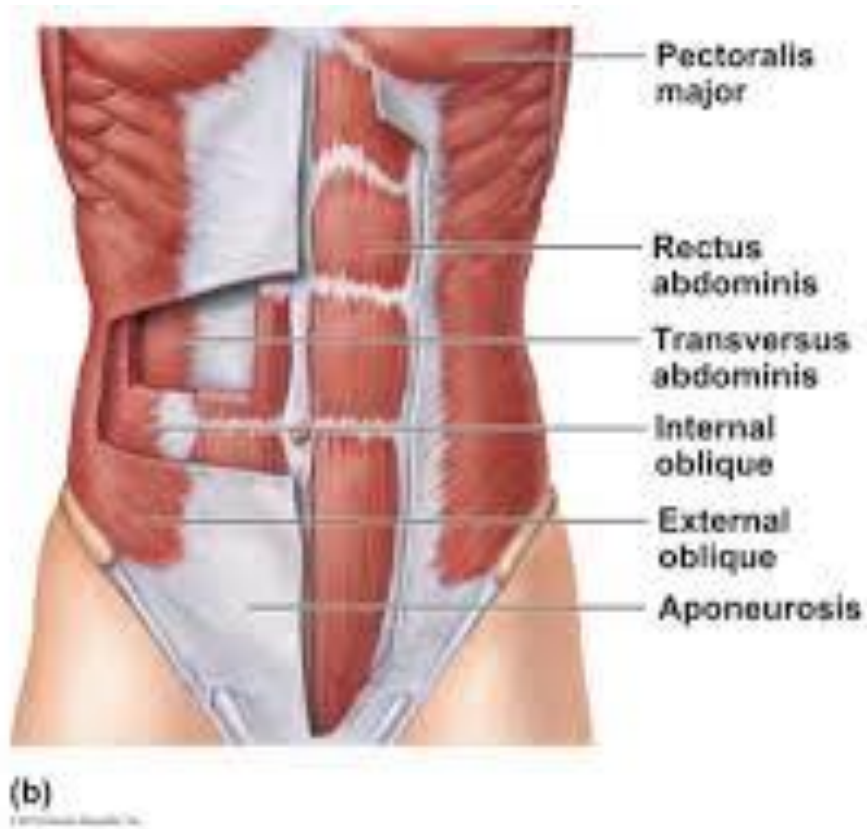
If you practice \_\_\_\_\_ your muscle memory will be to execute the action incorrectly. Therefore, if you practice \_\_\_\_\_ your muscles memory will be to execute the action correctly.

PRACTICE REALLY DOES MAKE PERFECT!!



## THE ABODMINALS

## THE ABODMINALS



### REFLECT:

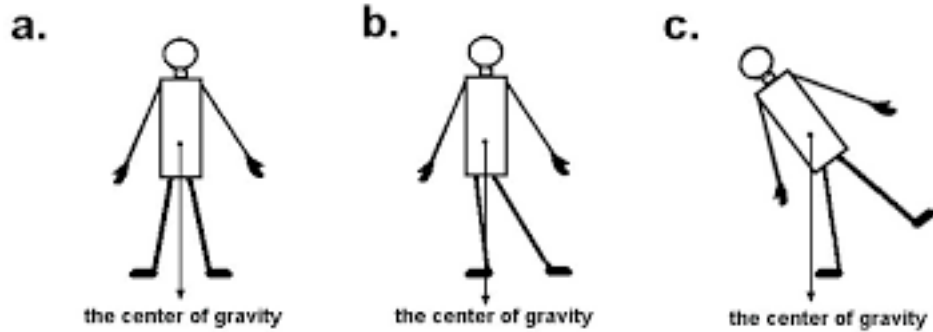
Pick a muscle and develop a 5 minute “warm-up” that incorporates both conditioning and stretching exercises of your selected muscle. For a harder challenge, repeat this activity for different muscles.

Consider leading a sibling or parent through your “warmup”. Can they identify which muscle/s you are focused on?

# THE BODY PLANES/AXES

&

# THE CENTER OF GRAVITY



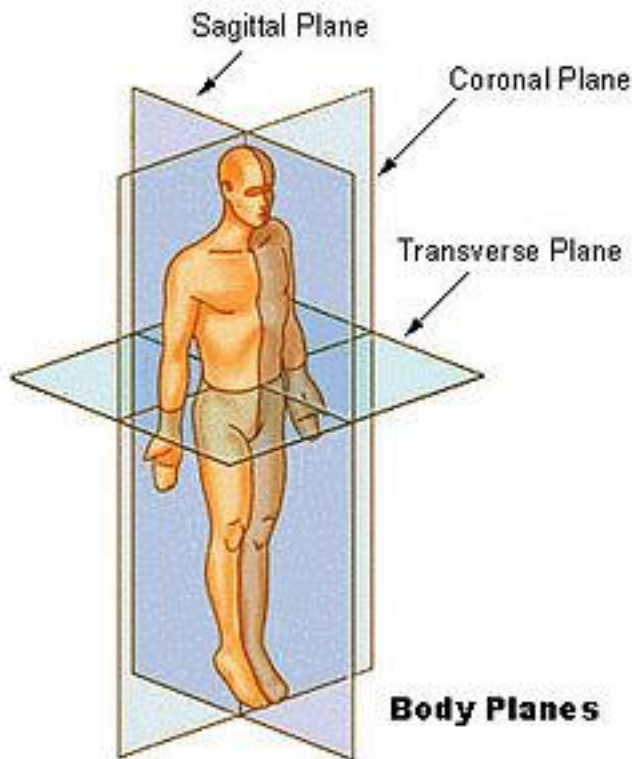
REFLECT:

Before we begin, please film yourself doing 3 tendu prep pirouettes on the right and left side. Ready GO!!! Hold onto this video on yourself. We will come back to this later.

## BODY PLANES

\_\_\_\_\_ : lines of reference of which the body can be divided.

→Planes are abstract concepts, not actual volumes.



**THE SAGITAL PLANE-** divides the body \_\_\_\_\_ to \_\_\_\_\_.

**THE CORONAL/FRONTAL PLANE-** divides the body \_\_\_\_\_ to \_\_\_\_\_.

**THE TRANSVERSE/HORIZONTAL PLANE -** divides the body \_\_\_\_\_ to \_\_\_\_\_.

An infinite number of planes may be used to bisect the body in each of the three classes of planes. But one and only one plane of each will bisect the body equally by \_\_\_\_\_.

**The Mid Sagittal**-bisects the body equally by weight right from left.

**The Mid Frontal**- bisects the body equally by weight front from back or \_\_\_\_\_ from \_\_\_\_\_.

**The Mid Transverse**-bisects the body equally by weight top from bottom or \_\_\_\_\_ from \_\_\_\_\_.

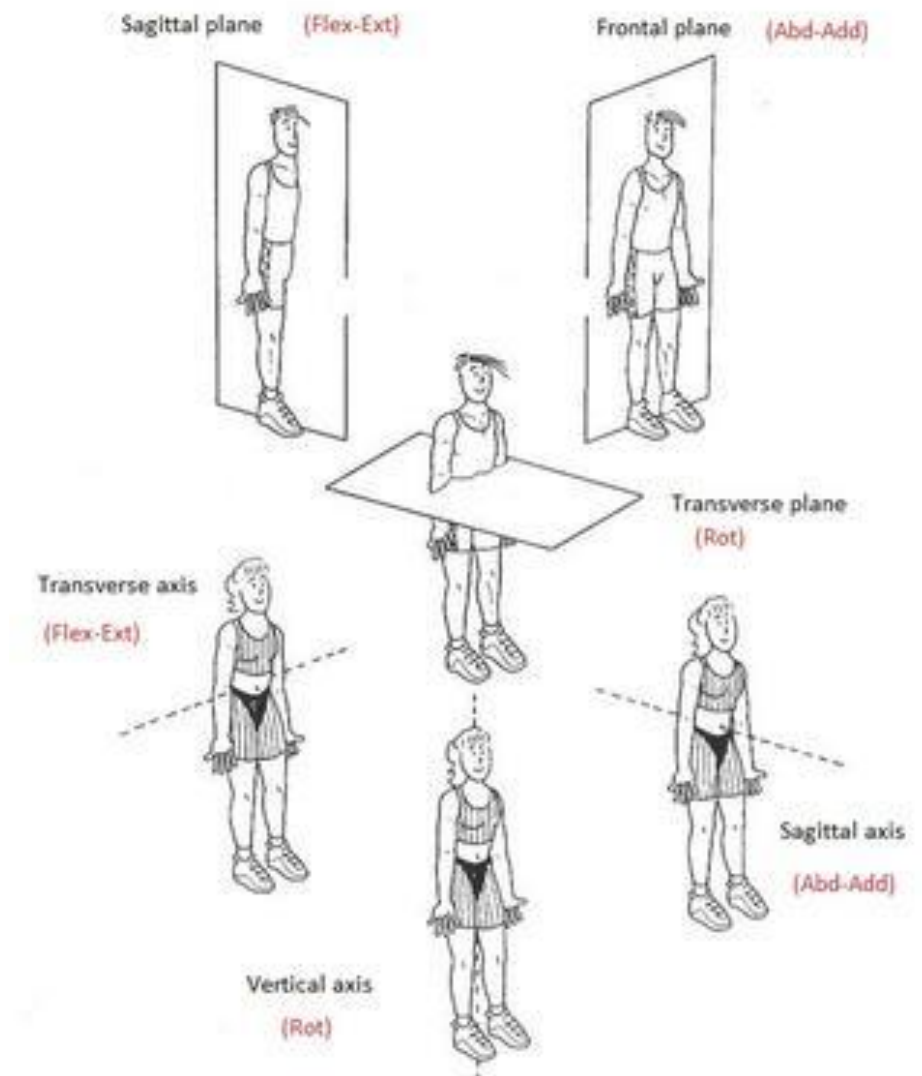
### **THE BODY AXES**

The human body's height, measured in anatomical position is represented by a line segment that extends from the soles of the feet to the crown of the head= **Vertical Dimension** or \_\_\_\_\_.

The human body's width, may be measured at any level of the body (the shoulders, the pelvis, etc.) Wherever width is measured it represents the **Horizontal Dimension** or \_\_\_\_\_.

The human body's depth may be measured at any level of the body as well, wherever it is measure represents the **A.P. Dimension** or \_\_\_\_\_.

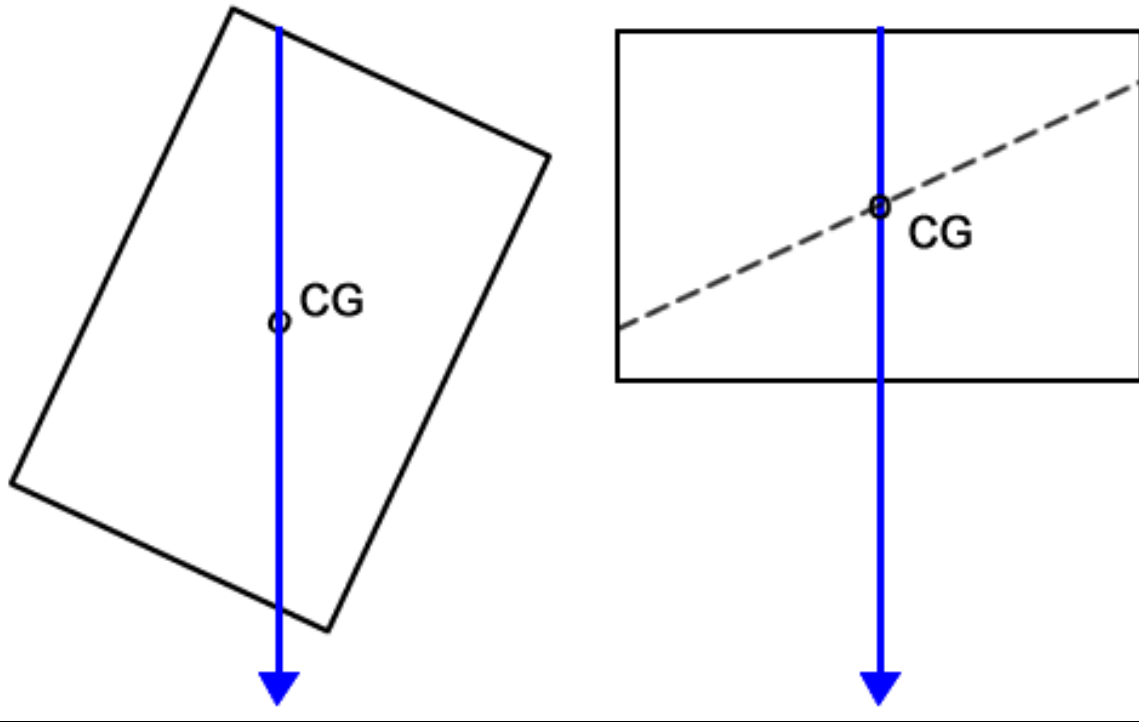




## **THE CENTER OF GRAVITY (COG)**

**Points-** geometrical references that have no dimensions. Points are derived by the intersection of \_\_\_\_\_ or more line segments (axes).

The center of gravity of the body is a \_\_\_\_\_. It is derived by the intersection of the three primary body axes. Around the COG, all movement tendencies are resolved; \_\_\_\_\_.



REFLECT:

Again, Film yourself doing 3 tendu prep pirouettes on the right and left side.

Now you have before and after footage on your pirouettes. Compare the two videos. Are they different now? If so, why?

# **THE KNEE JOINT**

**&**

# **THE HIP JOINT**



**→ COMMON INJURIES & TREATMENTS**

**→ THE PSOAS**

**→ LIGAMENTS OF THE HIP**

# THE KNEE JOINT



## **THE PATELLOFEMORAL JOINT:**

During Flexion and Extension, the

\_\_\_\_\_ undergoes a complex gliding movement that includes movements \_\_\_\_\_ & \_\_\_\_\_ with very slight medial, lateral and rotational components.

## **MCL Injury-**

A sprain or tear to the medial collateral ligament. The MCL keeps the knee from bending inward. Characterized by pain on the inside of the knee. An MCL injury is the most commonly occurring injury in sports.

Tenderness and swelling are commonly presented.

Such injuries often result from a \_\_\_\_\_ directed force against the \_\_\_\_\_ side of knee. This is known as VALGUS stress.

*Treatment: Most MCL injuries can be treated at home with rest, ice and anti-inflammatory medicine. Crutches or a brace may be recommended. Activity may be limited for a few weeks.*

### **ACL Injury-**

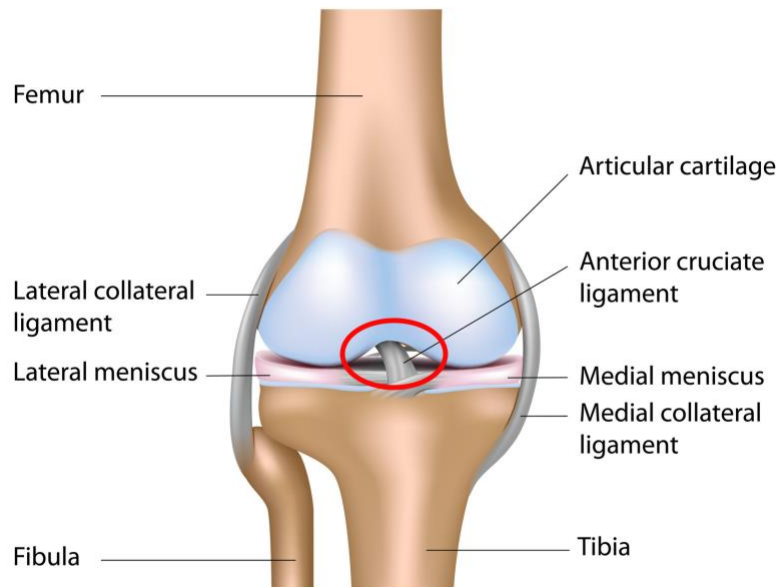
Most prevalent mechanism of injury in Modern, Jazz and Ballet dance is landing a jump in \_\_\_\_\_. Characterized by an initial “pop”, instability, pain and rapid swelling.

A common mechanism for injury to this ligament is a blow to the LATERAL knee that includes EXTERNAL ROTATION. When a person tears their ACL it is due to \_\_\_\_\_ & \_\_\_\_\_ their knee.

Symptoms of a torn ACL include major swelling and not being able to bend the knee. The symptoms of an ACL injury are relatively similar for an MCL injury.

*Treatment: Immobilization, ice & rest, followed by strengthening exercises and physical therapy. This injury may require surgery.*

## Anterior view of the right knee



### Meniscus Injury-

One of the most common mechanisms of injury of the meniscus is \_\_\_\_\_ from a \_\_\_\_\_ abducted position of the knee, while the leg is \_\_\_\_\_ with the foot fixed; \_\_\_\_\_!

-In dance, it is believed that this mechanism may be operative chronically, that is that \_\_\_\_\_ may result in long-term wearing and splitting of the meniscus.

*Treatment: Initial treatment includes anti-inflammatory medications, followed by strengthening exercises. Some small tears may heal themselves, but if the knee does not respond adequately to therapy, surgery is usually recommended.*

## UNDERSTANDING THE DIFFERENCE:

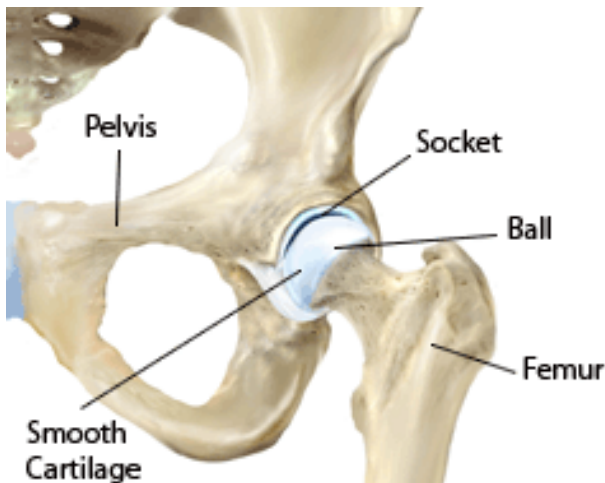
A sprain is the stretching or tearing of \_\_\_\_\_ (the tough bands of fibrous tissue that connect two bones together in your joints.) The most common location for a sprain is in your \_\_\_\_\_.

A strain is the stretching or tearing of a \_\_\_\_\_ or \_\_\_\_\_. A tendon is a fibrous cord of tissue that connects \_\_\_\_\_ to \_\_\_\_\_.

*Treatment: Control swelling with \_\_\_\_\_.*

1. *Rest*
2. *Ice for \_\_\_\_\_ minutes.*
3. *Compress (lightly do NOT tightly wrap the injury).*
4. *\_\_\_\_\_ the area above the heart level.*

## THE HIP JOINT



The hip is a \_\_\_\_\_ & \_\_\_\_\_ joint.

The hip socket and femoral head are both lined with \_\_\_\_\_ which allows the bones to glide together with little friction.

## THE PSOAS

The **iliopsoas** is a deep hip flexor tendon that passes along the front of the hip joint. The iliopsoas tendon attaches the iliopsoas muscle (iliacus, psoas major, and psoas minor muscles) to the femur at the lesser trochanter and is the \_\_\_\_\_ hip flexor muscle.

The iliopsoas is a combination of three muscles: **psoas major, psoas minor, and iliacus.**

1. One of the most powerful muscles in the entire body and is the most important muscle for hip flexion above 90 degrees.
2. The iliopsoas is the only muscle in the human body that has attachments on the \_\_\_\_\_, \_\_\_\_\_ & \_\_\_\_\_. Due to this, the iliopsoas is in a unique position to produce movement and to \_\_\_\_\_ the hip.

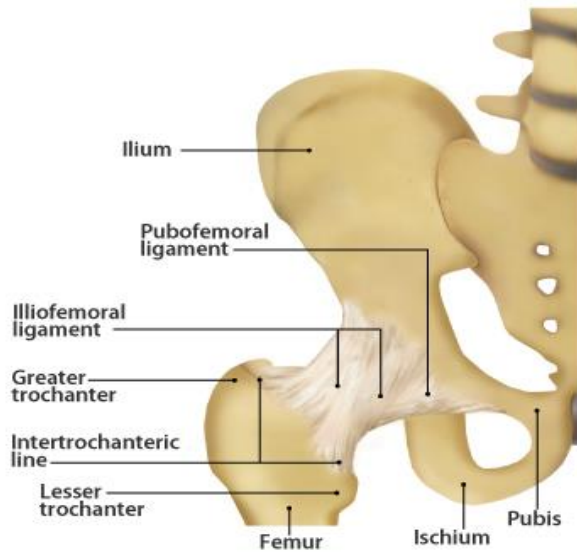
*Fun Fact: When the psoas is tight it will cause an arched back.*



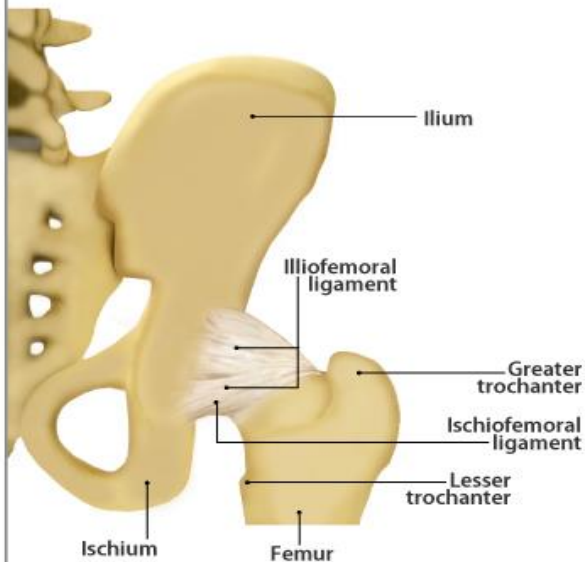


## Skeletal Anatomy of the Hip

Anterior View



Posterior View

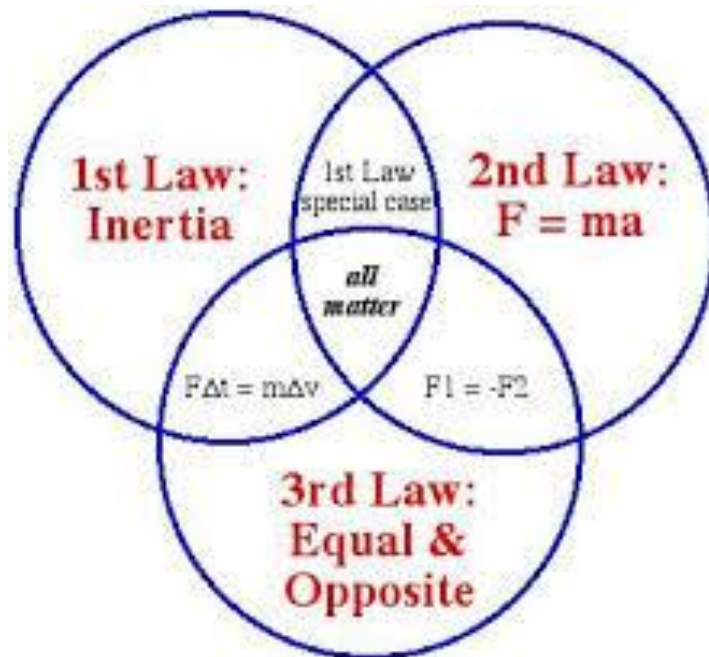


MendMeShop™ © 2011

### Ligaments of the Hip Joint:

1. **The Ischiofemoral Ligament-** makes up the joint capsule of the hip & helps control movement of the hip.
2. **The Ilioferomral Ligament-** is the strongest ligament in the body. This ligament \_\_\_\_\_ the hip and helps to prevent the joint from \_\_\_\_\_.
3. **The pubofemoral Ligament-** starts at the pubis and attaches to the femur.

# THE LAWS OF MOTION



## Newton's Laws

- A DEEPER LOOK INTO:
- CENTER OF GRAVITY
  - BASE OF SUPPORT
  - BALANCE

## THE LAWS OF MOTION

**MOTION** = the act or process of changing place or position.

All motion, including motions of the human body, planets or the strength of buildings and bridges is the result of the applications of \_\_\_\_\_ and is subject to the laws and principles that govern \_\_\_\_\_ & \_\_\_\_\_.

**FORCE**= Is any action or influence that \_\_\_\_\_ an object.

**MASS**= refers to the \_\_\_\_\_ of \_\_\_\_\_ that a body contains (size & weight).

*Example:* \_\_\_\_\_.

**INERTIA**= is the property of mass that causes it to \_\_\_\_\_ any change of its motion in either speed or direction.

→ *The tendency of an object to stay at \_\_\_\_\_ or to stay in*

\_\_\_\_\_.

**TORQUE**= is the tendency or ability of force to produce

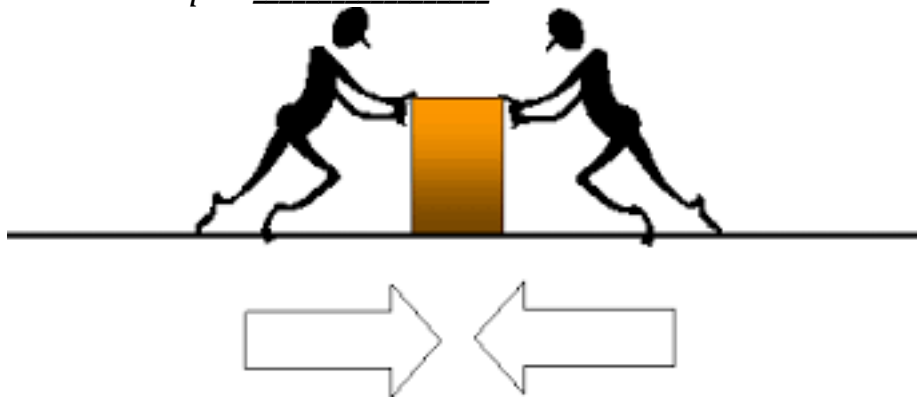
\_\_\_\_\_ about an axis.

*Example:* \_\_\_\_\_

**FRICITION**= is a force developed by two surfaces, which tends to

\_\_\_\_\_ motion of one surface across another.

Example: \_\_\_\_\_.



**THE NATURE OF FORCE**= objects start moving when they are pushed or pulled!!

1. Forces \_\_\_\_\_ motion.
2. Forces \_\_\_\_\_ motion.
3. Forces \_\_\_\_\_ speed.
4. Forces can cause objects to \_\_\_\_\_.

**FORCE IS THE EFFECT THAT ONE BODY OR OBJECT HAS ON ANOTHER!!!!**

### **INTERNAL & EXTERNAL FORCE**

Internal Force= usually classified as \_\_\_\_\_ forces acting on various structures of the body.

External Force= are those \_\_\_\_\_ the body.

Example: \_\_\_\_\_.

**SIR ISAAC NEWTONS (1642-1727)**  
**THREE LAWS OF MOTION**



**I. THE LAW OF INERTIA**

- A body at rest tends to remain at \_\_\_\_\_.
- A body in motion tends to remain in \_\_\_\_\_, with consistent speed and in the same direction unless acted upon by an outside force

**II. THE LAW OF ACCELERATION**

- The amount of acceleration of an object /body depends on the strength of the force applied to the object.
- The change in direction of an object depends on the force applied to it!

- If you apply the same amount of force to two objects of differing masses, the object with the greater mass will
- accelerate \_\_\_\_\_ than the object with lesser mass.

### III. THE LAW OF ACTION

- For every \_\_\_\_\_ there is an \_\_\_\_\_ or
- \_\_\_\_\_.
- The production of any force will create another force which
- will be opposite (in \_\_\_\_\_) and equal to (in
- \_\_\_\_\_) to the first force.

### **BALANCE & STABILITY**

**GRAVITY**= is the mutual attraction between the \_\_\_\_\_ & an \_\_\_\_\_.

**GRAVITATIONAL FORCE** = is always directed vertically downward toward the center of the earth (down towards the ground).

#### **BALANCE:**

1. The \_\_\_\_\_ force on the body equals the
2. \_\_\_\_\_ force.
3. When an object (or body) is balanced, all forces acting on it are
4. \_\_\_\_\_, and it is in a state of equilibrium.
5. How secure or precarious this state of equilibrium is depends on
6. the relationship between the objects \_\_\_\_\_ and \_\_\_\_\_.

7. Gravity downward and floor upward are the only forces acting on the body when we are in a state of balance.

### **CENTER OF GRAVITY**

That point in any body around which all movement tendencies are neutralized, resolved, or \_\_\_\_\_!!



**COG/CENTER OF GRAVITY-** the balance point of an object at which weight on all three sides is \_\_\_\_\_ The point at which

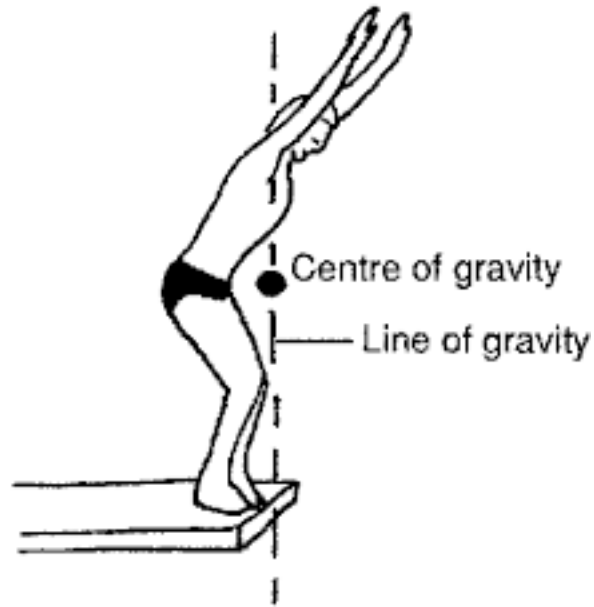
all three planes \_\_\_\_\_ the body.

**LOG/LINE OF GRAVITY-** This is an imaginary vertical line passing through the

\_\_\_\_\_ toward the center of the earth.

**BOS/BASE OF SUPPORT-** is the part of a body that is in contact with the supporting surface.

1. The lower the COG to the earth, the more stable the object.
2. The \_\_\_\_\_ the BOS, the more stable the object.
3. The COG and LOG must remain within the BOS for an object to remain stable



REFLECT:

Develop a phrase or complete a 30 second improvisation in which demonstrates at least one law of motion. For a harder challenge, illustrate all 3 laws of motion!!

Film yourself and send it to a friend who is also taking the class, can they identify which law of motion you selected?