



Unit 1: Fundamentals of Human Anatomy and Musculoskeletal System

Subject: Human Anatomy

Unit 1: Fundamentals of Human Anatomy and the Musculoskeletal System

1.1 Introduction to Anatomy

Anatomy is the study of body structure—what parts exist, where they lie, how they connect, and why that matters for function and clinical care. For a Yoga & Naturopathy student, anatomy guides **safe alignment**, **injury prevention**, and **therapeutic modification**. Structure and function are inseparable: bones and joints provide **levers**, muscles supply **force**, fascia coordinates **tension**, and nerves control **timing**.

Levels of organization: chemical → cell → tissue → organ → system → organism.

Core idea: sound practice respects tissues' **biological limits** and **loading capacity**.

1.2 Terms, Terminology & Regions of the Body

1.2.1 Anatomical position & directions

- **Anatomical position:** standing upright, face forward, arms at sides, palms forward, feet together.
- **Directional terms:**
Superior/Inferior (toward head/feet), **Anterior/Posterior** (front/back), **Medial/Lateral** (midline/side), **Proximal/Distal** (near/far from trunk), **Superficial/Deep**, **Ipsilateral/Contralateral**.

1.2.2 Planes & axes (movement language)

Plane	Axis	Major movements	Yoga examples
Sagittal (divides L/R)	Mediolateral	Flexion, extension	Forward fold (hip flexion), backbend (spine extension)
Frontal/Coronal (front/back)	Anteroposterior	Abduction, adduction, lateral flexion	Triangle pose (hip abduction; spine lateral flexion)
Transverse (upper/lower)	Vertical	Rotation, pronation/supination	Seated twist; forearm pronation in table-top

Special terms: dorsiflexion/plantarflexion (ankle), inversion/eversion (foot), protraction/retraction & elevation/depression (scapula), circumduction (cone-like movement).

1.2.3 Regions & surface anatomy

Head & neck; **trunk** (thorax, abdomen, pelvis/perineum); **upper limb** (shoulder/arm/forearm/hand); **lower limb** (gluteal/thigh/leg/foot).

Abdominal quadrants (RUQ, LUQ, RLQ, LLQ) help localize viscera and pain.

1.3 Body Cavities & Organ Systems

Cavity	Subdivisions	Membranes (serosa)	Major organs
Dorsal	Cranial, Vertebral	-	Brain; spinal cord



Cavity	Subdivisions	Membranes (serosa)	Major organs
Ventral	Thoracic (pleural ×2, pericardial within mediastinum)	Pleura, Pericardium	Lungs; heart
	Abdominopelvic (abdominal, pelvic)	Peritoneum	GI tract, liver, spleen; urinary & reproductive organs

Systems overview: skeletal, muscular, nervous, cardiovascular, respiratory, digestive, urinary, endocrine, lymphatic/immune, reproductive, integumentary. Coordination of these systems underlies **posture, breath, and recovery**.

1.4 Cells & Tissues: Structure and Types

1.4.1 The cell (essentials)

Plasma membrane (selective barrier), **cytoplasm** with organelles—**mitochondria** (ATP), **ribosomes** (protein synthesis), **ER/Golgi** (processing), **lysosomes** (digestion), **cytoskeleton** (shape/movement), **nucleus** (DNA). **Cell junctions** (tight, desmosomes, gap junctions) create tissue integrity and communication.

1.4.2 Four basic tissues

Tissue	Key features	Examples	Relevance
Epithelium	Sheets; avascular; polar; rests on basement membrane	Skin epidermis; airway lining; glands	Protection, absorption, secretion
Connective	Cells + extracellular matrix (fibers & ground substance)	Loose/dense CT, adipose, cartilage, bone, blood	Support, transport, defense
Muscle	Contractile proteins	Skeletal, cardiac, smooth	Movement, posture, propulsion
Nervous	Neurons + glia	Brain, spinal cord, peripheral nerves	Control, integration, sensation

1.5 Musculoskeletal System: The Movement Apparatus

Bones (levers), joints (axes), muscles (motors), tendons (force transmission), ligaments (stability), **fascia** (continuity), nerves (control), vessels (fuel).

Proprioception—sensors in muscles and joints—guides alignment; refined by **slow, mindful practice**.

1.6 Bone: Structure & Classification

1.6.1 Gross structure

- **Diaphysis** (shaft) of **compact bone**; **epiphyses** (ends) with **spongy (cancellous) bone**; **metaphysis** with growth plate (children).
- **Periosteum** (outer fibrous + inner osteogenic layer), **endosteum** (lining).
- **Marrow:** red (hematopoietic) vs yellow (fat).
- **Blood supply:** nutrient artery, periosteal vessels.

1.6.2 Bone cells & remodeling

Cell	Role
Osteoblast	Forms osteoid; builds bone
Osteocyte	Mature cell; mechanosensor in lacunae



Cell **Role**
Osteoclast Resorbs bone; remodeling partner

Remodeling adapts trabeculae along lines of stress (use it wisely → stronger bone).

1.6.3 Development & classification

- **Ossification: intramembranous** (flat skull bones, clavicle); **endochondral** (long bones).
- **By shape:**

Type	Examples	Function
Long	Femur, humerus	Levers; weight-bearing
Short	Carpals, tarsals	Glide; stability
Flat	Sternum, scapula, ribs	Protection; muscle attachment
Irregular	Vertebrae	Complex loads; protection
Sesamoid	Patella	Alters pull; protects tendon
Pneumatic	Maxilla (sinuses)	Lighten skull; resonance

Applied note: Vitamin D, load-bearing, and adequate protein support bone health; smoking and inactivity weaken it.

1.7 Joints: Structure, Types & Movements

1.7.1 What makes a joint?

Articular cartilage, synovial cavity with **synovial fluid, fibrous capsule** and **synovial membrane, ligaments**, sometimes **menisci/labrum, bursae**.

1.7.2 Classification & examples

Class	Subtype	Example	Movements
Fibrous	Sutures, syndesmosis, gomphosis	Skull sutures; distal tibiofibular	Minimal movement
Cartilaginous	Primary (synchondrosis); Secondary (symphysis)	Epiphyseal plate; intervertebral disc , pubic symphysis	Slight movement; shock absorption
Synovial	Plane	Intercarpals	Gliding
	Hinge	Elbow, knee	Flexion/extension
	Pivot	Atlanto-axial, radioulnar	Rotation
	Condyloid	Wrist (radiocarpal)	Flex/Ext; Abd/Add
	Saddle	Thumb CMC	Flex/Ext; Abd/Add; opposition
	Ball & socket	Hip, shoulder	Multiaxial (incl. rotation)

Stability vs mobility: the shoulder favors mobility (needs rotator cuff training); the hip favors stability (deep socket).

Injury language: **sprain** = ligament injury; **strain** = muscle/tendon injury.

1.8 Spine & Thorax

1.8.1 Vertebral column

- **Regions (33 vertebrae):** 7 cervical, 12 thoracic, 5 lumbar, 5 sacral (fused), 3-5 coccygeal.
- **Curvatures:** cervical & lumbar **lordosis**; thoracic & sacral **kyphosis** (balanced curves distribute load).



- **Typical vertebra:** body (weight), arch, pedicles, laminae, spinous/transverse processes, facet joints (zygapophyseal).
- **Intervertebral disc:** **annulus fibrosus** (fibrocartilage) + **nucleus pulposus** (gel). Hydration & loading history affect disc behavior.

Clinical correlations: disc herniation (often posterolateral), spondylolisthesis, scoliosis, excessive kypho-/lordosis.

Yoga relevance: neutral spine in load; hinge at hips for forward folds; avoid end-range spinal flexion with heavy lift.

1.8.2 Thoracic cage

- **Sternum** (manubrium, body, xiphoid), **12 pairs of ribs**—1-7 true, 8-10 false, 11-12 floating; **intercostal spaces** with vessels & nerves.
- **Respiratory mechanics:**
Diaphragm (primary), **external intercostals** (inspiration), **internal intercostals** (forced expiration).
Rib motion: **pump-handle** (AP diameter ↑), **bucket-handle** (transverse diameter ↑).

Practice link: diaphragmatic breathing mobilizes lower ribs, reduces accessory-neck muscle overuse.

1.9 Muscles: Types, Structure, Tone, Fatigue

1.9.1 Types & microstructure

- **Skeletal (striated, voluntary):** attached to bone via tendons.
- **Cardiac (striated, involuntary):** heart; intercalated discs.
- **Smooth (non-striated, involuntary):** viscera, vessels.

Sarcomere model (skeletal/cardiac): Z-Z boundaries; **actin** (thin) + **myosin** (thick); **troponin-tropomyosin** complex regulates.

Sliding filament: Ca²⁺ binds troponin → cross-bridge cycling with ATP → shortening.

Motor unit: one α-motor neuron + all fibers it innervates. Recruitment from **slow (Type I)** → **fast (Type II)** as force needs rise.

1.9.2 Tone & reflexes

Muscle tone = baseline contractile readiness via spinal reflexes (muscle spindle, γ-system). Postural muscles (calves, back extensors) exhibit higher tonic activity.

Clinical sense: hypotonia (low tone) vs hypertonia/spasticity (high tone).

1.9.3 Fatigue

- **Peripheral:** substrate depletion, ionic shifts, metabolite accumulation; temporary force decline.
- **Central:** reduced drive from CNS (motivation, neurotransmitter availability).
DOMS (delayed-onset muscle soreness) follows unaccustomed **eccentric** load; recovers with rest, gradual loading, hydration, and sleep.

Length-tension & force-velocity: mid-length fibers produce most force; faster shortening → less force; slow, controlled work builds strength safely.

1.10 Movements & Applied Anatomy

1.10.1 Movement glossary (quick map)

Movement	Plane	Prime joints
Flexion/Extension	Sagittal	Spine, shoulder, hip, knee, elbow
Abduction/Adduction	Frontal	Shoulder, hip, fingers/toes
Rotation (int/ext)	Transverse	Shoulder, hip; axial spine (C1-C2 high)
Pronation/Supination	Transverse	Forearm (radioulnar)
Inversion/Eversion	Frontal	Subtalar foot
Dorsi-/Plantarflexion	Sagittal	Ankle
Elevation/Depression; Protraction/Retraction	Mixed	Scapulothoracic articulation

1.10.2 Lever classes (why alignment matters)

Class	Fulcrum-Load-Force order	Body example	Yoga cue
I	F-L-Frc	Atlanto-occipital nodding	Maintain neutral head; balance load
II	F-L-Frc	Plantarflexion (tiptoe)	Strong calf lever; control descent
III	F-Frc-L	Biceps curl	Most common; favors speed/ROM—protect elbow/shoulder

1.10.3 Common applied notes (practice safety)

Region	Common issue	Anatomical cause	Safer cue
Shoulder	Impingement in overhead work	Narrow subacromial space; poor scapular rotation	Upwardly rotate & posteriorly tilt scapula; avoid shrugging
Knee	Valgus collapse in squats/lunges	Weak hip abductors; foot pronation	Track knee over 2nd toe; engage gluteus medius
Lumbar spine	Excess extension in backbends	Facet compression	Lengthen through crown; engage abdominals; hinge at hips
Wrist	Discomfort in weight-bearing	Extended wrist + small contact area	Spread hand, externally rotate humerus; use wedges/props

Unit Summary

This unit mapped the **language and landscape of anatomy**—from **planes and regions** to **cells and tissues**, from **bone architecture and remodeling** to **joint classifications and movements**, then into the **vertebral column and thoracic cage**, and finally to **muscle microstructure, tone, and fatigue**. The musculoskeletal system acts as an **integrated kinetic chain**: bones provide leverage, joints set axes, muscles supply controlled force, and fascia/nerves coordinate timing. For clinical yoga practice, **alignment, gradual loading, and breath-led pacing** safeguard tissues while improving function.

Key Terms

- Anatomical position • Planes (sagittal, frontal, transverse) • Axes
- Epithelium/Connective/Muscle/Nervous tissue • Periosteum/Endosteum
- Compact vs Cancellous bone • Osteoblast/Osteoclast/Osteocyte
- Synarthrosis/Amphiarthrosis/Diarthrosis • Synovial joint subtypes
- Intervertebral disc (annulus/nucleus) • Lordosis/Kyphosis/Scoliosis
- Sarcomere • Motor unit • Length-tension • DOMS • Proprioception



Self-Assessment

MCQs

1. **Which joint** is a **saddle** synovial joint?
a) Elbow b) Knee c) Thumb CMC d) Hip
2. **Annulus fibrosus** and **nucleus pulposus** belong to:
a) Meniscus b) Intervertebral disc c) Labrum d) Bursa
3. **Periosteum** primarily provides:
a) Hematopoiesis b) Synovial fluid c) Osteogenic cells & periosteal blood supply d) Cartilage growth
4. **Type I muscle fibers** are best characterized by:
a) Fast, easily fatigued b) Slow, fatigue-resistant c) Anaerobic power only d) Found only in arms
5. The movement **plane** for hip **abduction** is:
a) Sagittal b) Frontal c) Transverse d) Oblique

Answer key: 1-c, 2-b, 3-c, 4-b, 5-b

Short Answer

1. Distinguish **fibrous, cartilaginous, and synovial** joints with one example and typical movement range.
2. Describe the **structure of a long bone** and the roles of **periosteum, marrow, and nutrient artery**.
3. Explain **muscle tone** and how it supports posture during quiet standing.
4. Outline safe anatomical cues to protect the **lumbar spine** in backbends.

Reflective/Application

1. Observe your next practice: choose one movement (e.g., shoulder flexion to 170-180°). Identify the **primary plane, scapular motion, and muscle groups** involved. What cue improved comfort?
2. Keep a 3-day log of **DOMS** after a new sequence. Which movements produced it (likely eccentric)? How did you modify intensity and recovery?

End of Unit 1: Fundamentals of Human Anatomy and the Musculoskeletal System