The Skeletal, Muscular and Integumentary Systems

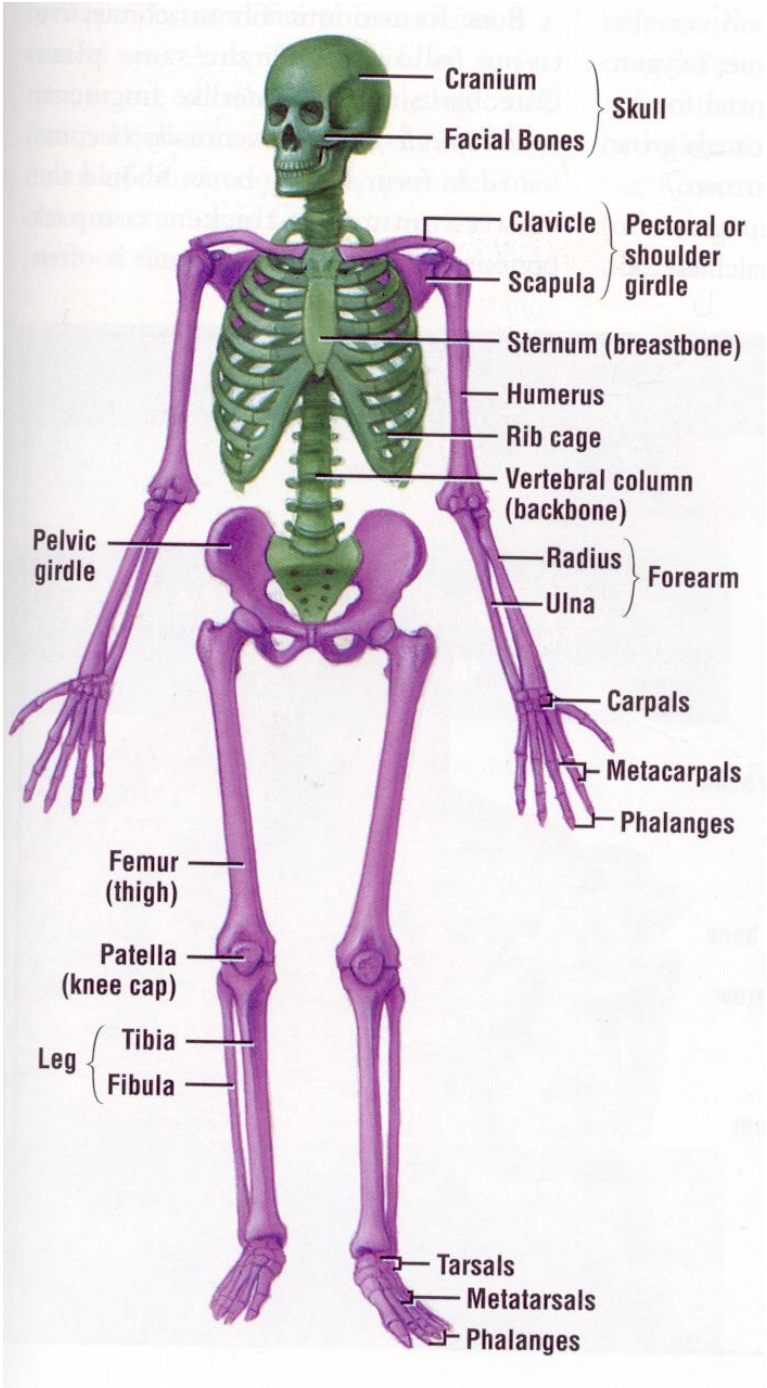
Chapter 36

36-1 The Skeleton

- Functions:
- Supports body
- Protects organs
- Provides movement
- Stores minerals
- Provides site for blood cell formation

36-1 The Skeleton

- Structure
- 206 bones in adult
- Axial-supports center of body, includes skull, vertebral column and rib cage
- Appendicular-includes arms, legs, pelvis and shoulders

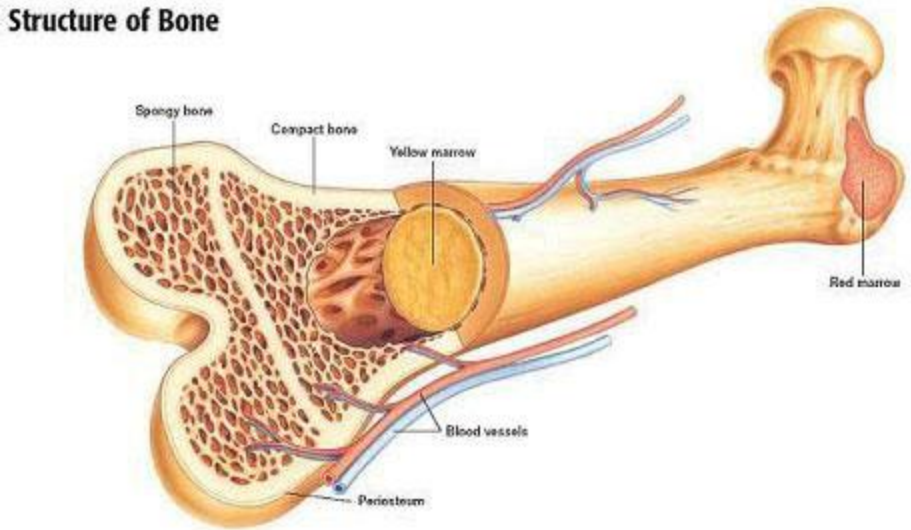

Cranium
Facial Bones
Skull
Clavicle
Scapula
Pectoral or shoulder girdle
Sternum (breastbone)
Humerus
Rib cage
Vertebral column (backbone)
Pelvic girdle
Radius
Ulna
Forearm
Carpals
Metacarpals
Phalanges
Femur (thigh)
Patella (knee cap)
Leg
Tibia
Fibula
Tarsals
Metatarsals
Phalanges

36-1 Structure of Bones

- Most of the mass is minerals (salts)
- A solid network of living cells and protein fibers surrounded by calcium and phosphorus

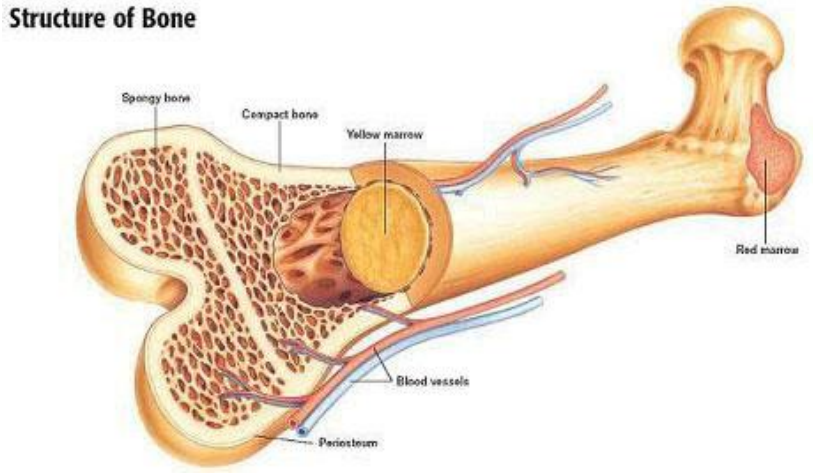
36-1 Structure of Bones

- **Outer layer**
- Periosteum-tough layer of connective tissue
- Blood vessels inside to carry oxygen and nutrients to bones



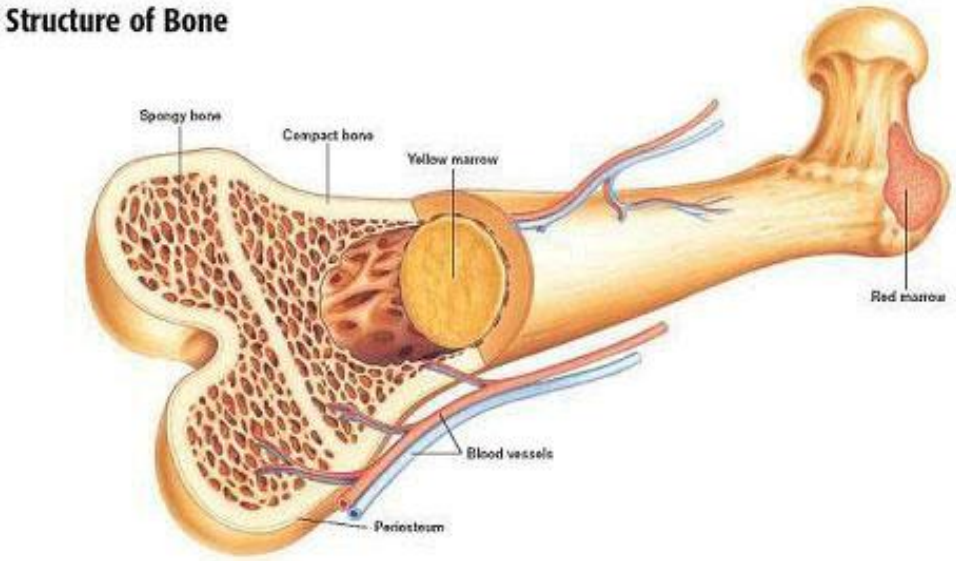
36-1 Structure of Bones

- **Compact bone**
- Thick, dense, not solid
- Haversian canals run through that have blood vessels and nerves
- Spongy layer on inside at end of long bones and center of short flat bones, provides latticework/structure without a lot of mass

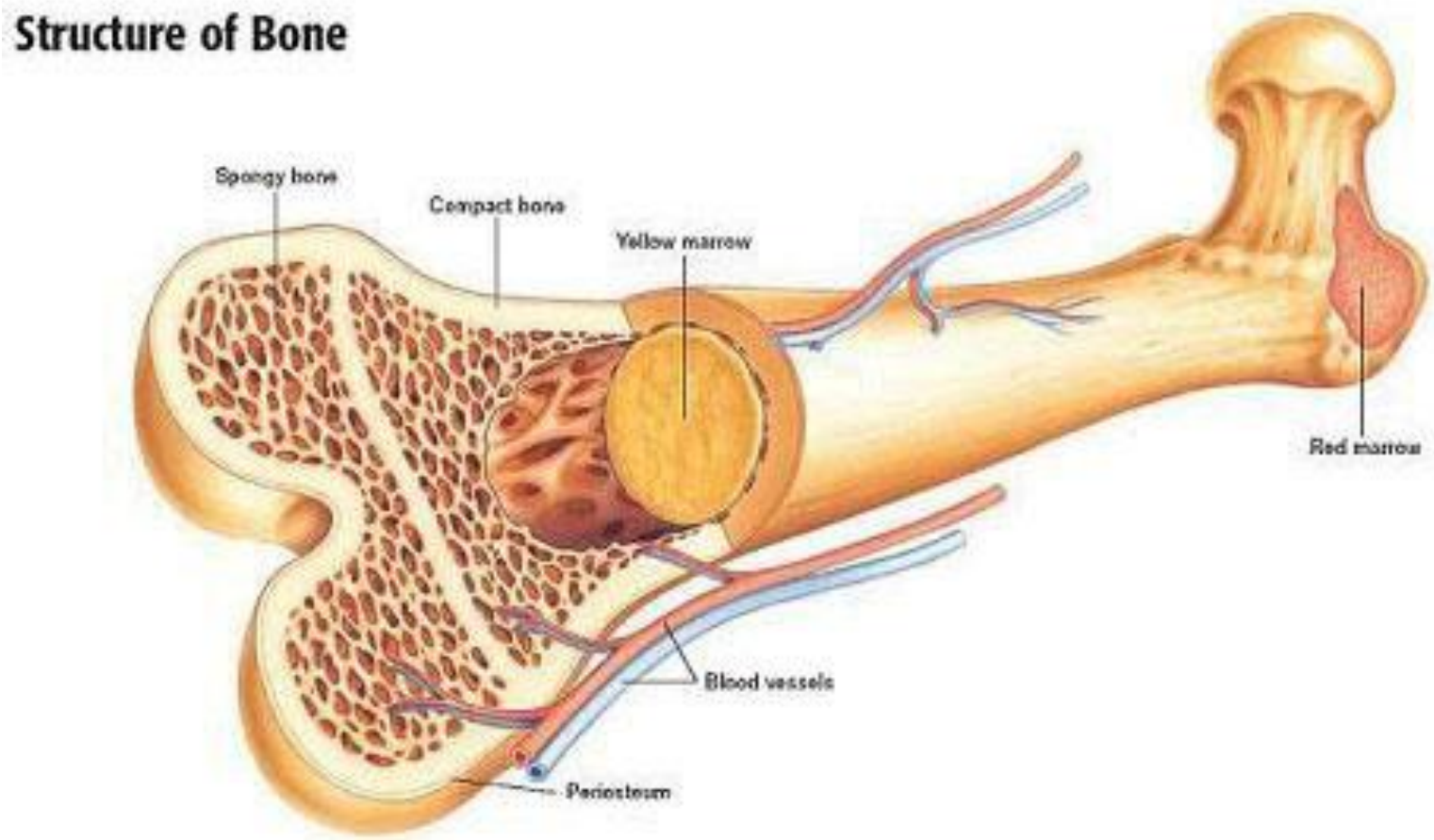


36-1 Structure of Bones

- **Bone marrow**
- Yellow-mainly fat cells
- Red-produce red blood cells, some white blood cells and platelets

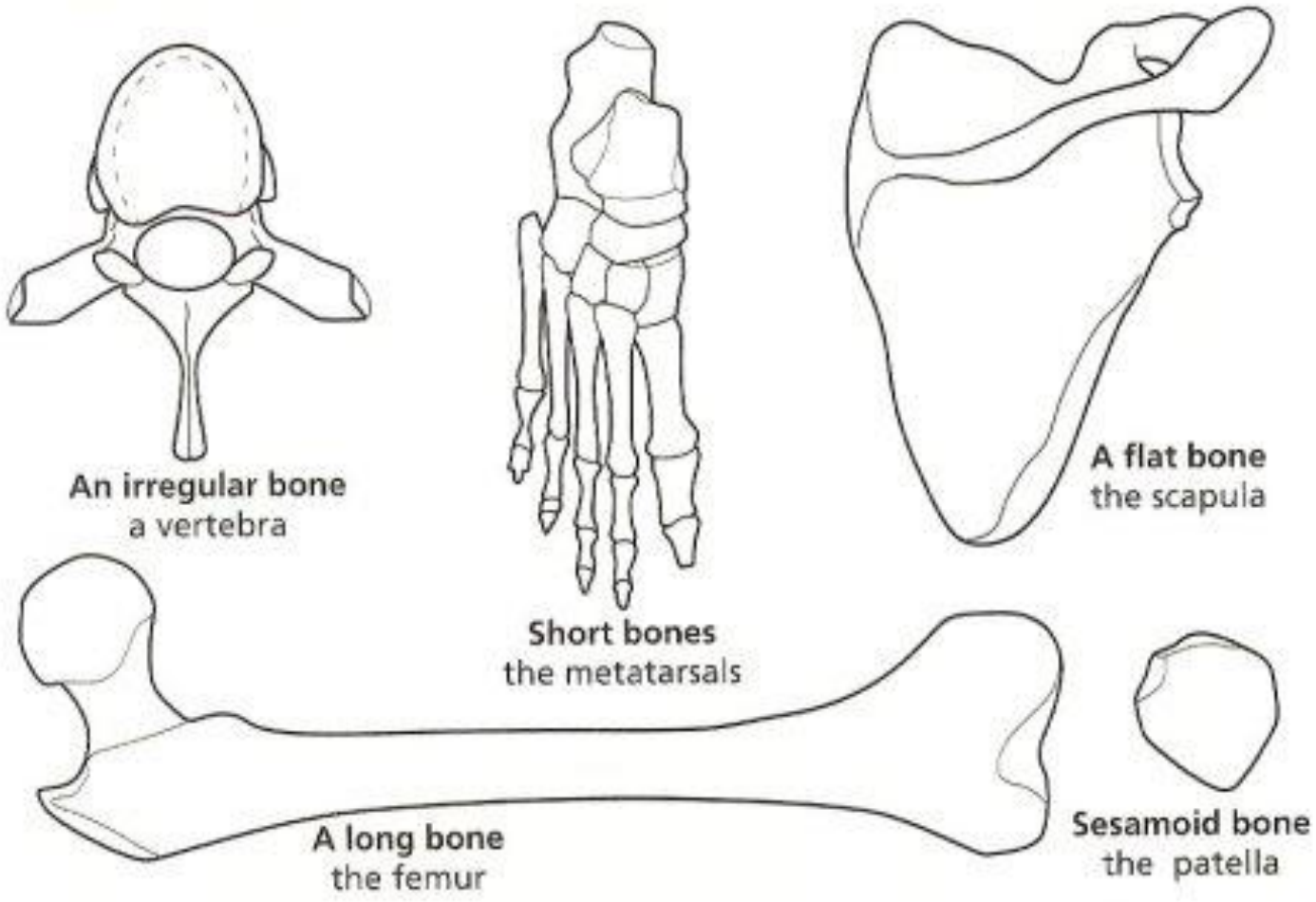


36-1 Structure of Bones



36-1 Structure of Bones

Examples of each type of bone are shown in *Figure 1.1*.



36-1 Development of Bones

- As newborns, comprised of cartilage
- Cartilage cells in a network of protein fibers-collagen, elastin. Dense, fibrous supportive and flexible
- As we age, ossification (bone formation) occurs-cartilage is replaced by bones

36-1 Development of Bones

- Osteoblasts create bone
- Osteo-bone
- Blast-cells that form new cells
- Osteoclasts break down bone
- Osteo-bone
- Clast-cells that break cells

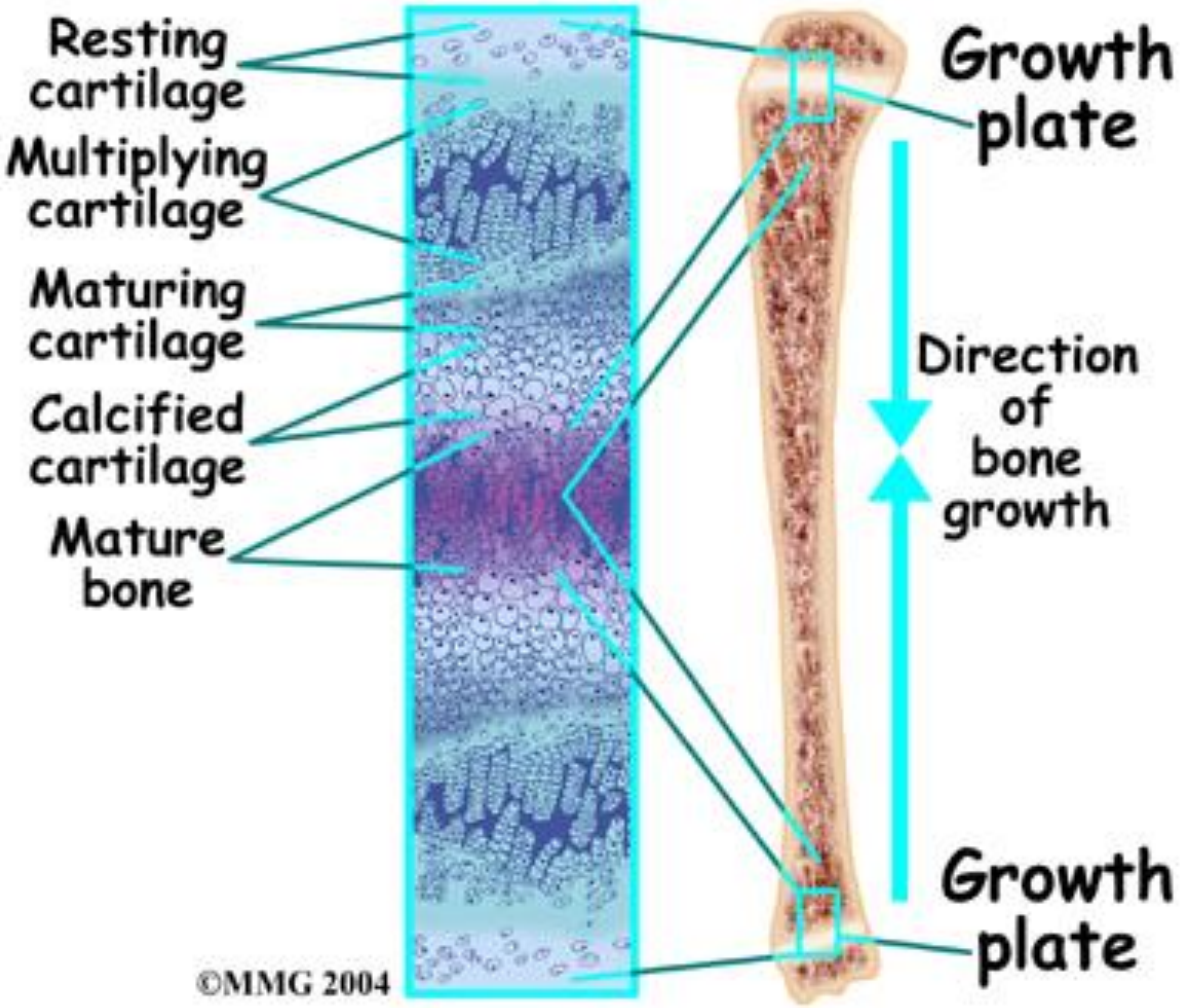
36-1 Development of Bones

- Ossification-begins 7 months before birth
- Osteoblasts secrete mineral deposits
- Osteoblasts become surrounded by bone and become osteocytes (-cyte=cell)
- Occurs at end of bones at growth plates
- Stops when you stop growing

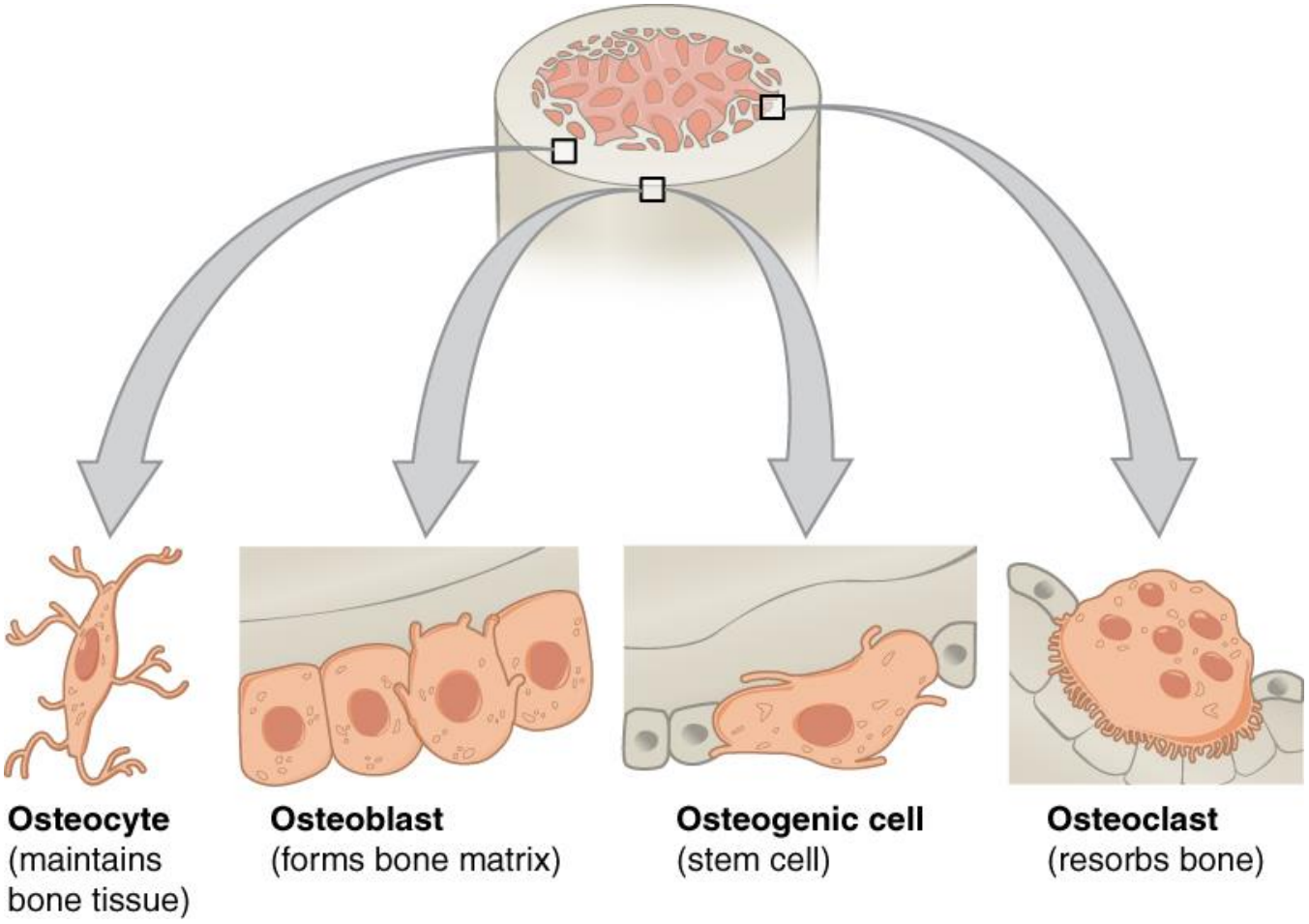
36-1 Development of Bones

- Also occurs when bones are broken
  - Osteoclasts remove damaged bone
  - Osteoblasts provide new bone
- Cartilage remains in places where flexibility is needed
  - Tip of nose, external part of ears, where rib bones are attached to sternum (breast bone at center of rib cage)

36-1 Development of Bones



36-1 Development of Bones



36-1 Types of Joints

- Immovable-bones in skull
- Slightly movable-joints between vertebrae
- Freely moving joints-ball and socket, pivot, hinge, saddle joints

36-1 Types of Joints

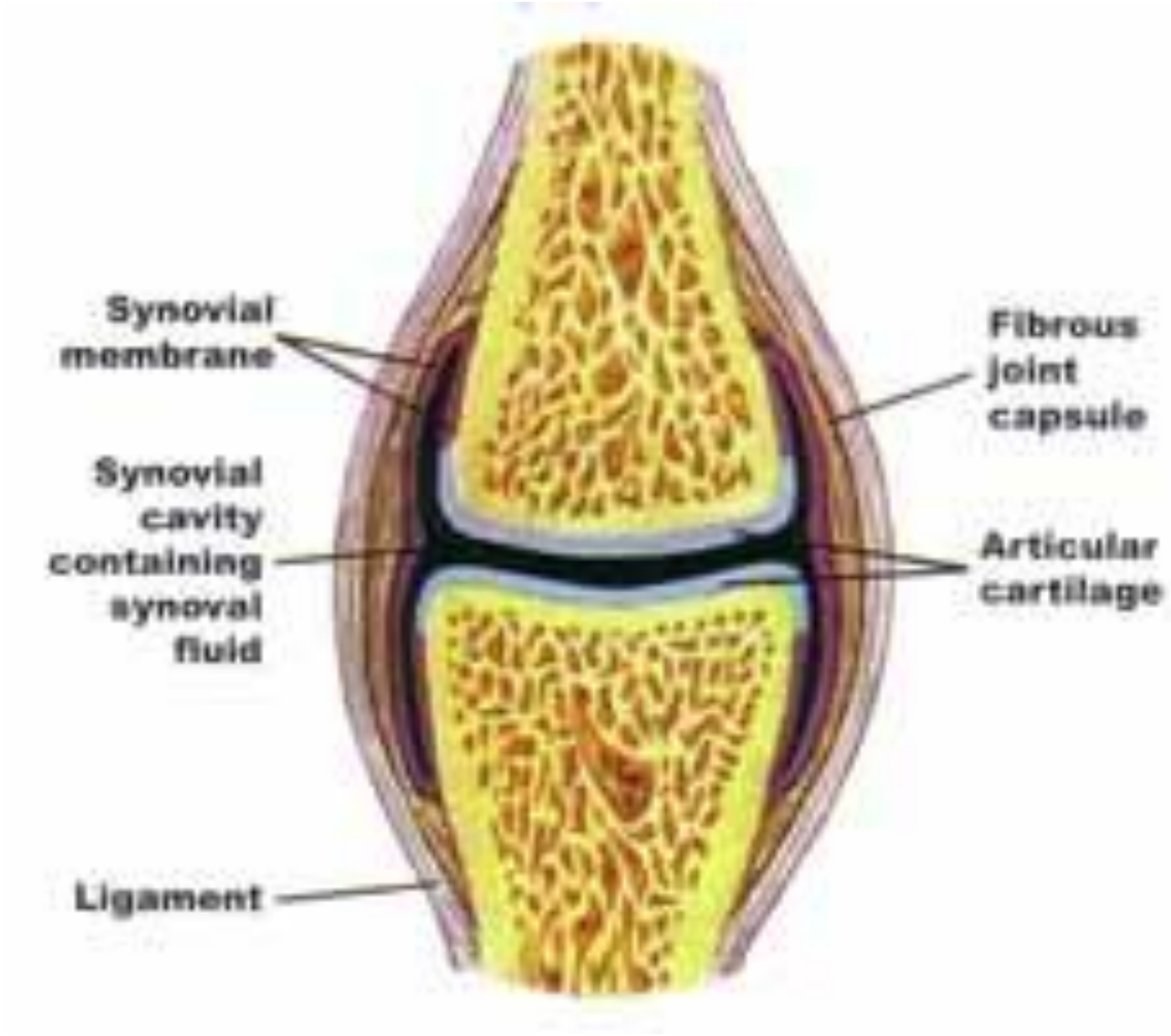
36-1 Structure of Joints

- In freely movable joints, ends are covered by cartilage to protect bones from rubbing against each other
- Surrounded by a fibrous joint capsule
  - Ligaments
  - Layer of cells that produce synovial fluid
  - Bursa are sacs of synovial fluid (knees, some other joints)

36-1 Structure of Joints

- When tissue is damaged, inflammation is the body's response
  - Swelling, redness, heat, pain
  - Bursitis-occurs in bursa
  - Arthritis-100 types, affects 10% world's population

36-1 Structure of Joints



36-2 The Muscular System

- 40% of mass of your body is muscle
- Function:
- Moves bones, maintains blood pressure, moves food through digestive system, all movement

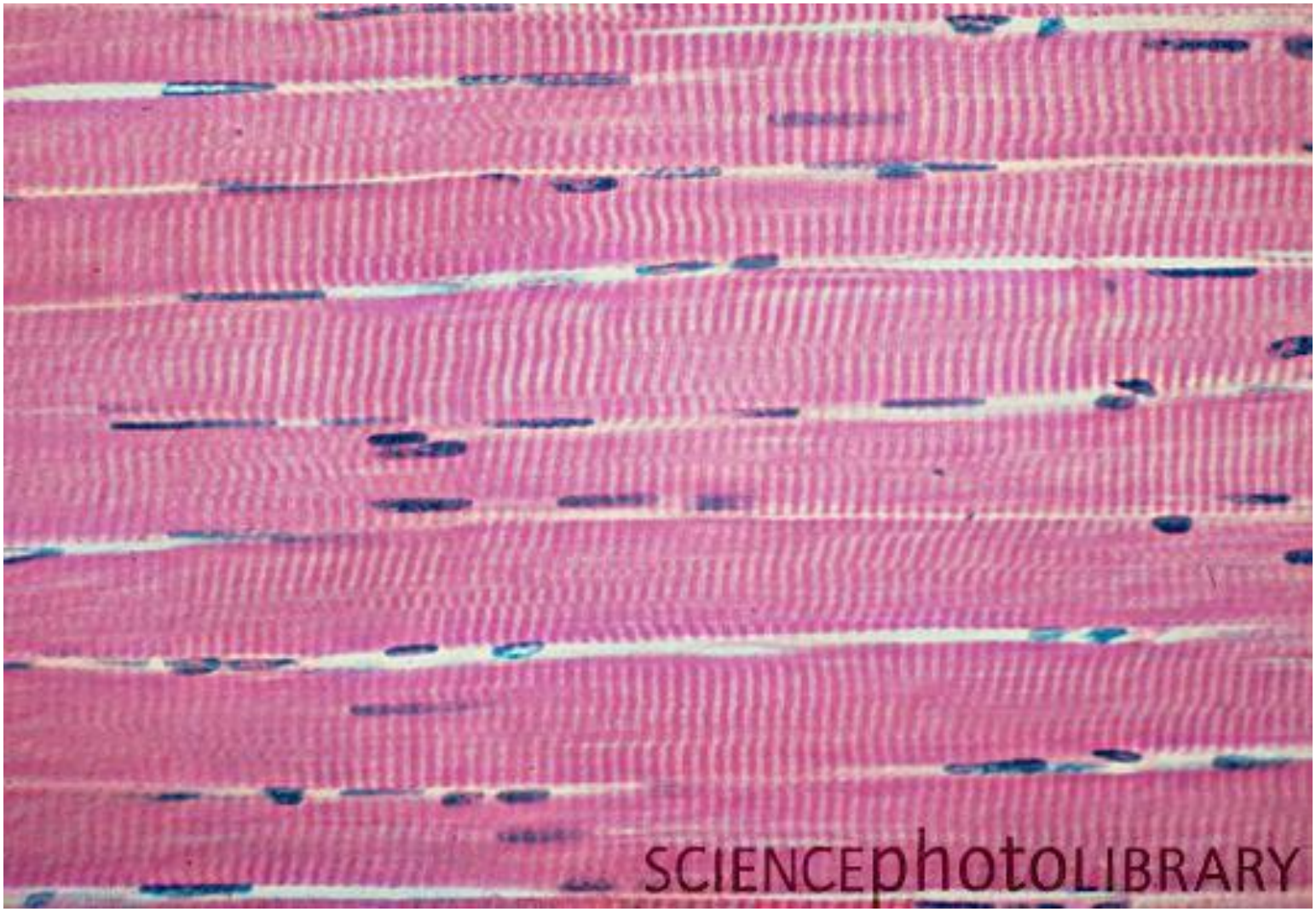
36-2 The Muscular System

- Three types of muscle
- Skeletal
- Smooth
- Cardiac

36-2 The Muscular System

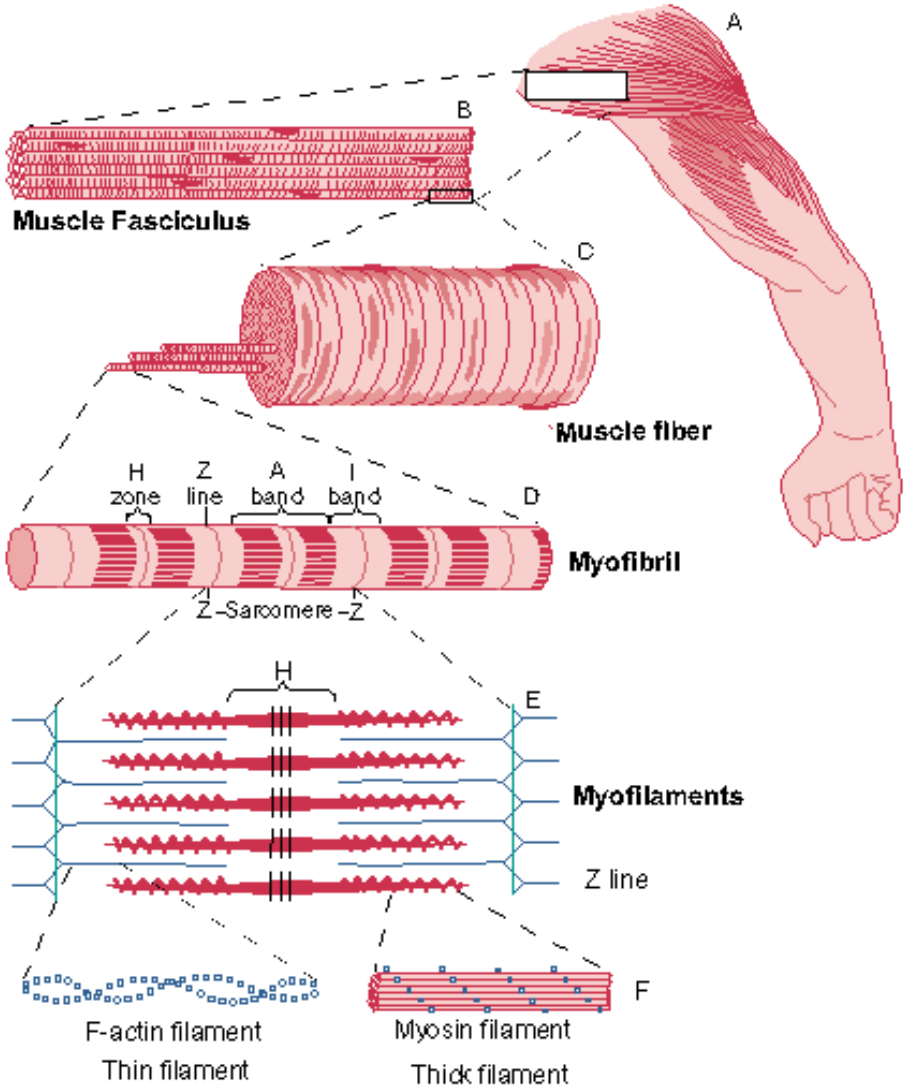
- Skeletal muscle
- Attached to bone
- Voluntary movement, most controlled by CNS
- Under microscope, alternating light and dark bands-striations
- Large (1mm-30 cm) and multinucleated
- Made of muscle fibers, connective tissue, blood vessels and nerves

36-2 Skeletal Muscle



36-2 Skeletal Muscle

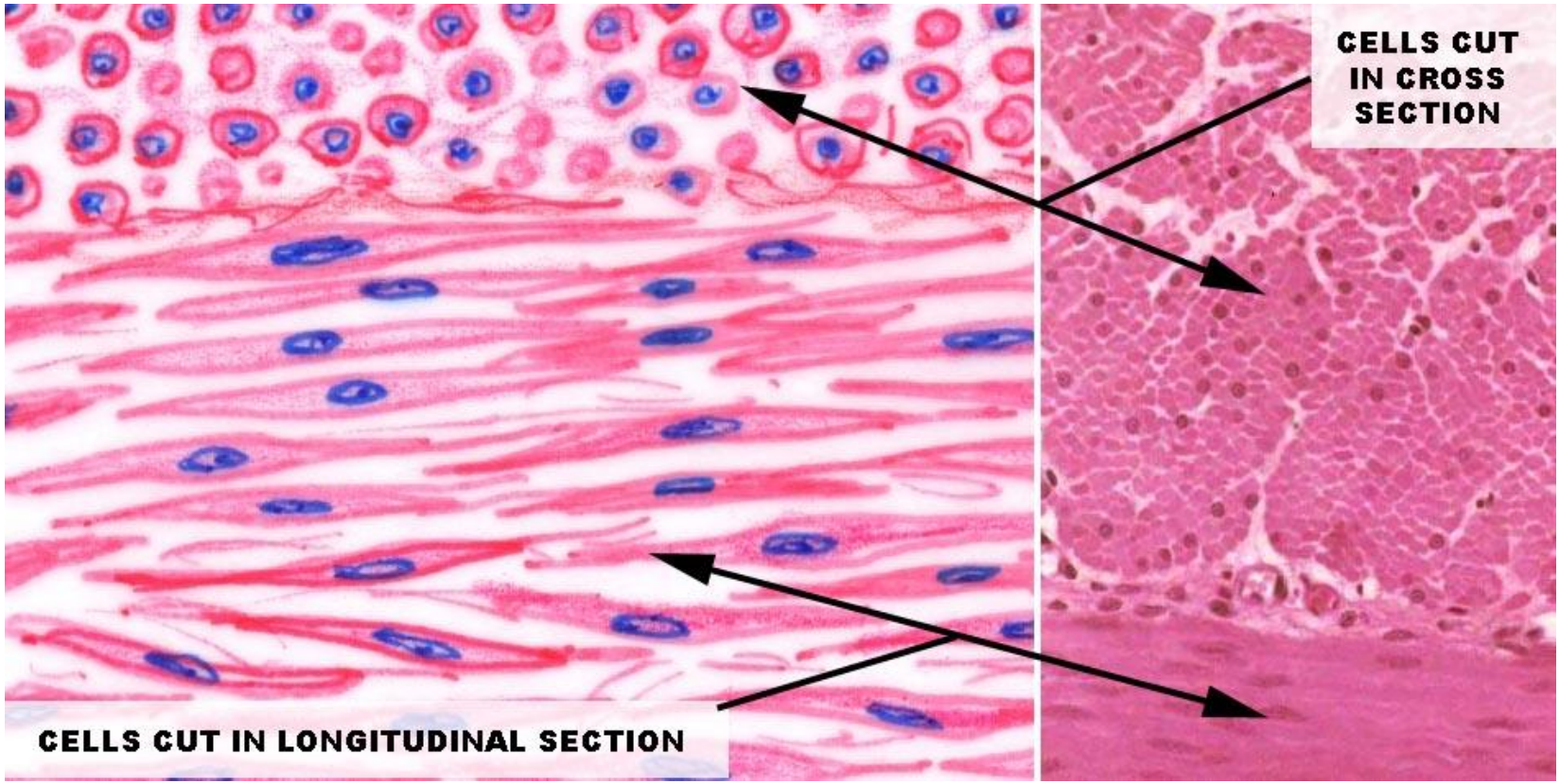
- Muscle
  - Bundle muscle fibers
    - Muscle fiber (cell)
      - Myofibril
        - » Z disc and sarcomere
          - Myosin, actin



36-2 Smooth Muscle

- Usually not under voluntary control
- Spindle shaped
- Not striated
- Not multinucleated
- Found in hollow structures-intestines, blood vessels
- Most can function without nervous stimulation, are connected to each other trough gap junctions so nerve impulses can pass from one cell to the next

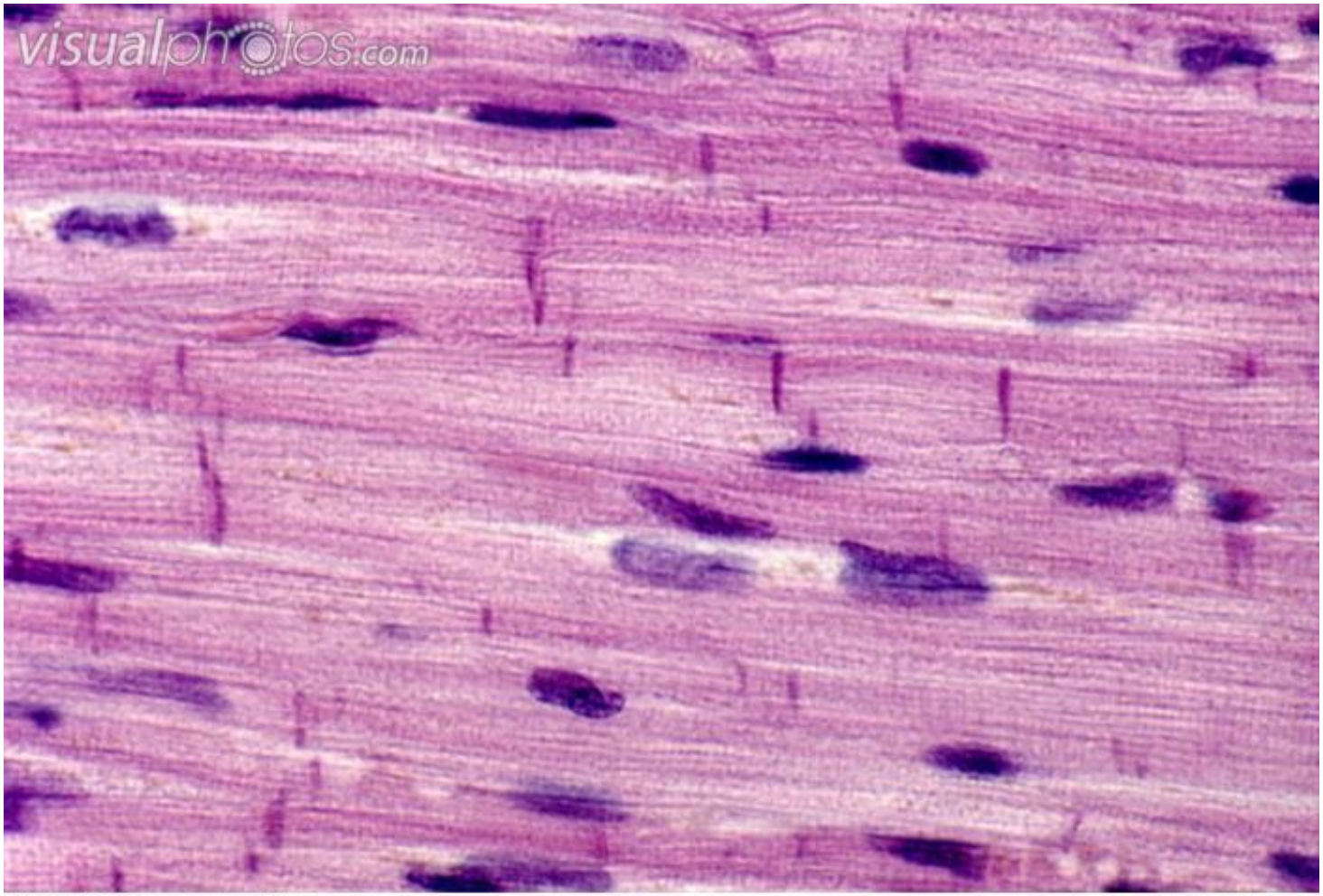
36-2 Smooth Muscle



36-2 Cardiac muscle

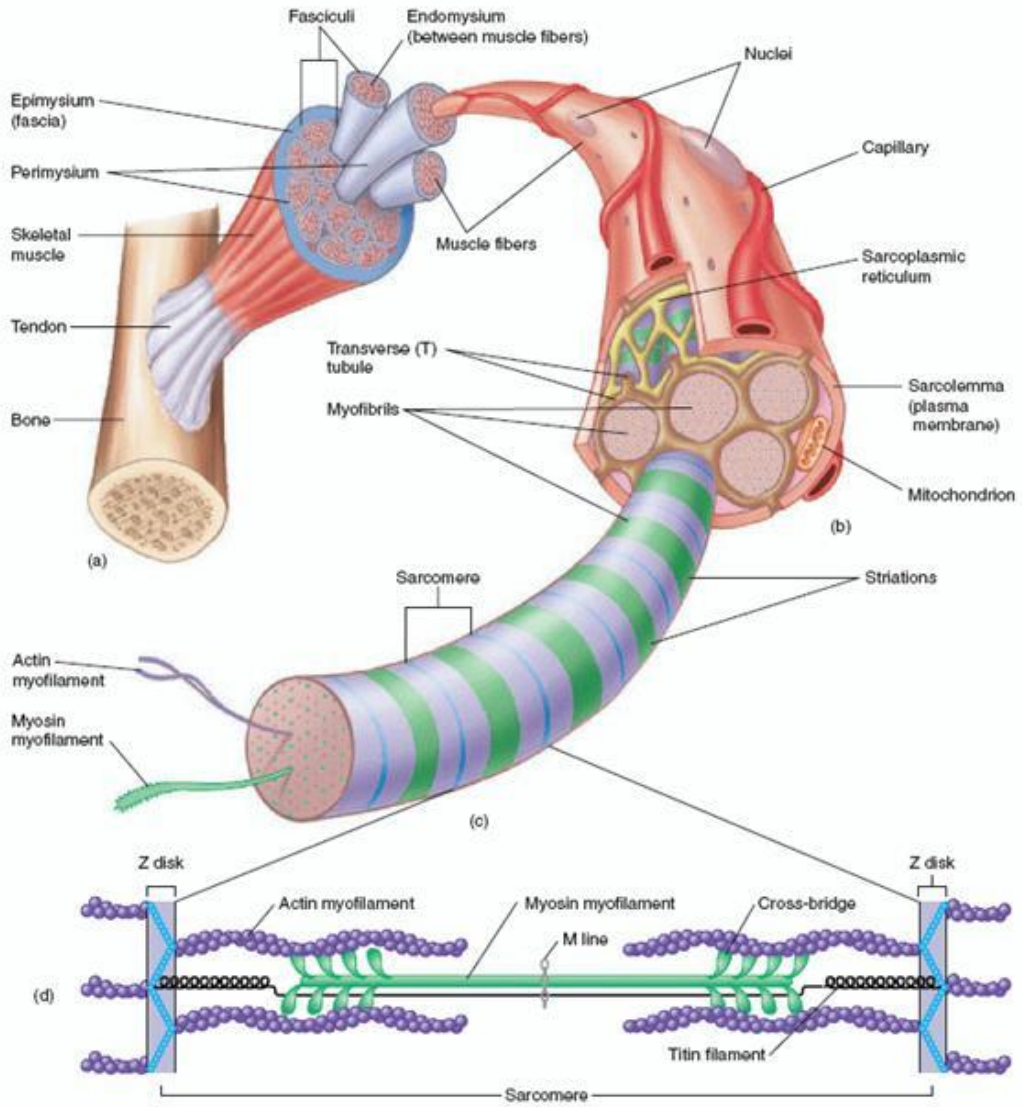
- Found only in heart
- Striated
- Cells smaller than skeletal muscle
- One or two nuclei
- Can function without nervous stimulation, are connected to each other trough gap junctions so nerve impulses can pass from one cell to the next

36-2 Cardiac muscle



36-2 Muscle Contraction

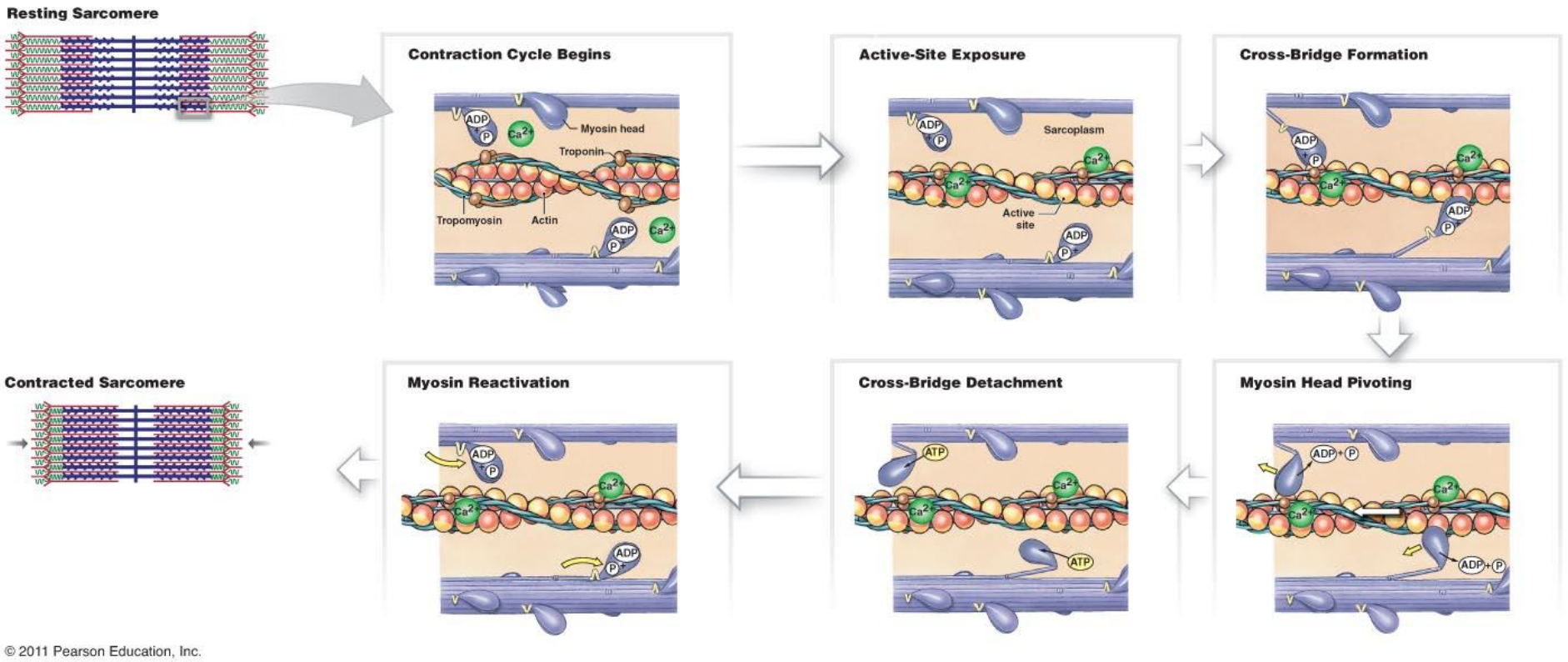
- Myofibrils
  - Myofilaments
    - Thick and thin
    - Myosin and actin



36-2 Muscle Contraction

- Contraction occurs when thick and thin filaments (myosin and actin proteins) move past each other
- Cross bridges form between the two protein molecules
- Cross bridge changes shape, pulls on actin filament which slides toward center of sarcomere (smallest unit of muscle proteins that can contract) and distance between the Z discs (ends of sarcomeres) decreases
- Cross bridge released
- Process repeated

36-2 Muscle Contraction

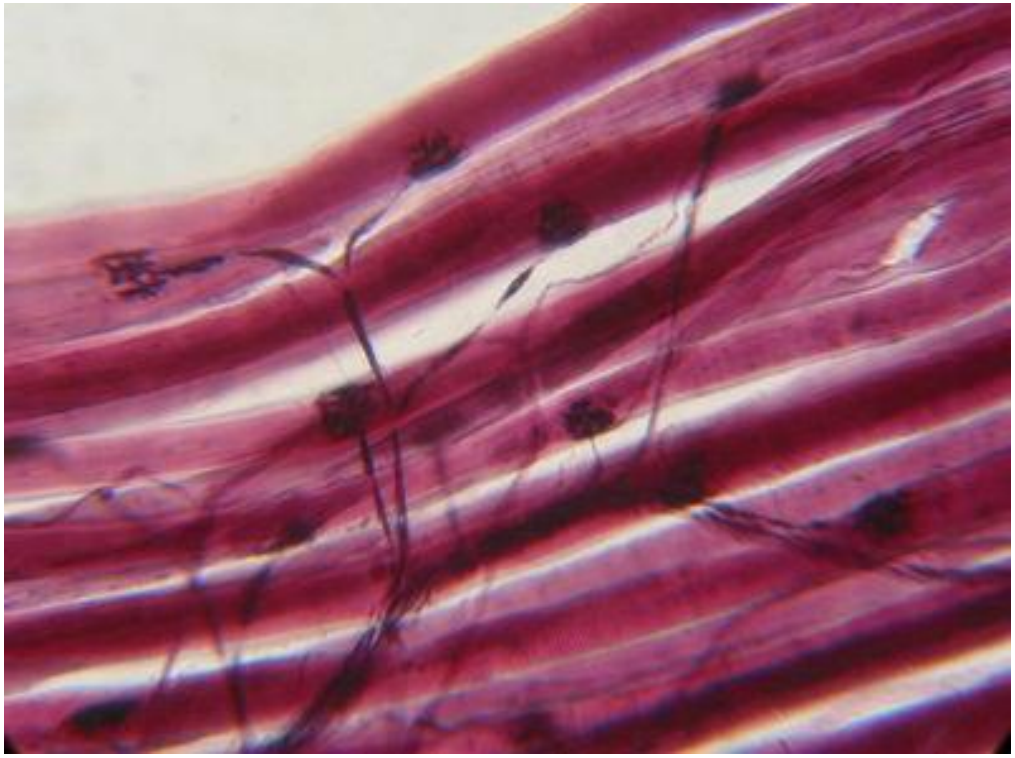


36-2 Control of muscle contraction

- Skeletal muscle must contract in a controlled fashion
- Controlled by CNS and PNS, brain to motor neurons to muscle

36-2 Control of muscle contraction

- Neuromuscular junction-where motor neuron meets muscle



36-2 Control of muscle contraction

- Pockets (vesicles) in axons of motor neuron release acetycholine
- Acetycholine molecules diffuse across synapse
- Causes an “impulse” that causes the release of Ca^{++} (Ca^{2+}, calcium ions)
- Ca^{2+} causes proteins to make actin and myosin form cross bridges to cause contraction

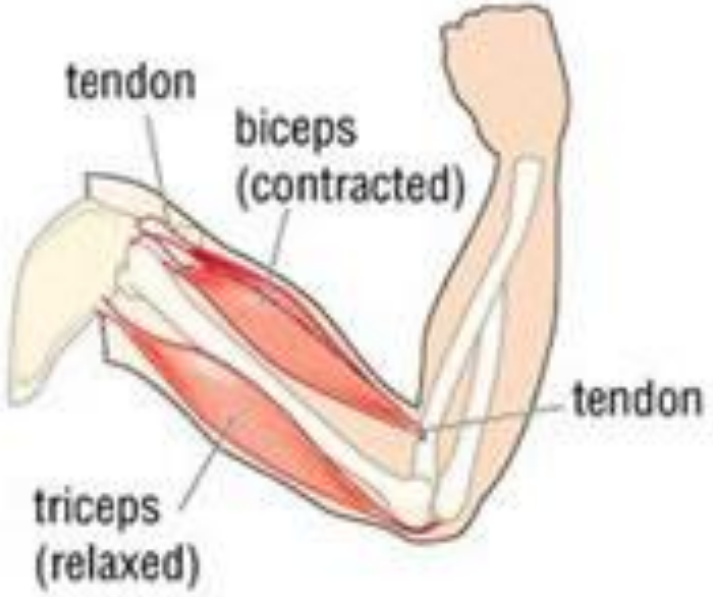
36-2 Muscle Contraction

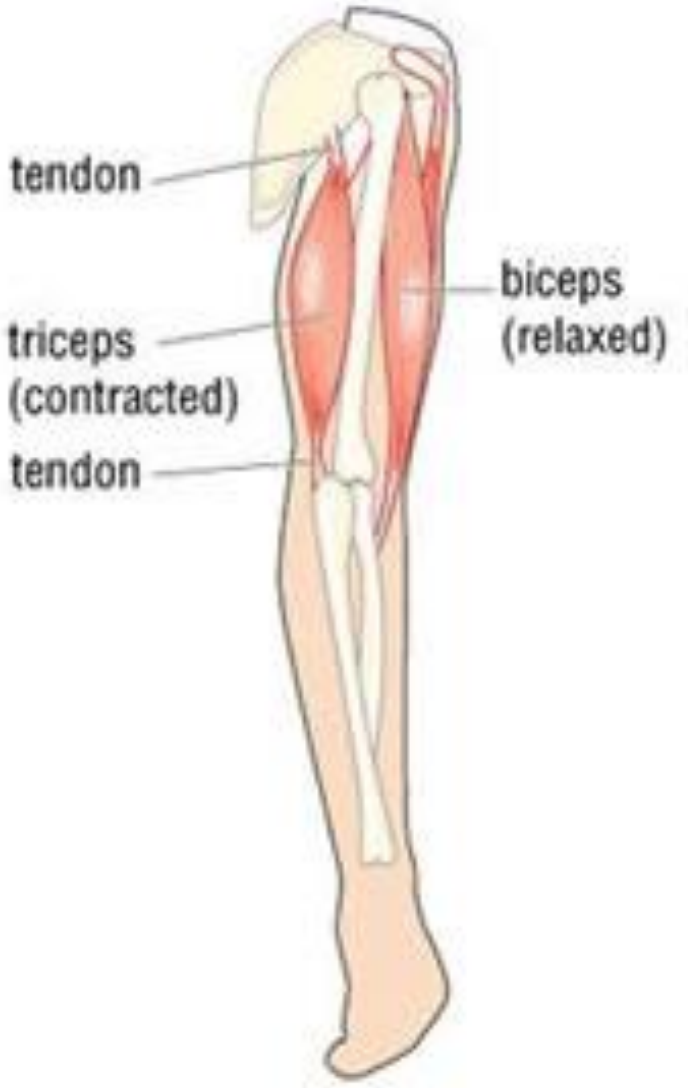
- https://www.youtube.com/watch?v=BMT4PtXRCVA

36-2 How muscles and bones interact

- Skeletal muscles generate force by contracting and pulling on bones
- Muscles are attached to bone by connective tissue called tendons
- Tendons pull on bones and make them act as levers
- Joint is the fulcrum
- Usually several muscle pull the lever (bone) in different directions
- Most skeletal muscles work as opposing pairs, when one contracts the other relaxes

36-2 How muscles and bones interact





36-2 How muscles and bones interact

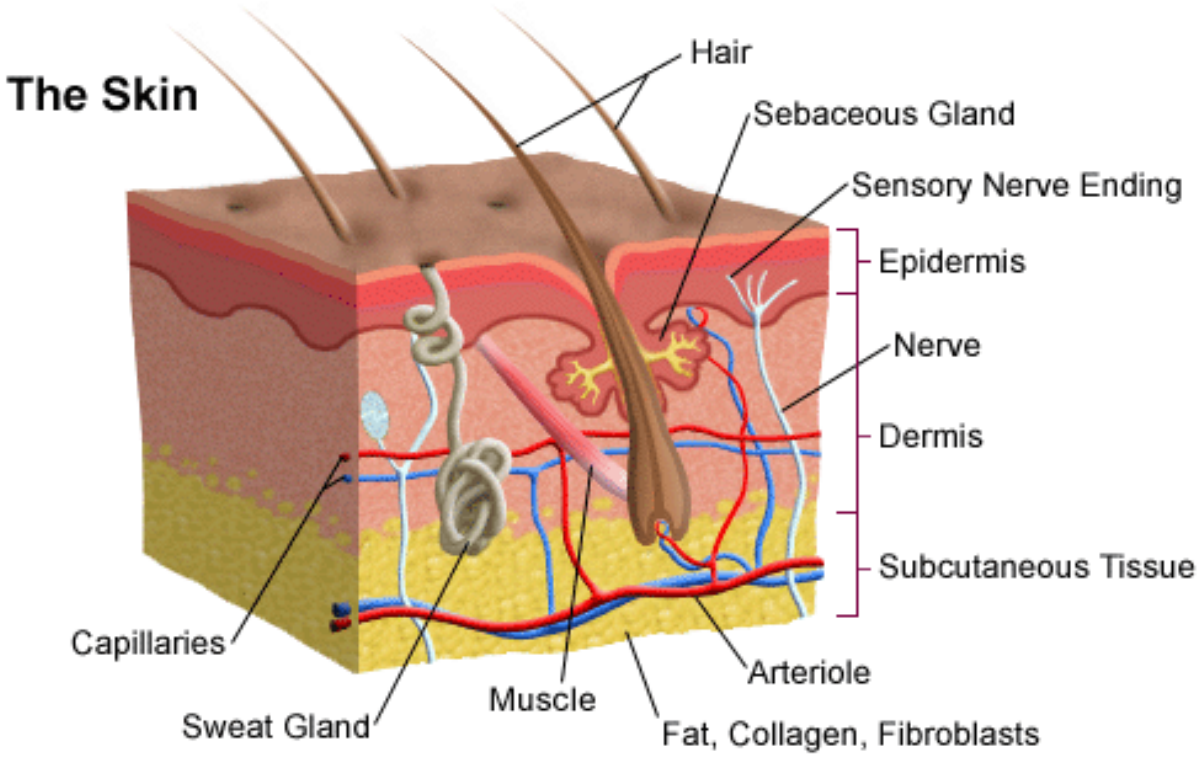
- Skeletal muscle mainly partially contracted, some of the cells are contracted, some are not-resting muscle tone
- Keeps back and legs straight
- Regular exercise increases muscle tone
- Muscles grow by making new material within the muscle cells
- Muscles not used get smaller and weaker

36-3 The Integumentary System

- The Skin-Functions
- Barrier against infection and injury
- Regulates body temperature
- Removes waste products
- Provides protection against UV radiation

36-3 The Skin

- 2 main layers-epidermis, dermis
- Underneath subcutaneous fat, connective tissue



36-3 The Skin

- Epidermis
- Outer layer of skin
- No blood vessels
- Outside made of dead cells
- Inside made of living cells
  - Cells reproduce rapidly
  - Cells form keratin
  - Melanocyte-pigment cells-melanin

36-3 The Skin

- Dermis
- Inner layer of skin
- Contains collagen, blood vessels, nerve endings, glands, sense organs, smooth muscles and hair follicles
- Blood vessels narrow when cold, widen when hot to regulate body temperature (change surface area of heat exchange between cells and blood)

36-3 The Skin

- Dermis (continued)
- Two types of glands
- Sebaceous glands-oil-secrets sebum which makes keratin waterproof
- Sweat glands-perspiration (water, salts, minerals) evaporates to regulate body temperature

36-3 UV Index

UV Index	Description	Recommended Protection	Sun Burn Time
0-2	No danger to the average person	Wearing a Hat and/or Sunglasses is Sufficient	1 Hour+
3-5	Little risk of harm from unprotected sun exposure	Wear a Hat and Sunglasses. Use SPF 15+ Sunscreen	40 Minutes
6-7	High risk of harm from unprotected sun exposure	Wear a Hat and Sunglasses. Use SPF 30+ Sunscreen. Cover the Body With Clothing. Avoid the Sun if Possible.	30 Minutes
8-10	Very high risk of harm from unprotected sun exposure	Wear a Hat and Sunglasses. Use SPF 30+ Sunscreen. Cover the Body With Clothing. Avoid the Sun if Possible.	20 Minutes
11+	Extreme risk of harm from unprotected sun exposure	Take All Precautions Possible. It is Advised to Stay Indoors.	Less Than 15 Minutes

36-3 Monthly UV Index in San Jose 2014

Month	Average
January	2.0
February	2.79
March	4.74
April	7.3
May	8.42
June	9.61
July	10.03
August	8.55
September	7
October	4.57
November	2.63
December	1.69

36-3 Hair and Nails

- Basic structure is keratin (same as bird feathers, reptile scales)
- Hair-protects from UV, provides insulation, prevent dirt and particles from entering eyes, nose, ears
  - Grow from hair follicles that are in close contact with sebaceous glands
  - Cells fill in with keratin as they grow, then die

36-3 Hair and Nails

- Nails-protect tips of fingers and toes
- Grow from nail root
- Cells fill in with keratin as they grow, then die
- Fingernails-3mm per month, toenails 4X as fast

36-2 Uses and Making of artificial skin

- https://www.youtube.com/watch?v=5A3VlwNHGII