# Histology of Muscle and Bone

## Muscle

<table>
<thead>
<tr>
<th>Type</th>
<th>Skeletal</th>
<th>Cardiac</th>
<th>Smooth</th>
</tr>
</thead>
<tbody>
<tr>
<td>Nucleus</td>
<td>multinucleated; on cell periphery</td>
<td>one nucleus; centrally located</td>
<td>one nucleus; centrally located</td>
</tr>
<tr>
<td>Cell Appearance</td>
<td>striated</td>
<td>striated</td>
<td>non-striated</td>
</tr>
<tr>
<td>Special Feature</td>
<td></td>
<td>intercalated discs*, cell branching</td>
<td>can tonically contract</td>
</tr>
<tr>
<td>Control</td>
<td>voluntary &amp; involuntary</td>
<td>involuntary</td>
<td>involuntary</td>
</tr>
<tr>
<td>Function</td>
<td>movement, heat generation, posture &amp; support</td>
<td>pump blood through heart &amp; body</td>
<td>movement of food, blood vessels, “goose bumps”</td>
</tr>
<tr>
<td>Location</td>
<td>attached to bones</td>
<td>heart</td>
<td>walls of internal organs, skin</td>
</tr>
</tbody>
</table>

*intercalated discs: specialized cell junctions (esp. gap junctions) that allow cardiac muscle cells to contract at the same time

### Skeletal Muscle

![Image of Skeletal Muscle](image1.png)

### Cardiac Muscle

![Image of Cardiac Muscle](image2.png)
Sarcomere

- Microscopic regions of muscles that give striated appearance
- Chain of proteins that act like a spring and shorten during contraction
- Contain two types of myofilaments:
  - Thick aka myosin
  - Thin aka actin

Z – Z disc: borders of sarcomere
A – A band: thick & thin filaments
I – I band: thin filaments - bisected by Z disc
H – H zone: thick filaments
M – M disc: bisect H zone

Bones
- Functions:
  - Attachment sites for muscles
  - Protection of internal organs
  - Calcium storage
• Three types of cells are found in bones:
  o Osteoblasts:
    ▪ Immature bone cells that secrete osteoid
      • Gives bone strength
      • Compared to hydroxyapatite that gives bone hardness
    ▪ Develop into osteocytes
  o Osteocytes:
    ▪ Mature bone cells
    ▪ Function to maintain bone
  o Osteoclasts
    ▪ Resorption of bone
    ▪ Releases calcium stored in bones back into blood

• Two types of bone:
  o Compact
    ▪ Made up of osteons

- Nutrients diffuse from vessels in central canal to osteocytes by way of the cell processes
- Central canals are connected by perforating canals (aka Volkmann’s canal)
- External layer
• Spongy bone
  ▪ Lack osteons, but are composed of trabeculae
  ▪ Support beams of bone
  ▪ Internal to compact bone

Bone Growth
• Endochondrial Ossification
  o The calcification of cartilage
  o Chondrocytes: cartilage cells

• Length
  o Occurs at epiphyseal plates aka growth plates
  o Involves hyaline cartilage

A – zone of resting cartilage: randomly arranged chondrocytes

B - zone of proliferation: chondrocytes line up in rows

C – zone of maturation & hypertrophy: chondrocytes enlarge and mature

D – zone of calcification: death of chondrocytes

Epiphysis is the End of a bone
Diaphysis is the shaft of a bone

• Width
  o Occurs by adding osteon to osteon