Smooth Muscle

- Found in walls of most hollow organs:
  - Respiratory, digestive, urinary, reproductive; circulatory (except in smallest of blood vessels)
  - Not found in heart – heart contains cardiac muscle, not smooth

- Most smooth muscle organized into sheets of tightly packed fibers

- Many organs contain two layers of sheets with fibers oriented at right angles to each other – but not in blood vessels
  - **Longitudinal layer:** fibers run parallel to long axis of organ
    - Contraction causes organ to shorten
  - **Circular layer:** fibers run around circumference of organ
    - Contraction causes lumen of organ to constrict

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Smooth Muscle in the Wall of a Blood Vessel

Differences Between Smooth and Skeletal Muscle

<table>
<thead>
<tr>
<th>Characteristic</th>
<th>Skeletal Muscle</th>
<th>Smooth Muscle</th>
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</table>
| Fiber Characteristics          | 1. Long, thin, multinucleate fibers  
2. Myofibrils highly organized into sarcomeres  
3. N-triplet system linking thin filaments to Z disks  
4. Sarcomeres arranged parallel to the length of the fiber during contraction | 1. Small, spindle-shaped, fibers each with a central nucleus  
2. Myofibrils not highly organized into sarcomeres  
3. No N-triplet system linking thin filaments to Z disks  
4. Sarcomeres not arranged parallel to the length of the fiber during contraction | |
| Connective Tissue Involvement   | Connective tissue throughout including organized layers - endo-, peri- and epimysium | Same endomysium present |
| Neural-Muscular Synapse         | Neuronal-muscular synapse contains chemical synapse between motor neuron and individual fiber | Automatic neuromuscular transmission of impulse between neurons containing multiple fibers |
| Junction-Coupling               | 1. Triads consisting of one T tubule flanked by SR terminal cisterns located at each of each A band  
2. Ca++ stores in SR stimulate cross bridge formation | 1. No T tubules or terminal cisterns, no pattern to SR  
2. Extracellular Ca++ primary stimulus for contraction  
3. Caveolae in sarcolemma contain gated Ca++ channels |
| Fiber-to-Fiber Communication    | NONE | 1. Gap junctions between fibers permit depolarization to spread  
2. Synchronized contraction like cardiac muscle |
Innervation of Smooth Muscle

Sources of Ca\(^{2+}\) for Smooth Muscle Contraction

Intermediate Filaments and Dense Bodies of Smooth Muscle Fibers Harness the Pull Generated by Myosin Cross Bridges
Smooth Muscle Contraction

- Slow, synchronized – slow to contract, slow to relax
  - Can stay contracted for long periods without fatigue
- Pacemaker cells present in some organs
  - Waves of contraction occur regularly in organs like intestines
- Exhibits tone in many organs
- Neurotransmitters and hormones may stimulate contraction or relaxation
  - ACh stimulates bronchial SM to contract; Norepinephrine inhibits causing relaxation
  - Highly dependent on location: NE in blood vessel SM causes contraction
- Stretch-relaxation response
  - In most cases, forces that stretch SM cause relaxation of fibers
  - Length vs tension response more tolerant of stretch