NOTES: The Muscular System (Ch 6, part 2)
MUSCULAR RESPONSES

THRESHOLD STIMULUS: the minimal stimulus required to cause a muscular contraction
MUSCULAR RESPONSES

ALL-OR-NONE RESPONSE:
-if a skeletal muscle fiber contracts at all, it will contract completely
-motor units (all muscle fibers innervated by the same motor neuron) also respond in an all-or-none manner
MUSCULAR RESPONSES

SUMMATION:

-a rapid series of stimuli may produce summation of **Twitches** (short contractions)

-forceful, sustained contraction without relaxation is a **tetanic contraction** (**Tetanus**)

![Graph showing the force of contraction over time with labeled phases: Contraction period, Latent period, Relaxation period.](image)
**Tetanus**

The baby has neonatal tetanus and is completely rigid.

The child has painful muscle spasms from tetanus; it is nearly impossible for her to move or control the muscles in her body.

Source: CDC

Organisms enter through large, small, or even unrecognized wound. Deep, infected punctures are most susceptible, since organisms thrive best anaerobically.

*Clostridium tetani*: gram-positive, spore-bearing rods

Toxin produced locally passes via bloodstream or along nerves to central nervous system.

Spasm of jaw, facial and neck muscles (trismus, lockjaw), risus sardonicus and dysphagia are often early symptoms after variable incubation period.

Motor neurons of spinal cord (anterior horn) and of brainstem become hyperactive because toxin specifically attacks inhibitory (Renshaw) cells.

Complete tetanic spasm in advanced disease. Patient rigid in moderate opisthotonos, with arms extended, abdomen boardlike. Respiratory arrest may occur.
MUSCULAR RESPONSES

*even when a muscle appears to be at rest, its fibers remain partially contracted...this is known as “muscle tone,” or **TONUS**
the contractile mechanism of smooth muscle is similar to that of skeletal muscle.
SMOOTH MUSCLE

⇒ Smooth Muscle Fibers:
> smooth muscle cells contain filaments of actin and myosin
Types of Smooth Muscle:

1) Multiunit Smooth Muscle:
   - muscle fibers are separate and organized into sheets
   - contracts in response to motor nerve impulses or certain hormones
   - found in:
     - the irises of the eyes
     - the walls of blood vessels
Types of Smooth Muscle:

2) Visceral Smooth Muscle:

- more common type of smooth muscle
- found in:
  - walls of hollow organs (e.g. stomach, intestines, urinary bladder)
• Visceral smooth muscle fibers have these unique characteristics:
  * they can stimulate one another to contract
  * they can self-stimulate
  * they display a repeated contraction pattern (they can self-stimulate) known as RHYTHMICITY
Smooth Muscle Contraction:

*resembles skeletal muscle contraction in many ways
Characteristics Unique to Smooth Muscle Contraction:

- affected by two neurotransmitters: **acetylcholine and norepinephrine** (in addition to hormones)

- can maintain a contraction longer than skeletal muscle

- **can change length without changing tension** (smooth muscle lining the stomach can stretch but still maintain pressure inside the stomach)
CARDIAC MUSCLE

• **found only in the heart**

• contraction mechanism is essentially the same as that of skeletal muscle and smooth muscle
Characteristics Unique to Cardiac Muscle:

• composed of striated cells joined end to end
• cardiac muscle twitches last longer than skeletal muscle twitches
• cells are connected by INTERCALATED DISCS (which function in transmitting the force of contraction from cell to cell)
Characteristics Unique to Cardiac Muscle:

• the network of cardiac cells contracts as a unit *(all-or-none response!)*
• cardiac muscle is **SELF-EXCITING** and **RHYTHMIC**
SKELETAL MUSCLE ACTIONS

*the type of movement a skeletal muscle produces depends on the way the muscle attaches on either side of a joint.

- **immovable end of a skeletal muscle** is called the **ORIGIN** (may be more than one)
- **movable end of a skeletal muscle** is called the **INSERTION**
SKELETAL MUSCLE ACTIONS

*when a muscle contracts, its insertion is pulled towards its origin.*
Interaction of Skeletal Muscles:

> skeletal muscles function in groups

> the muscle responsible for most of a movement is the: **PRIME MOVER** (or **AGONIST**)
Interaction of Skeletal Muscles:

> muscles that contract and assist the prime mover are: **SYNERGISTS**

> muscles that resist the action of the prime mover are: **ANTAGONISTS**