Energy for Muscle Contractions: Direct phosphorylation Aerobic respiration Anaerobic respiration (lactic acid fermentation)	 Creatine phosphate loses a phosphate to ADP to create ATP Requires oxygen to turn glucose into 38 ATP in the mitochondria – first pathway the body uses Does not require oxygen to turn glucose into only 2 ATP and builds up lactic acid as a by-product
Muscle Fatigue	Muscle is unable to contract even though it is still being stimulated
Causes of muscle fatigue	Lack of ATP Depletion of oxygen and glucose High levels of lactic acid
Isotonic Concentric Eccentric Isometric	Same tone or tension as the muscle moves through a range of motion Contracting and shortening the muscle Contracting and lengthening the muscle Same length and muscle does not shorten
Muscle Tone	Non-visible contraction of some fibers even when the muscle is relaxed

Aerobic or endurance exercise benefits	Stronger, more flexible muscles with greater resistance to fatigue Blood supply increases Mitochondria number increases Stores more oxygen Helps body metabolism and digestion Heart hypertrophies (enlarges) Lungs more efficient DOES NOT INCREASE SIZE OF MUSCLE
Resistance exercise benefits	Increases number of myofilaments not number of muscle cells Increases amount of connective tissue supporting the muscle
Paralysis	When nerve supply to a muscle is destroyed and muscle is no longer stimulated
Torticollis (wryneck)	When sternocleidomastoid or platysma gets injured during birth
Muscular dystrophy	Inherited muscle destroying diseases where fat gets deposited and muscle fibers degenerate and atrophy

Myasthenia gravis	Characterized by droopy eyelids, difficulty in swallowing and talking, and generalized muscle weakness There is a shortage of ACh and death usually involves respiratory failure
Muscle Development: Embryo to just after Birth	In embryo = muscles laid down in segments and then nerves attach Development of the muscular system occurs early in pregnancy 16th week = mother can feel the baby's movements After birth = movements are reflex type movements because nervous system is not mature yet
Muscle Development: Motor control changes to Old Age	Gross to fine motor control: Babies learn how to raise their head before they can sit up which is before they can walk OR Babies learn how to wave bye-bye before grasping a pen Mid-adolescence = reached peak of neural control Old Age = muscle tissue decreases which can cause a drop in weight and decrease in strength
Functions of Muscular System	External and internal body movement Maintains posture Stabilizes joints Generates heats by shivering
Skeletal Muscle	Location – attached to bone Striation – yes Number of nuclei – many Control - voluntary

Smooth Muscle	Location – walls of hollow organs Striation – no Number of nuclei – one Control - involuntary
Cardiac Muscle	Location – walls of heart Striation – yes Number of nuclei – one Control - involuntary
Parts of Muscle: Belly Origin Insertion	 Bulging part of a muscle The less moveable attachment(s) The moveable attachment
Flexion Extension	Decrease in joint angle and brings two bones closer together Increase in joint angle and brings two bones farther apart
Pronation Supination	Moving from upward facing or anterior to downward facing or posterior Moving from downward facing or posterior to upward facing or anterior

Abduction Adduction	Moving a limb away from the midline of the body Moving a limb towards the midline of the body
Circumduction	Combination of flexion, extension, adduction, and abduction
Dorsiflexion Plantarflexion	Movement of the ankle bringing the toes up towards the shin Movement of the ankle causing the toes to point down
Muscle Movements: Sternocleidomastoid Deltoid Biceps brachii Triceps brachii Platysma Masseter	 Rotates head Shoulder abduction Elbow flexion Elbow extension Pulls corners of lips inferior (frowns) Strongest muscle
Muscle Movements: Sartorius Adductor longus Quadriceps Hamstrings Gastrocnemius Tibialis anterior	 Hip rotation Hip adduction Knee extension Knee flexion Ankle plantarflexion Ankle dorsiflexion

Muscle Movements: Latissimus dorsi Gluteus medius Gluteus maximus Trapezius	Shoulder adduction Hip abduction Largest muscle / Hip extension Shrugs shoulders superiorly
True or False: Muscle can't push, they can only pull as they contract	True
Types of Muscles: Prime movers Antagonists Synergists	The muscle that has the major responsibility for causing the movement when multiple muscles are contracting at once Muscles that oppose or reverse a movement Help prime movers by making the same movement or reduce other unnecessary movements
How muscles get their names	Relative size Location Number of origins Location of muscle's origin and insertion Shape Action of the muscle
What two things influence the health of a muscle?	Sufficient nerve and blood supply

Fascia	Fibrous connective tissue under the hypodermis that surrounds functional groups of the muscle; multiple muscle bellies
Skeletal Muscle parts smallest to largest: sarcolemma, epimysium, myofilament, sarcomere, endomysium, myofibril, perimysium	Epimysium Perimysium Endomysium Sarcolemma Myofibril Sacromere Myofilament
Epimysium Perimysium Endomysium	Surrounds a single muscle belly made up of fascicles Surrounds a single fascicle Surrounds a single muscle fiber (cell)
Periosteum Tendon Fascicle	Membrane around a bone Connects periosteum on the bone to the epimysium on the muscle Bundle of muscle fibers
Sacromere Myofilaments	Smallest contractile unit of skeletal muscle Proteins which make up a sarcomere – actin and myosin

Parts of a Muscle Fiber: Sacrolemma Myofibrils Sacroplasm Mitochondria Sacroplasmic reticulum Transverse tubules (T tubes)	 Cell membrane of a muscle cell Bundles of proteins Gel-like part of the cell Produces energy Stores calcium Sends electric signals deep into the muscle cell
Myosin structure Actin structure	Thick protein, contains myosin heads that attach to the actin Thin protein, surrounded by the T and T system that covers the myosin binding sites
Parts of the Sacromere: Z line I band A band H zone	 Ends of the sarcomere where actin attaches Contains actin only Contains both actin and myosin Contains myosin only
Motor unit Neuromuscular junction	A nerve cell and all the muscle fibers it innervates Connection between the nerve cell and the muscle cell, separated by the synaptic cleft
Electrical impulse steps in nerve	Motor neuron – starts at spinal cord, down axon to axon terminal Happens through depolarization – Na moving into the cell

Electrical impulse steps in neuromuscular junction	Impulse causes Acetylcholine (ACh) that are stored in vesicles to move out of axon terminal ACH goes into the synaptic cleft ACh attaches to a protein on sarcolemma Protein opens, Na comes into muscle, and new electrical impulse is generated
Sliding Filament Theory	Impulse causes Ca to be released from sarcoplasmic reticulum Ca binds to T and T system of actin, moves the protein and exposes the binding sites Myosin attaches and pivots with the use of ATP and never completely lets go of the actin as it shortens
Muscle relaxation steps	ACh is broken down in the synaptic cleft Ca moves back to sarcoplasmic reticulum Proteins can't attach and muscle relaxes
All or None Law Graded response	Muscle cell will contract to its fullest when adequately stimulated Degree of shortening depends on speed of muscle contraction and number of muscle cells being stimulated
Complete tetanas Muscle twitch	Very rapid stimuli that causes the muscle cells to not have time to relax between stimuli Single, brief, jerky muscle contraction