**Flexibility: A Definition**

- Flexibility is the range of motion (ROM) within a joint along the various planes of motion.

- A number of factors can limit joint mobility:
  - Genetic inheritance
  - Joint structure itself
  - Connective tissue elasticity with muscles, tendons, or skin surrounding a joint
  - Strength of the opposing muscle group
  - Neuromuscular coordination
Flexibility: A Definition

- There are two (2) basic types of flexibility:
  1. Static - impacted by body core temperature, body structure, muscle fiber lengths, connective tissue viscosity/elasticity, & muscle tendon attachment points.
  2. Dynamic - movement through a range of motion with an emphasis on maintaining both speed & force; impacted by same variable as static flexibility plus neuromuscular variables, balance, speed, and torque.
Flexibility: A Definition

- Different training methods for flexibility include full usable and safe range of motion (ROM) at various speeds of movement.

- The benefits of each include:
  - Increased physical efficiency and performance.
  - Decreased risk of injury.
  - Increased blood supply and nutrients to joint structures.
  - Improved nutrient exchange.
  - Increased neuromuscular coordination.
  - Improved muscular balance and postural awareness.
  - Decreased risk of low-back pain.
  - Enhanced enjoyment.
Flexibility: A Definition

- Overtraining for flexibility have potential disadvantages:
  1. Overstretched ligaments (ligament laxity)
  2. Increased risk of incurring injury
  3. Hyperflexibility with reduced muscle strength to support movement
  4. Decreased joint protective reflexes
  5. Decreased neuromuscular coordination
  6. Degenerative (arthritic) joint changes
The Mechanics of Stretching

- There are two (2) stretching methods:
  1. Elastic - elongation of tissues that recovers when the tension is removed; referred to as temporary or recoverable elongation (deformation); compared to spring-like model.
  2. Plastic - elongation in which the deformation to tissue remains even after the tension is removed; referred to as permanent or nonrecoverable elongation; compared to a hydraulic cylinder.
The Mechanics of Stretching

• Connective tissue is composed of non-elastic collagen fibers and a small number of elastic fibers within a protein matrix that creates various soft tissue structures including tendons, ligaments, & fascia.

• Connective tissue has a very high tensile strength, giving it the ability to support and protect underlying structures from injury.

• Organized connective tissue is viscoelastic - combination of two (2) mechanical properties: elasticity & viscosity.
The Mechanics of Stretching

• Two (2) predominant factors in promoting permanent elongation:
  1. A high-force, short-duration stretch performed when the tissue temperature is near or below normal will produce elastic deformation (temporary, recoverable elongation).
  2. A low-force, long-duration stretch at slightly elevated tissue temperature will produce viscous (plastic) deformation (permanent, nonrecoverable elongation).
The Stretch Reflex

- Myotatic Stretch Reflex - muscular reflex created by excessive muscle spindle stimulation to prevent potential tissue damage.

- The reflex evoked when the patellar ligament is tapped directly below the kneecap during an examination is a classic example of the stretch reflex.
The Stretch Reflex

- Reciprocal innervation - when you contract a muscle, its antagonist group relaxes. This allows you to then stretch that antagonist group more efficiently when it is relaxed and its opposing muscle group is contracted.

- Muscle spindles - these respond to actual stretch, not speed. When a muscle fiber is overstretched, muscle spindles will fire and will cause the muscle to contract to protect itself.
The Stretch Reflex

- Golgi tendon organs (GTO) - located in the muscle tendon, Golgi tendon organs respond to tension, so that when tension is great they fire, causing the muscle to relax and reduce tension.
Types of Stretching

- There are two (2) main categories of stretching:
  1. Passive - a stretch in which the elastic components of the muscle are relaxed and the portion of muscle most likely to be loaded is the connective tissue (e.g., a static stretch).
  2. Active - a stretching technique modeled after traditional strength-training workouts. Stretches are held very briefly in sets of a specified number of repetitions, with a goal of isolating an individual muscle in each set.
Types of Stretching

• Static stretching (passive) is a low-force, long-duration stretch that holds the desired muscles at their greatest possible length for 15-20 seconds.

• Ballistic stretching is a high-force, short-duration stretch using rapid bouncing movements.
Types of Stretching

• Proprioceptive Neuromuscular Facilitation (PNF) is a method of promoting the response of neuromuscular mechanisms through the stimulation of proprioceptors in an attempt to gain more stretch in muscle; often referred to as a contract/relax method of stretching.
Factors Affecting Flexibility

- Clearly, different stretching techniques will produce different flexibility results.
- A number of other factors influence a flexibility program:
  - Age
  - Gender
  - Joint structure
  - Muscle tendon attachments
  - Muscle cross-sectional area
  - Body temperature
  - Pregnancy
Factors Affecting Flexibility

- A warm-up is a slow, rhythmic exercise of larger muscle groups performed before an activity that provides the body with a period of adjustment between rest & performance of that activity.

- Generally, a warm-up lasts 5-15 minutes is gradually warms tissues, increases blood flow and nutrient exchange to active structures, and fine-tunes CNS receptors to improve kinesthetic awareness.
Principles of Stretching

- Most experts recommend stretching both before & after intense activity albeit for different reasons.

- Professionals agree that daily stretching is best, and, at the very least, stretching should be performed before and after activity sessions.
Principles of Stretching

• When designing a stretching program, keep the following in mind:
  1. Connective tissue elongation (plastic) is the primary target when stretching.
  2. The two most important factors influencing stretching are intensity & duration.
  3. Elevated tissue temperature facilitates range of motion.
  4. Flexibility is specific to each joint or muscle group.
  5. Proper alignment for each stretch is critical.
  6. Most stretches should be held for 10-30 seconds and repeated 2-3 times each.
Flexibility Exercises

The following exercises are important to use for most clients:
- Anterior shoulder stretch
- Posterior shoulder stretch
- Triceps stretch
- Low-back stretch
- Outer hip (rotator) stretch
- Thoracic & lumbar spine motion exercises
- Torso stretch
- Adductor stretch
- Hip flexor stretch
- Quadriceps stretch
- Hamstring stretch
- Calf stretches
- Soleus stretch