PNF (Proprioceptive Neuromuscular Facilitation)

In the early to mid 1900s physiologist Charles Sherrington popularized a model for how the neuromuscular system operates. His terminology and discoveries have given rise to many of the hands-on training techniques still in use today. Examples of his concepts should be very familiar to you:

- **Irradiation** - Maximal contraction of a muscle recruits the help of additional muscles.

- **Reciprocal Innervation** - Causes one muscle to relax when its antagonist contracts, allowing a joint to bend.

- **Successive Induction** - The contraction of one muscle followed immediately by the contraction of its antagonist, and this promotes strength and flexibility.

Based on that, Herman Kabat, a neurophysiologist, began in 1946 to look for natural patterns of movement for rehabilitating the muscles of polio patients. He knew of the myotatic stretch reflex which causes a muscle to contract when lengthened too quickly, and of the inverse stretch reflex, which causes a muscle to relax when its tendon is pulled with too much force. He believed combinations of movement would be better than the traditional moving of one joint at a time.

To find specific techniques, he started an institute in Washington, DC and by 1951 had two offices in California as well. His assistants Margaret Knott and Dorothy Voss in California applied PNF to all types of therapeutic exercise and began presenting the techniques in workshops in 1952. During the 1960s, the physical therapy departments of several universities began offering courses in PNF and by the late 1970s PNF stretching began to be used by athletes and other healthy people for more flexibility and range of motion.

Terms about muscle contraction are commonly used when discussing PNF. Concentric isotonic contraction is when the muscle shortens, eccentric isotonic is when it lengthens even though resisting a force, and isometric is when it remains the same. PNF is generally a combination of passive and isometric stretching. There are many different versions and forms.
PNF Methods:

**Repeated Contraction (Repeated Stretch):** Isotonic contraction against maximal resistance both concentrically and eccentrically throughout the range of motion.

Goals:
- Increase active ROM
- Increase strength
- Reduce fatigue

Procedure:
- Coach resists an isotonic contraction of the antagonists.
- Coach then resists an isotonic contraction of the agonists.
- Once maximum range of motion is reached, coach resists and isometric contraction of the agonists.

**Rhythmic Initiation:** Rhythmic motion done through the desired range, starting with passive motion and progressing to active resisted movement.

Goals:
- Initiate motion
- Improve coordination and proprioception
- Normalize rate of motion
- Teach motion
- Aid relaxation

Procedure:
- Initial passive motion through desired range
- Active-assistive – athlete begins “helping” in the desired direction. Coach passively returns to start.
- Active movement through agonist pattern.

**Rhythmic Stabilization:** Isometric contraction of the agonist followed by an isometric contraction of the antagonist.

Goals:
- Increase active and passive ROM
- Increase strength
- Increase stability and balance
- Decrease pain

Procedure:
- Coach resists an isometric contraction of the agonists.
- Resistance is increased slowly as athlete maintains position.
- Coach then slowly switches to position and force to begin an isometric contraction of the antagonists.
**Slow Reversal:** Isotonic contraction of the agonist followed immediately by an isotonic contraction of the antagonist.

**Goals:**
- Increase active ROM
- Increase strength
- Increase coordination and smoothness of reversals
- Prevent or reduce fatigue

**Procedure:**
- Coach resists an isotonic contraction of the agonists.
- Coach then resists an isotonic contraction of the antagonists.

**Slow Reversal-Hold:** Isotonic contraction of the agonist followed immediately by an isometric contraction.

**Goals:**
- Increase stability, balance and coordination
- Increase strength

**Procedure:**
- Coach resists an isotonic contraction of the agonists followed by an immediate isometric contraction of the agonists.
- Coach then resists an isotonic contraction of the antagonists followed by an immediate isometric contraction of the antagonists.

**Contract-Relax:** Resisted isotonic contraction of the antagonist, followed by relaxation and passive stretch of the antagonist.

**Goals:**
- Increase passive ROM

**Procedure:**
- Coach resists an isotonic contraction of the antagonists.
- Athlete and coach BOTH relax.
- Stretch to new passive range of motion.
- Repeat until no further gains occur.

**Hold-Relax:** Resisted isometric contraction of the antagonist, followed by relaxation and passive stretch of the antagonist.

**Goals:**
- Increase passive ROM

**Procedure:**
- Coach resists an isometric contraction of the antagonists for 7-15 seconds.
- Athlete and coach BOTH relax.
- Stretch to new passive range of motion.
- Repeat until no further gains occur.
**Slow Reversal-Hold-Relax:** Resisted isotonic contraction of the antagonist, followed by isometric antagonist contraction, relaxation, isotonic contraction of agonist and relaxation.

**Goals:**
- Increase active ROM
- Increase strength
- Increase coordination
- Reduce fatigue

**Procedure:**
- Coach resists an isotonic contraction of the antagonists followed by a 7-15 second isometric contraction.
- Athlete and coach BOTH relax.
- Coach resists an isotonic contraction of the agonists
- Athlete and coach both relax.

**Agonist Reversal: Resisted concentric and eccentric contraction of agonist.**

**Goals:**
- Increase active ROM
- Increase strength
- Increase coordination
- Reduce fatigue

**Procedure:**
- Coach resists an isotonic contraction of the agonists.
- Coach then provides an "overcoming" eccentric contraction of the agonists.
- Athlete and coach both relax.
- Coach provides another eccentric contraction of the agonists.

**Contract-Relax-Antagonist-Contract** - Resisted isotonic contraction of the antagonist, followed by relaxation and isotonic contraction of the antagonists (agonists).

**Goals:**
- Increase passive ROM

**Procedure:**
- Coach resists an isotonic contraction of the antagonists.
- Athlete and coach BOTH relax.
- Stretch to new passive range of motion.
- Athlete performs an isotonic contraction of the antagonists.
**Hold-Relax-Swing:** Resisted isometric contraction of the antagonist, followed by relaxation and dynamic stretch of the antagonist.

**Goals:**
- a. Increase passive ROM
- b. Increase active ROM
- c. Increase dynamic coordination

**Procedure:**
- a. Coach resists an isometric contraction of the antagonists for 7-15 seconds.
- b. Athlete relaxes for 2-3 seconds.
- c. For 10-15 seconds athlete engages in gradually increasing dynamic stretching.
- d. Relax for 10-20 seconds.
- e. Repeat.
These excellent illustrations are from Michael Alter’s book: *Science of Flexibility, 3rd Edition*