DEVELOPING PHYSICAL CAPACITIES - SPEED

Speed is one of the main fitness components, whether one plays sports or not, everybody needs speed because movements in everyday situations have to be performed at the appropriate speed in order to be successful (catching a falling object so that it doesn´t break, stepping on a piece of paper if it´s being blown by the wind...).

Speed also has a very important role in many sports. For some athletes such as Track and Field sprinters, sprint swimmers, cyclists and speed skaters, speed is the most important aspect of fitness. In many other sports, including team field sports, good speed is also very important as part of the overall fitness profile.

If you remember from other courses we can define speed as the capacity of performing a movement or covering a distance as fast as possible.

Speed is a physical component that has a direct relationship with the nervous system and the muscular system. The movements your muscles make are coordinated and controlled by the brain and nervous system.

The voluntary or striated muscles (they are attached to the skeleton) are regulated by the parts of the brain known as the cerebral motor cortex and the cerebellum.

If you want to move part of your body, the motor cortex in the brain sends a message to the cerebellum (it controls the movement coordination) and to a particular neurons (nerve cells), called upper motor neurons. Upper motor neurons have long tails (axons) that go into and through the brain, and into the spinal cord, where they connect with lower motor neurons. The lower motor neurons in the spinal cord send their axons via nerves in the arms and legs directly to the muscle they control so it contracts.

The combination of the nervous system and muscles, working together to permit movement, is known as the neuromuscular system.
MUSCLES FIBRES

There are two types of fibres present in voluntary muscles:

**Slow-twitch fibres (Type I):** These are red with a good oxygen supply which helps to maintain the use of the aerobic energy system. They contract slowly and they are more resistant to fatigue than fast-twitch fibers making these fibres more effective for endurance activities.

**Fast-twitch fibres (type II a and b):** these are white and produce fast and strong muscle contractions using both aerobic and anaerobic metabolism, although they are more prone to fatigue than type I fibres. They are suitable for explosive activities.

**Type IIa fibres** can be used for moderate intensity exercise. They are also often used for low intensity aerobic activities when we are very fatigued and the Type I fibres are tired. **Type IIb fibres** are used in explosive, powerful, fast movements. They tire very quickly.

Human muscle has a mixture of fibre types but the number of fast and slow twitch fibres is mainly hereditary, so training cannot affect the distribution of them but there is some evidence that training can make slow-twitch fibres take on characteristics of type IIa fast-twitch fibres. The average person has approximately 60% fast muscle fiber and 40% slow-twitch fiber (type I).

TYPES OF SPEED

**Reaction speed:** is how quickly a person can respond to an external stimulus. It can be tactile, visual or auditory. Reactions can be simple or complex:
- **Simple:** the performer is involved in only one stimulus and one response, both known in advance ((the start in a race responding to the starting pistol).
- **Complex:** the performer must react to different types of stimulus and choose between different reactions using the most suitable in each situation (goalkeeper actions, combat sports actions)

**Displacement speed:** the ability to cover a certain distance as fast as possible. (How fast the runner can run, or the swimmer can swim).
It depends on:
- Range of movement.
- Strength of muscles involved.
- Frequency of the movement.
- Correct technique.

**Movement speed:** is how quickly a person can carry out a movement or perform a skill (tennis serve, kicking a ball, hitting a baseball). Coordination is a very important factor in this type of speed, it’s also related to a correct learning in the specific sport movement or technique.
FACTORS AFFECTING SPEED

- **Speed in the transmission of nerve impulses** (it varies from one person to another).
- **Neuromuscular coordination**: it relates to the ability of the nervous system to efficiently recruit a muscle or group of muscles in order to perform a specific task. Neuromuscular coordination works on two levels:
  1) **Intra-Muscular Coordination**: If the fibers in the muscle all contract and relax in synchronization, then you are producing more muscle power. Basically, the better your intramuscular coordination, the more efficiently the muscle is working.
  2) **Inter-Muscular Coordination** is the coordination between different muscles or group muscles (agonists, antagonists, stabilizers and neutralizers) while performing a specific task or activity.

  Intra and inter-muscular coordination improve with repetitions training; muscles adapt and learn to do those specific sport movements more and more efficiently, once a person develops a certain level of coordination in a movement they don’t need to focus as much on it.

- **Speed in the muscle contraction**: Speed of contraction depends on the characteristics and distribution of slow and fast twitch fibers each person mainly has and it is genetically determined so it does not change significantly with training. The fast muscle (type IIa) moves 5 times faster than the slow muscle, and the super-fast (type IIb) moves 10 times faster than the slow muscle fiber.

- **Muscle strength levels**: There is a strong link between speed and strength; both contribute to power (the ability to produce strength quickly over a certain distance or time).

- **Gender and age**: Speed levels increase at the same time that the nervous system and the locomotor system develop. Boys and girls have the same speed levels until the beginning of puberty (12 years old); during puberty, muscular strength develops in both genders but is more pronounced in boys, therefore it provides them higher speed levels. The maximum speed development is achieved around the age of 20 years and with the appropriate training it can be maintained and even get better until 30-35 years old age.

- **Proper technique and sport performance**: will allow you to be more efficiently in your movements, do them faster and also avoid injuries. You can improve the biomechanical sport movements by teaching the body and the mind the correct motor patterns and store them in your muscle memory so you can repeat them without thinking particularly when you are tired.

- **Attentional states**: influence the response time to the stimulus. Developing anticipation skills is one the characteristics of great athletes. **Anticipation** is a sport specific ability to reduce the time it takes to respond to a stimulus, being able to react to an event before it has actually happened (a tennis player who anticipates the type of serve the opponent will use, detecting certain cues early in the serving sequence that predicts the potential type of serve so the player can start moving towards the direction of the serve quicker than usual). Experience is also a very important factor in anticipation.
HOW TO DEVELOP SPEED

Speed training is based in fractional training methods. These training systems divide the training session in parts, with complete or incomplete resting periods between them, depending on the training objective.

**Interval training:** It consists of exercising through relatively short distances followed by incomplete resting periods. Intensity can be high, between 70-95 % of the maximum. Distances are from 100 m to 400 m if running or efforts lasting between 15’-4’; repetitions are between 10-30, and the resting periods can be done, resting, walking or with very easy running, until the heart rate reaches 120-140 bpm.

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<th>Interval Training For 10-km Runners</th>
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<tr>
<td>Best 10-km time (min)</td>
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**Repetitions training:** It consists of exercising through relatively short distances or time followed by complete resting periods. This allows a higher intensity of workout. Intensity is very high, between 85-100 % of the maximum; it can be done using series (3-5) and repetitions (3-5). Recovering between repetitions and series should be until the heart rate reaches around 90-bmp.
Other complementary methods to develop speed are:

- **Plyometrics** to develop explosive hopping, jumping, bounding, hitting, and kicking.
- **Ballistics** to develop high-speed sending and receiving movements.
- **Sprinting form and speed endurance** to develop sprinting technique and improving the length of time you are able to maintain your speed.
- **Specific sport loading movements** to develop specific speed. (Parachute, belts...)
- **Weight lifting** to improve muscle strength.
- Running **uphill and downhill** to work on muscle strength and running technique.
- **Overspeed training**: reacting to things that move faster than the needs of the sport to improve reaction time: a baseball player might take batting practice while using a special pitching machine that throws pitches at 130-150 miles/hour. His brain would adapt to seeing the faster pitches, this would improve his ability to react to a real pitch (90-100 mile/hour)

**Things to take into account for developing speed**

The development of speed is highly specific and to achieve it we should ensure that:

- All speed workouts should include an appropriate **warm up and cool down**.
- Sprint and speed training drills should be used only after a **general level of fitness** has been achieved.
- **Flexibility** is developed and maintained all year round (joint mobility and muscular elasticity)
- **Strength and speed** are developed in parallel.
- Skill development and coordination **(technique)** should be **pre-learned**, rehearsed and perfected before it is done at high speed levels.
- Speed training is performed by using **high velocity** for brief intervals. This will ultimately bring into play the correct neuromuscular pathways and energy sources used.
- Control resting periods not only with the heart rate but also with **muscle fatigue**.
- It is necessary to rest from **48 to 72 hours** between speed training sessions.
- If in the same session more physical components are going to be worked, the training should start with speed.