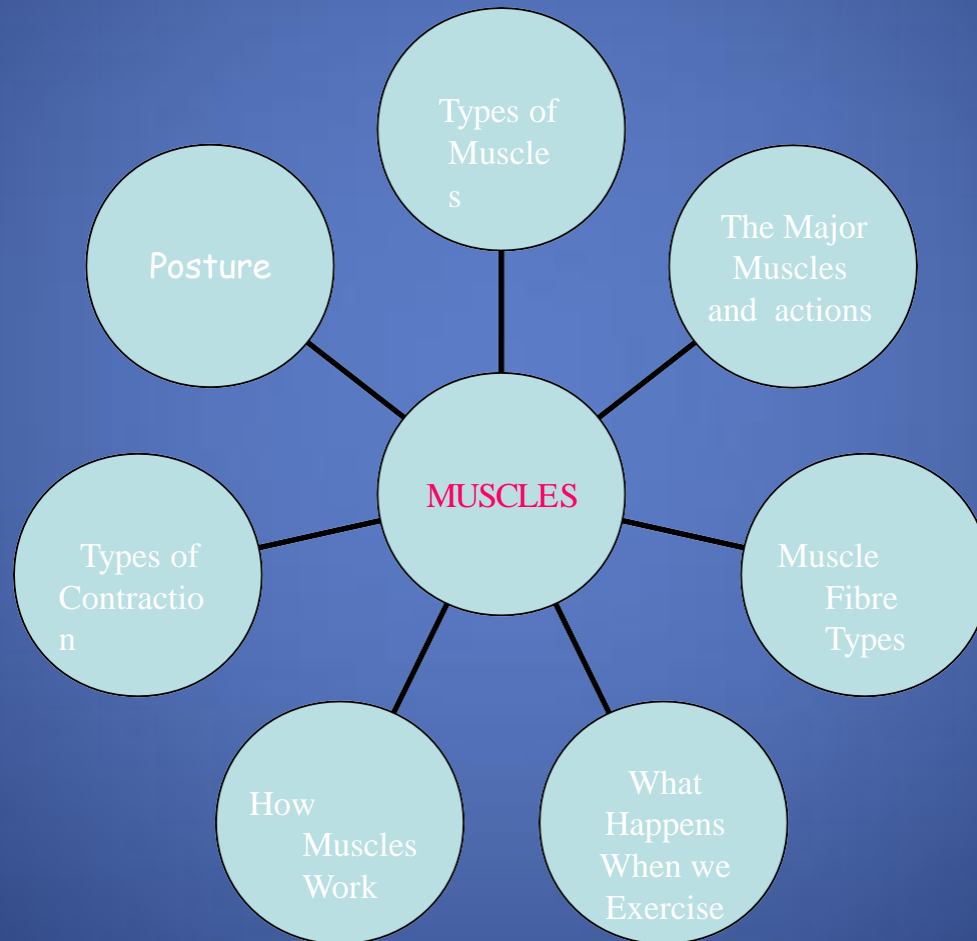


THE MUSCULAR SYSTEM

AIM: To understand the structure and function of muscles.

DR VISHAL BANNE

WHAT I NEED TO KNOW



WHAT DO OUR MUSCLES DO?

OUR MUSCLES:

- Enable us to move our body parts.
- Give us our individual shape.
- Protect and keep in place our abdominal organs.
- Enable us to maintain good posture.
- Help in the circulation of our blood.
- Generate body heat when they contract.

THERE ARE OVER 600 SKELETAL MUSCLES IN THE BODY- 150 IN THE HEAD AND NECK.

TYPES OF MUSCLE

We can put muscles into 3 types based on how they work:

- Skeletal/Striped or Voluntary Muscle
- Smooth or Involuntary Muscles.
- Cardiac Muscle



Cardiac muscle cell



Skeletal muscle cell



Smooth muscle cell

SKELETAL or VOLUNTARY MUSCLES

They are under our conscious control.

This means we instruct them to perform everyday actions such as walking, running and jumping.

How many can you name?



THE MAJOR SKELETAL MUSCLES

- Deltoid
- Biceps
- Abdominals
(4
muscles)
- Quadriceps
(4 muscles)
- Pectorals
- Latissimus dorsi
- Trapezius
- Triceps
- Gluteals (3 muscles)
- Hamstrings (3
muscles)
- Gastrocnemius

MUSCLE

MAIN ACTION(S)

Deltoid

Raises your arm sideways at the shoulder Bends your arm at the elbow

Biceps

Abdominals

Pull in your abdomen. Flex your trunk so you can bend forward

Quadriceps

Straighten your leg at the knee and keep it straight when you stand

Pectorals

Raises your arm at the shoulder. Draws it across your chest

Latissimus dorsi

Pulls your arm down at the shoulder. Draws it behind your back

Trapezius

Holds and rotates your shoulders. Moves your head back and sideways

Triceps

Straightens your arm at the elbow

Gluteals

Pull your leg back at the hip. Raise it sideways at the hip. Gluteus maximus is the biggest

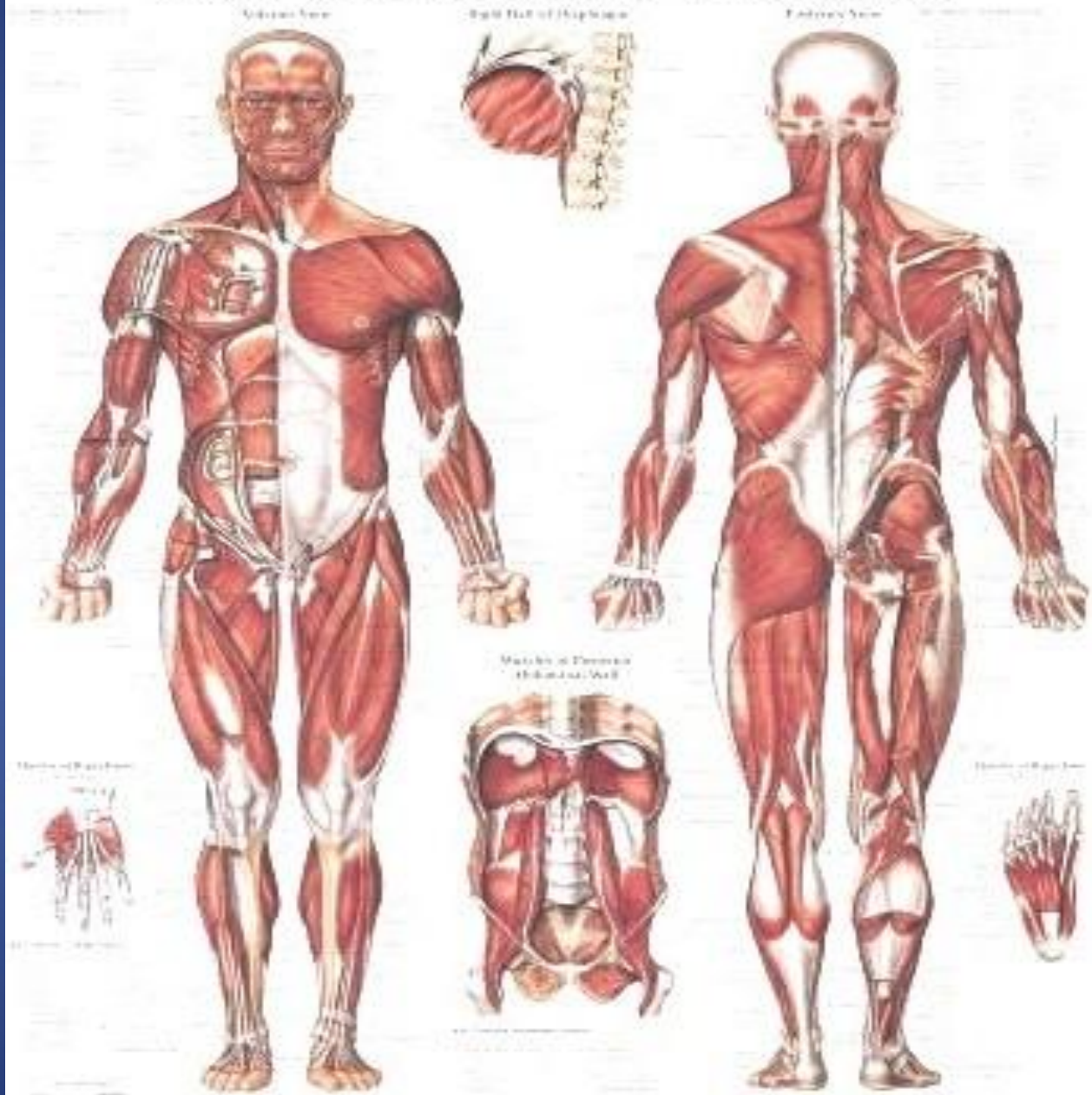
Hamstrings

Bend your leg at the knee

gastrocnemius

Straightens the ankle joint so you can stand on tiptoes

THE MUSCULAR SYSTEM

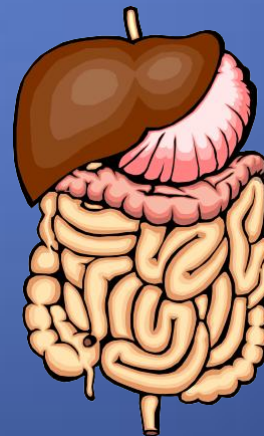


SMOOTH or INVOLUNTARY MUSCLES

These muscles work automatically - they are not under our conscious control.

e.g. Muscles of the digestive system.

Can you think of any more?



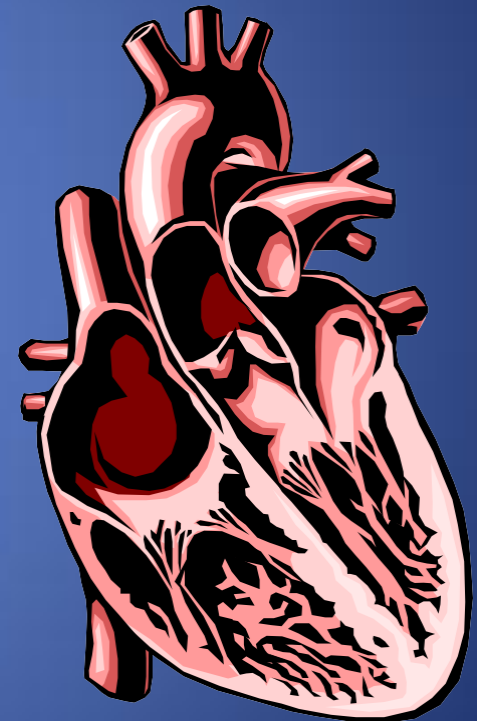
CARDIAC MUSCLE

Cardiac is a special type of involuntary Muscle.

It is **ONLY** found in the heart.

It contracts regularly, continuously and without tiring.

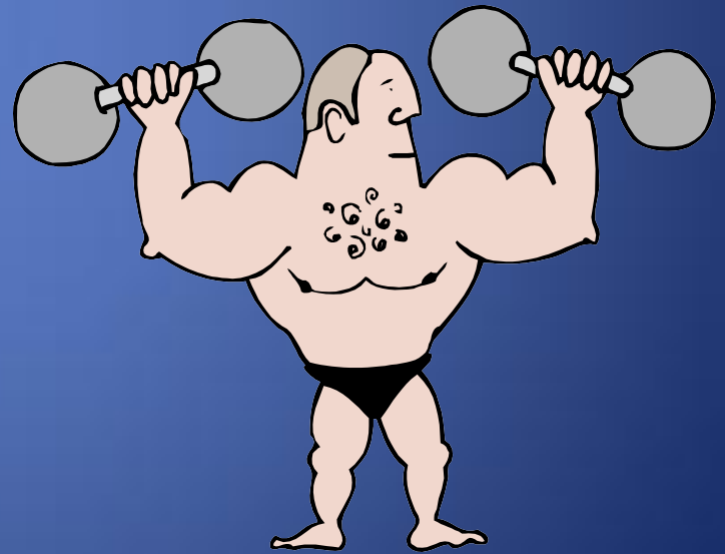
It works automatically but is under constant nervous and chemical control.



HOW DO OUR MUSCLES WORK?

There are 3 main types of muscular contraction:

- Isotonic and concentric
- Isotonic and eccentric
- Isometric



ISOTONIC and CONCENTRIC

- Our muscles shorten as they contract.
- The ends of the muscle move closer together.

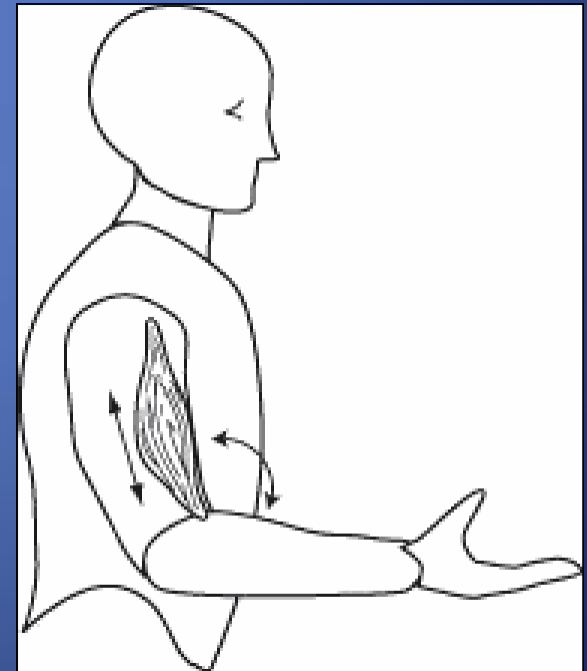
e.g. the biceps during a pull-up

- Most sporting movements are of this type.



ISOTONIC and ECCENTRIC

- Our muscles lengthen as they contract under tension.
 - The ends of the muscle move further apart.
- e.g. the biceps when we lower down from a pull-up.
- Plyometric exercise uses eccentric contractions.



ISOMETRIC

- Our muscles stay the same length as they contract.
- There is no movement, so the ends of the muscles stay the same distance apart.
e.g. our shoulder muscles during a tug of war.
- In many sporting movements the stabilising muscles hold parts of the body steady as other parts move.

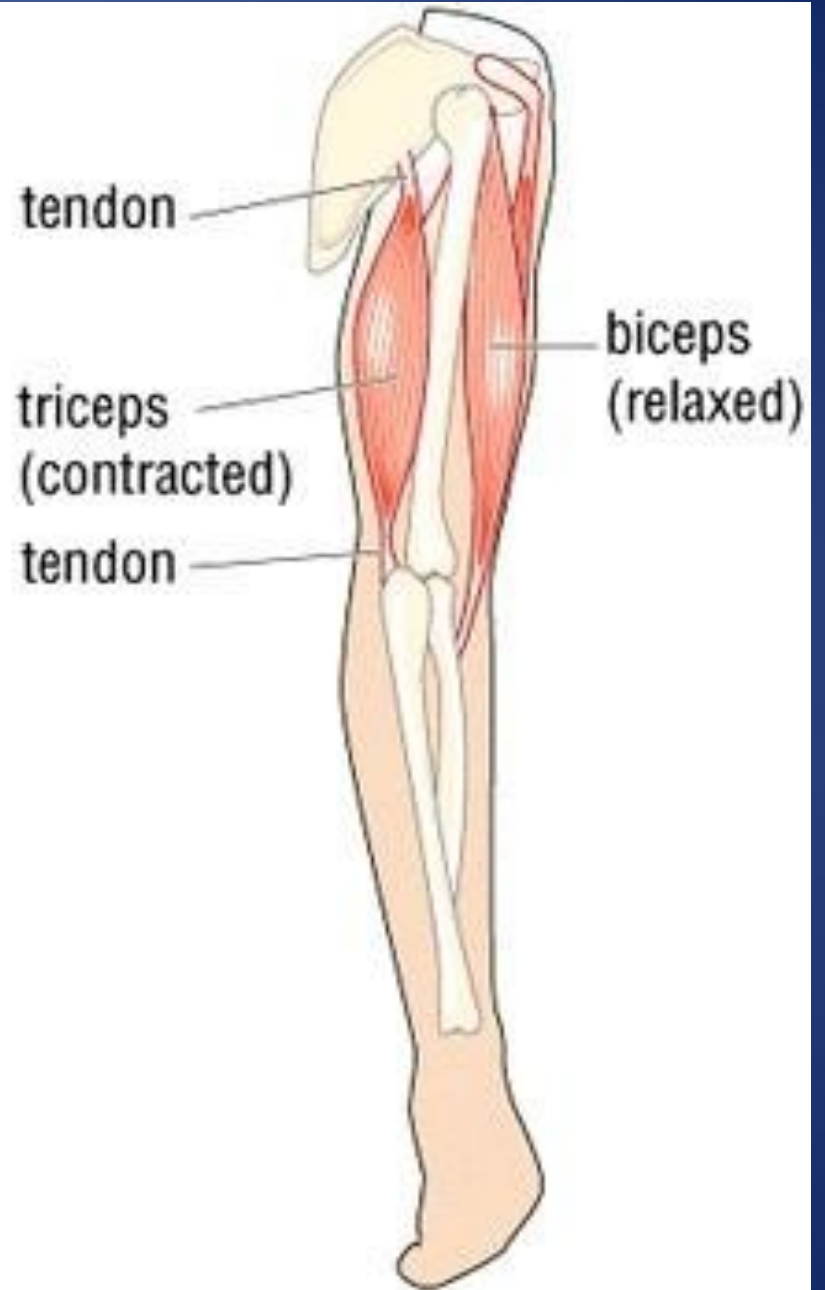
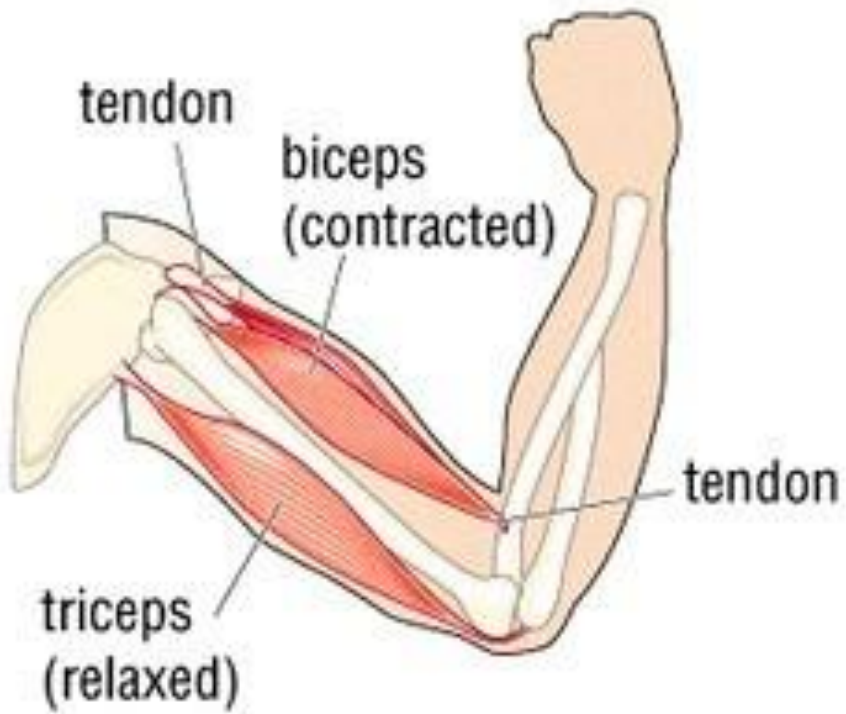
HOW DO MUSCLES WORK TOGETHER?

Muscles can only contract. If one muscle contracts to bring two bones together another muscle is need to Contract to bring the bones apart again.

e.g. a bicep curl

So, **MUSCLES ALWAYS WORK IN PAIRS**

We need large numbers of pairs of muscles to work together in different ways for even simple body movements. Our muscles take on different roles depending on the movement they are performing.



MUSCLES CAN WORK AS:

- **Flexors** - contracting to bend our joints.
- **Extensors** - contracting to straighten joints.
- **Prime movers (agonists)** - contracting to start a movement.
- **Antagonists** - relaxing to allow movement to take place.
- **Fixators** - contracting to give the working muscles a firm base.
- **Synergists** - stabilising the area around the prime mover and fine tuning our movement.

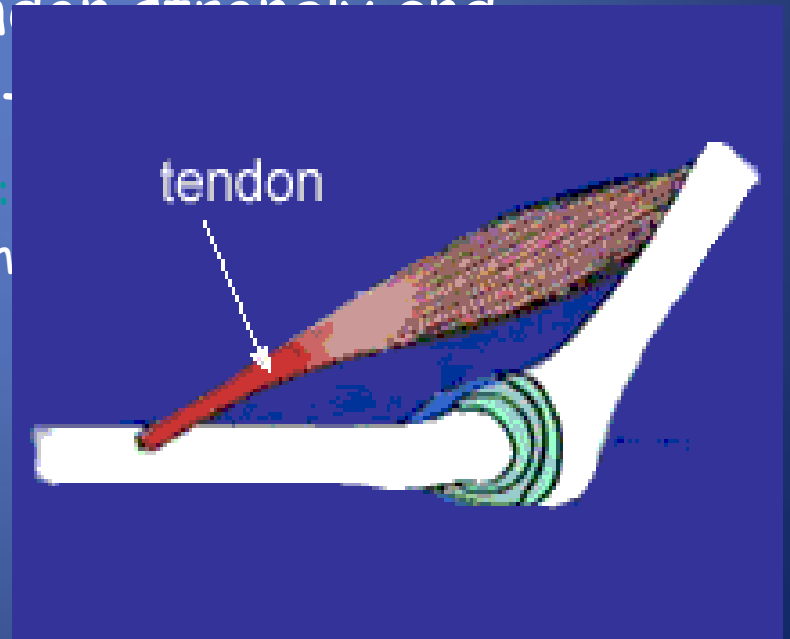
HOW ARE MUSCLES ATTACHED TO BONES?

Muscles are usually attached to 2 or more different bones.

The muscle fibres end in a strong, white flexible cord, called a **TENDON**. At the bone, the fibres of the tendon are embedded in the **PERIOSTIUM** of the bone. This anchors the tendon strongly and spreads the force of the contraction.

REMEMBER:

Tendons join muscle to bone. Ligaments join bone to bone.

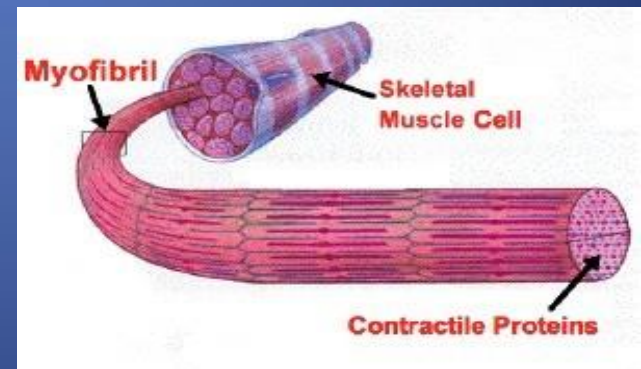


MUSCLE SPEED and TONE

Muscle Fibres

Our muscles are made up cells called muscle fibres. These tiny threadlike fibres are packed together in bundles. Muscles contract (shorten) because the fibres do.

Muscle fibres don't all contract together. The number contracting at any one time depends on how much force is needed



MUSCLE FIBRE TYPES

We have two different types of fibres in skeletal muscle:

- SLOW-TWITCH

- FAST-TWITCH



FAST-TWITCH MUSCLE FIBRES

- Do not have a good oxygen supply.
- Tire very quickly.
- Are stronger than slow-twitch fibres.
- Contract very quickly.
- Are used when we need fast, powerful movements.
- Are used only in high intensity exercise.
- Are used in anaerobic activities.

Can you think of sports that use fast-twitch Fibres?

SLOW-TWITCH MUSCLE FIBRES

- Have a very good oxygen supply.
- Work for a long time without tiring.
- Are not as strong as fast-twitch fibres
- Take longer to contract.
- Are used in all types of exercise.
- Are used especially in aerobic activities.

Can you think of sports that use slow-twitch Fibres?

MIXTURE OF MUSCLE FIBRES

Every muscle contains a **mixture** of fast and slow twitch muscle fibres. BUT:

- **The mixture is different in different muscles** e.g. the gastrocnemius contains a lot of fast twitch fibres so standing on your toes is tiring
- **The mixture is different for different people.** Some distance runners have 80% slow twitch fibres while some power lifters have 80% fast twitch

MUSCLE SPEED and PERFORMANCE

The more fast twitch fibres you have the more suited you are to sports requiring bursts of strength and power.

Consider two sprinters X and Y. They are the same age, weight and fitness. But X has 75% fast twitch fibres in his legs and Y has 55%.

Who is the quickest?

MUSCLE FIBRES and SPORT

If we jog slowly, only a few of our slow-twitch fibres contract to move our legs. When we increase our speed we use more slow-twitch fibres. As we run faster our fast-twitch fibres also start to contract to help out. More and more will start to contract as we run even faster. At top speed all of our fast-twitch and slow-twitch fibres will be working.

MUSCLE CHANGES AND SPORT

Muscle **hypertrophy** - the muscle increases in size

Muscle **atrophy** - muscle decreases in size.

WHAT HAPPENS AS WE EXERCISE?

- There is an increased flow of blood to the working muscles.
- Muscles take up more oxygen from the blood.
- The muscles contract more often and more quickly.
- More of the muscle fibres contract.
- There is a rise in the temperature of the muscle.
- Our stores of **Adenosine Triphosphate** (ATP) and **Creatine Phosphate** (CP) in the muscles are used up.
- Waste products such as Carbon Dioxide and Lactic Acid build up in the muscles.
- These waste products lead to tiredness and cramp.
- Stores of muscle glucose are used up.
- Our ability to carry on may be affected.
- Overuse of muscles can lead to soreness and strains.

MUSCLE TONE

Even when a muscle is relaxed, a small number of fibres are contracted - enough to keep the muscle taut but not enough to cause movement.

This partial state of contraction is called Muscle Tone
Without muscle tone you would not be able to stand up straight!

To maintain muscle tone without getting tired, groups of muscles take it in turns to contract. They work in relays

Poor muscle tone leads to poor posture. Exercise improves muscle tone - it makes the fibres thicker so they contract more strongly