NHS Education for Scotland

NHS Training for
AHP Support Workers

Workbook 4

The musculoskeletal system

NHS SCOTLAND

Contents

Workbook 4

The musculoskeletal system

4.1 Aim

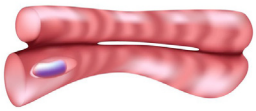
The aim of this workbook is to provide the Healthcare Support Worker (HCSW) with the knowledge and understanding of the musculo-skeletal system and the effects of exercise upon it.

4.2 Learning outcomes

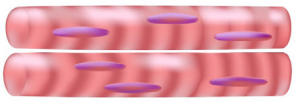
By the end of this workbook you will be able to:

- Describe the functions of muscle.
- Understand the different types of skeletal muscle fibres used in different types of exercise.
- Name, describe and demonstrate the action of the major muscle groups of the body.

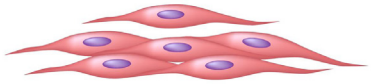
4.3 Types of muscle



Cardiac muscle cell



Skeletal muscle cells



Smooth muscle cells

Types of muscle

There are three types of muscle in the body, each with different functions:

- cardiac muscle
- skeletal muscle
- smooth muscle

Skeletal muscle

These muscles are attached to bones. There are over 600 skeletal muscles which contract and relax around our joints to enable us to move. The muscles are made up of striated or banded fibres.

We can control muscles voluntarily for locomotion, facial expressions, posture, and other body movements. For example:

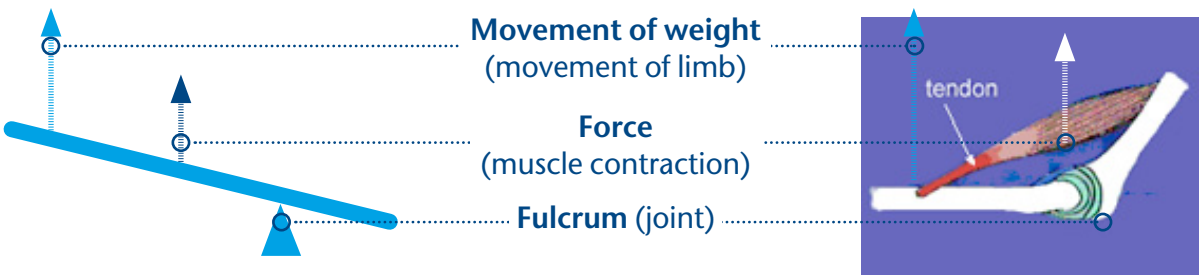
- When muscles at the front of the leg (**quadriceps**) contract, the knee straightens while back leg muscles (**hamstrings**) relax.
- Conversely, to bend the knee, back leg muscles (**hamstrings**) contract while front leg muscles (**quadriceps**) relax.

Some muscles are named for their ability to extend or flex a joint; for example,

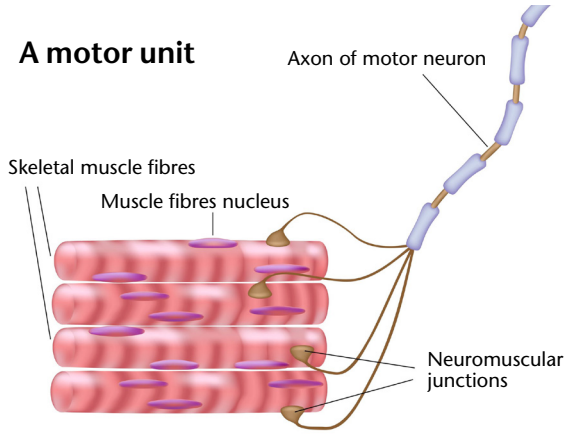
- **Extensor carporadialis longus muscle** which extends the wrist.
- **Flexor digitorum brevis muscle** which flexes the fingers.

Muscles work as a system of forces and levers

Body movement occurs by employing the principles of force and levers. Muscles apply **force**, bones serve as **levers** and joints function as **fulcrums**.



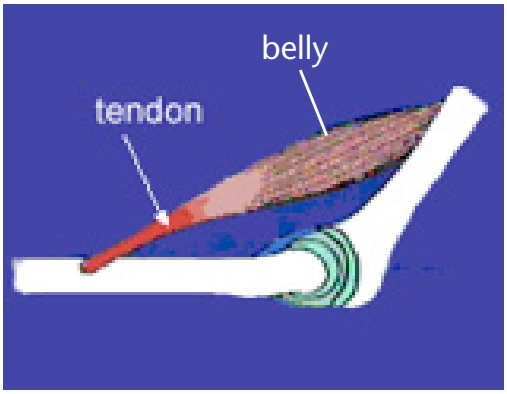
4.4 How a muscle contracts



Muscles work in groups in response to nerve impulses to cause movement.

Nerve impulses from the spinal cord travel along the motor nerve and arrive at the muscle at a point called the neuromuscular junction. Each nerve fibre supplies several bundles of muscle fibres, and makes them contract. The nerve and muscle fibres together are known as the motor unit.

When one group of muscles around a joint contracts the opposite group relaxes.



Tendons
Tendons attach most skeletal muscles to bones. Tendons are strong sheets of connective tissue that are identical to ligaments.

Tendons and ligaments differ in function only: tendons attach muscle to bone and ligaments attach bone to bone. Physical exercise strengthens the attachment of tendons to bones.

Muscle tone
Skeletal muscles have muscle tone (remain partly contracted), which helps maintain body posture. Ongoing signals from the nervous system to the muscle cells help maintain tone and readiness for physical activity.

Skeletal muscle aids heat generation. During muscle contractions, muscle cells expend much energy, most of which is converted to heat.

To prevent overheating, glands in the skin produce sweat to cool the skin; the body radiates heat from the blood and tissues through the skin. When the body is chilly, shivering causes quick muscle contractions that generate heat.

4.5 Cardiac muscle

Cardiac muscle is only in the heart and makes up the atria and ventricles (heart walls).

Like skeletal muscle, cardiac muscle contains striated fibres.

Cardiac muscle is called involuntary muscle because conscious thought does not control its contractions. Specialised cardiac muscle cells, called pacemaker cells, maintain a consistent heart rate.

4.6 Smooth muscle

Smooth muscle is found throughout the body, including in visceral (internal) organs, blood vessels, and glands.

Like cardiac muscle, smooth muscle contraction is involuntary.

Unlike skeletal and cardiac muscle, smooth muscle is not striated (not banded). Smooth muscle, which is extensively within the walls of digestive tract organs, causes peristalsis (wave-like contractions) that aids in food digestion and transport.

Apart from contraction of the heart, any action that the body performs without conscious thought is performed by smooth muscle contractions. This includes diverse activities such as constricting (closing) the bronchioles (air passages) of the lungs or pupils of the eye.

Evidence

What are muscles for?
Name the different types of muscle, where you would find them, and what they do
What are tendons and what is their function?

4.7 Muscle fibres and exercise

Skeletal muscles have two types of muscle fibres: **fast-twitch** and **slow-twitch**.

Anaerobic exercise

- Anaerobic exercise uses fast-twitch fibres. Such exercise includes activities that are fleeting and require brief high-energy expenditure.
- Weightlifting, sprinting, and push-ups are examples of anaerobic exercise.

Oxygen is required to convert excess lactic acid (a waste product of anaerobic exercise) into glucose. Anaerobic exercise depletes oxygen reserves in the muscle cells quickly. This results in an oxygen debt. To repay the debt, humans breathe deeply and rapidly, which restores the oxygen level.

Aerobic exercise

- Aerobic exercise uses slow-twitch muscle fibres.
- Such exercise includes activities that are prolonged and require constant energy.
- Long distance running and cycling are examples of aerobic exercise.

In aerobic exercise, the muscle cell requires the same amount of oxygen that the body supplies. The oxygen debt is slashed and lactic acid is not formed.

Evidence

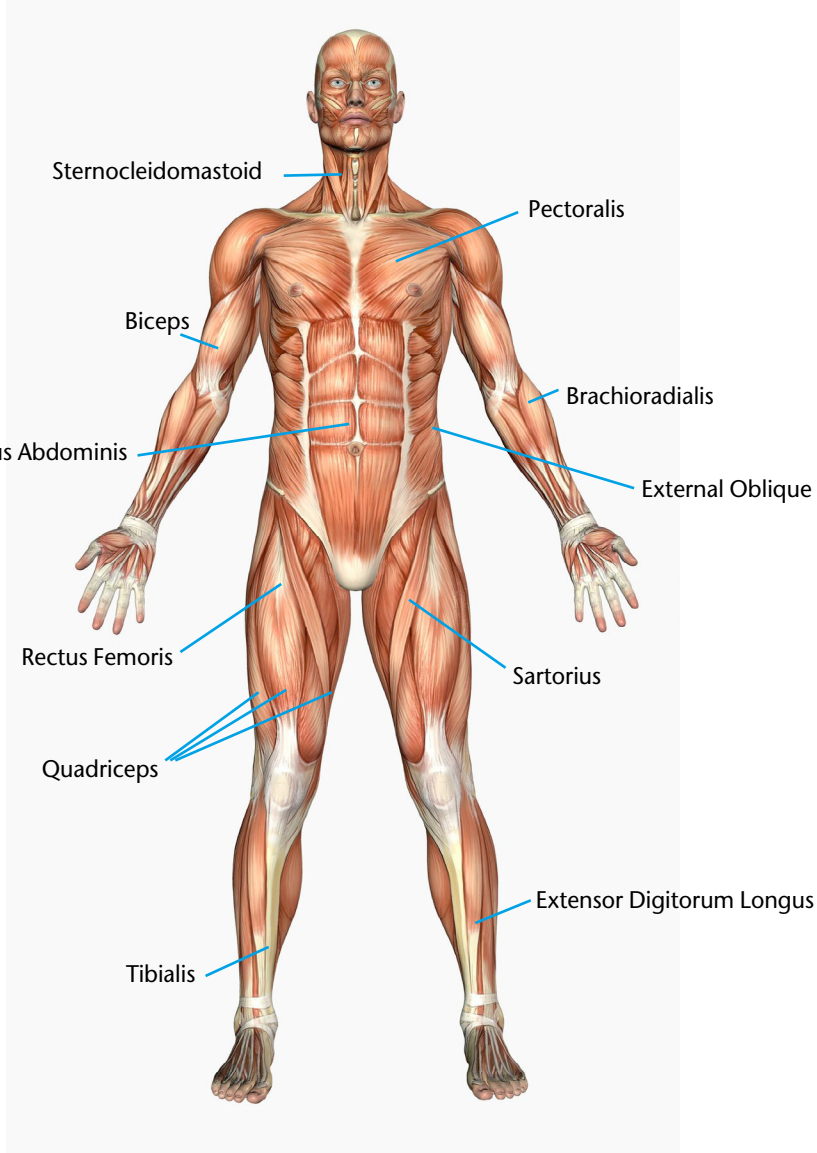
What types of muscle fibre exist in skeletal muscle?
What types of exercise most utilise fast-twitch muscle fibres?
What types of exercise most utilise slow-twitch fibres?
Why would knowledge of muscle fibre types be important in physiotherapy?

4.8 The major muscle groups in the body

Anterior

The muscles in the diagram below are the major groups at the front of the body.

The movement that they generate is dependent on where they are located in relation to the joint or joints that they are connected to.



Activity

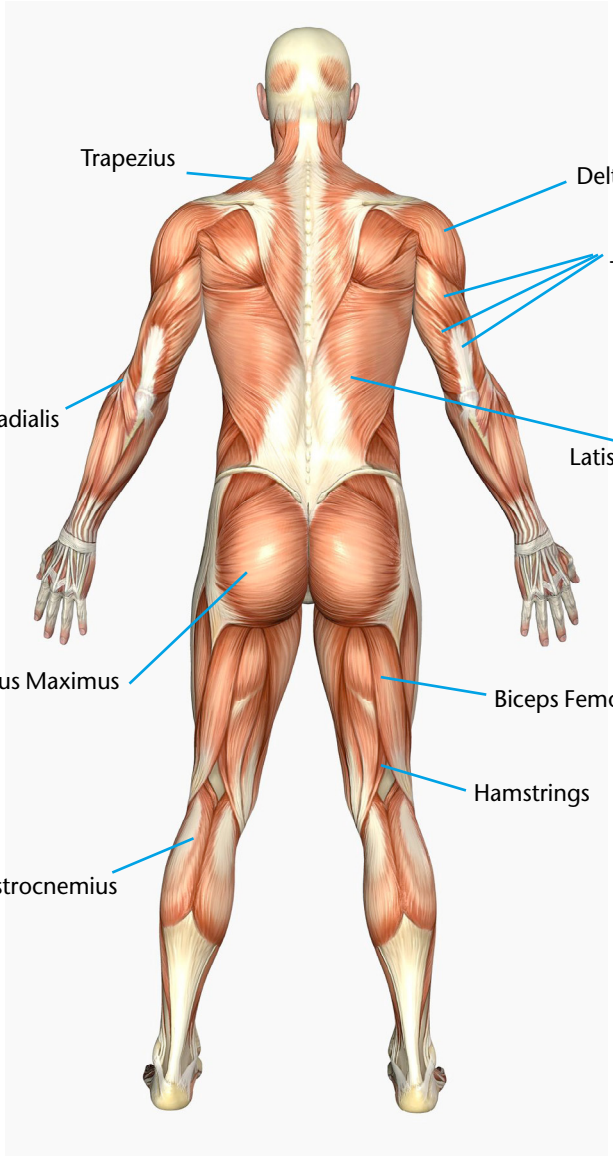
These are some common muscles that you may come across in your work as a support worker. You should learn where they are, and what movements they produce.

- **Sternocleidomastoid** This muscle flexes and rotates the head towards the opposite side.
- **Pectoralis** This muscle flexes the upper arm and draws it across the chest.
- **Biceps** Flexes the elbow and turns the hand palm up.
- **Brachioradialis** Flexes the elbow and turns the hand palm up.
- **External oblique** A muscle that supports the abdomen and flexes and rotates the lumbar spine.
- **Rectus abdominus** A muscle that supports the abdomen and flexes the lumbar spine.
- **Iliopsoas** Two closely arranged muscles that flex the hip, and abduct and externally rotate it.
- **Rectus femoris** One of four muscles in the quadriceps group that extend the knee. The rectus femoris also flexes the hip.
- **Tibialis** Flexes the foot and turns it in.
- **Extensor digitorum longus** Extends the toes.

Posterior

The muscles in the diagram are the major groups at the back of the body.

Try to learn where the muscles are on the body and what movements they perform.



Activity

These are some common muscles that you may come across in your work as a support worker. Again, you should learn where they are, and what movements they produce.

- **Trapezius** Raises or lowers the shoulders and shrugs them.
- **Deltoid** Abducts the upper arm and assists in flexion of the upper arm.
- **Triceps** Extends the lower arm.
- **Brachioradialis** Extends the lower arm.
- **Latissimus dorsi** Extends upper arm and adducts it.
- **Gluteus maximus** Extends the hip and moves it outwards.
  Other muscles adjacent to gluteus maximus – **gluteus minimus** and **medius** – also abduct the hip.
- **Biceps femoris** With the other hamstrings this muscle flexes the knee.
- **Hamstrings** These muscles flex the knee as well as extending the hip.
- **Gastrocnemius** Extends the foot and flexes the knee.

Evidence

Describe the location of the following muscles, and write down what they do.

Sternocleidomastiod
Pectoralis
Biceps brachii
Bracioradialis
Abdominal muscles
Hip flexors
Quadriceps
Tibialis
Extensor digitorum longus
Trapezius
Deltoid
Triceps
Latissimus dorsi
Gluteus maximus
Hamstrings
Gastrocnemius

4.9 Practical anatomy tutorial

Your mentor will demonstrate the location and activity of the major groups of muscles that you have learned about above.

Activity

You should be able to demonstrate the action of the muscles you have learned about. Your supervisor will verify in your portfolio that you can demonstrate the main actions of the following muscles.

- Sternocleidomastiod
- Pectoralis
- Biceps brachii
- Bracioradialis
- Abdominal muscles
- Hip flexors
- Quadriceps
- Tibialis
- Extensor digitorum longus
- Trapezius
- Deltoid
- Triceps
- Latissimus dorsi
- Gluteus maximus
- Hamstrings
- Gastrocnemius

Acknowledgements
NHS Tayside

4.10 The musculoskeletal system workbook completion

Your supervising physiotherapist will sign your portfolio to indicate that you have completed this workbook successfully.

Objective	Therapist's signature	Date
Describe the functions of muscle		
Describe the effects of different types of exercise on skeletal muscle		
Name the different types of muscle in the body and describe their location		
Describe the actions of the major muscle groups in the body		
Demonstrate the actions of the major muscle groups in the body		

Support worker (name)
Support worker's signature
Therapist (name)
Therapist's signature
Date

4.11 The musculoskeletal system reflection

Suggested KSF Dimensions: C2, HWB2
This form should be placed in the appropriate section of your portfolio.

What did you learn from this module?
How has this influenced your work?
Date module completed

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