

EXERCISE PHYSIOLOGY

Section 2: Muscular System

Section Contents:

- 2.1 Introduction and Objectives
- 2.2 Muscle Classification
- 2.3 Muscle Types
- 2.4 Features of Muscle Types
- 2.5 Structure of Skeletal Muscle
- 2.6 Factors Affecting Muscular Strength
- 2.7 Types of Muscle Contraction
- 2.8 Revision Questions

2.1 Introduction and Objectives

INTRODUCTION

The body is made up of a number of working systems. These systems are responsible for maintaining the functioning of our body. One of these systems is the **muscular system**. The muscular system covers those responsible for movement, heartbeat, and movement of food through the gut for example.

Of particular interest to us are those muscles responsible for movement. There are over 500 voluntary muscles in the body. Almost 150 of these are located in the head alone!

In this unit we will not be learning the names of muscles as we did in the last unit. Here we look at the muscle itself in greater detail. We will be asking ourselves questions such as:

- How does a muscle contract?
- What affects the amount of strength I have?
- Is the muscle makeup different for a sprinter?

OBJECTIVES

The following objectives relate directly to Unit Standard 12543 (version 4) "*Apply knowledge of exercise physiology to physical activity*" – specifically:

Element 1: Describe the structure and function of the major physiological systems important in physical activity.

1.1 The neuromuscular system is described as it relates to its structure and function.

By the end of this section you should be able to

(As you complete each item, tick the box)

Identify the two main muscle classifications.

☐

Identify and provide examples of the three types of muscle in the body.

☐

Identify key features of all muscle types.

☐

Identify the components of a muscle from muscle belly to sarcomere.

☐

2.2 Muscle Classification

All muscles are classified into one of two main categories. These are:

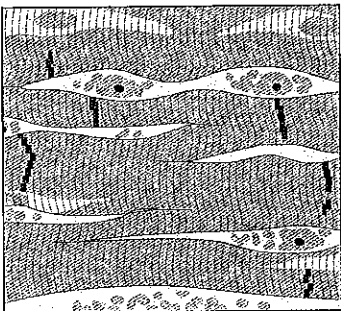
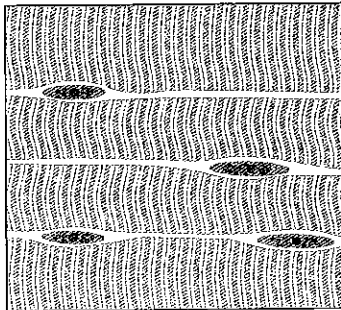
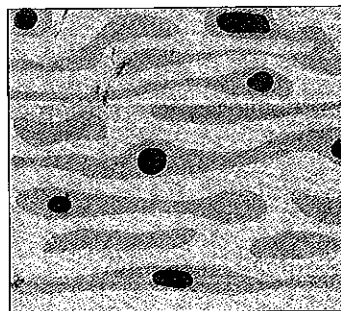
A. Voluntary

B. Involuntary

2.3 Muscle Types

There are three main types of muscle in the body.

Using your textbook, or with direction from your teacher, complete the following table:

MUSCLE TYPE	ILLUSTRATION	EXAMPLES
Smooth		
		
		Found <i>only</i> in the walls of the heart . On their own they twitch at different rates but once joined together they all contract together.

2.4 Features of Muscle Types

All muscles regardless of type or classification share common features.

Look at the muscles on your forearm. Examine them closely. Move them. Take your observations and knowledge you may already have about muscles and complete the list below.

You may only be able to fill in the explanations on the right hand side if you do not know the correct term for what you are describing.

There are seven features in common:

1. _____: _____

2. _____: _____

3. _____: _____

4. _____: _____

5. _____: _____

6. _____: _____

7. _____: _____

2.5 Structure of Skeletal Muscle

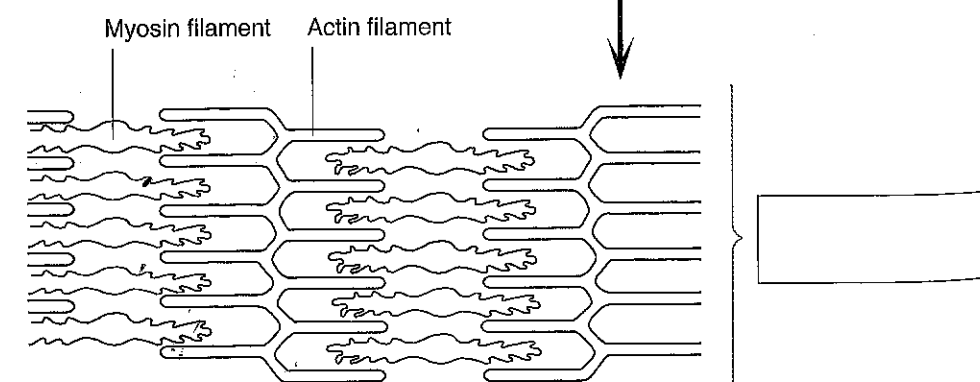
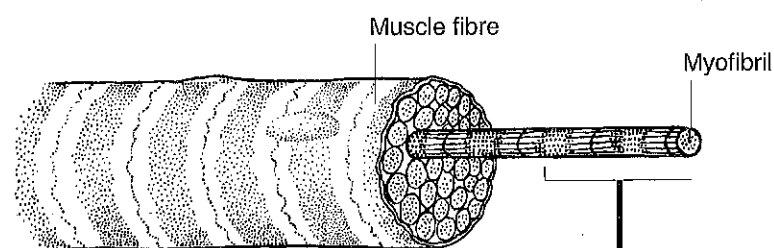
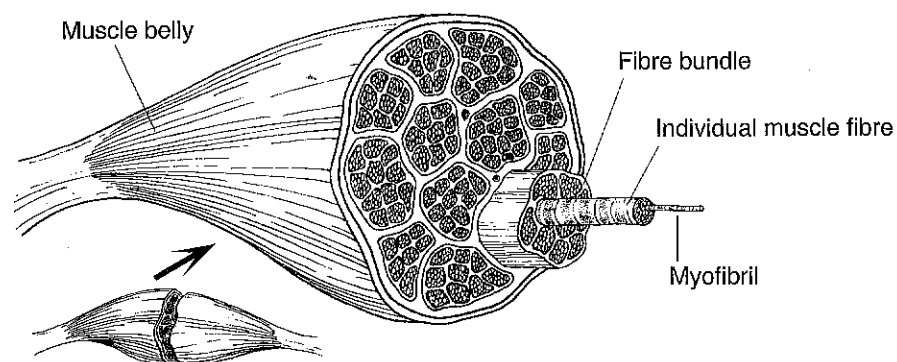
Around 40% of our body weight comes from skeletal muscles.

Just as nerves in *Section 1: Nervous System*, skeletal muscles are made up of smaller and smaller components.

From *largest to smallest*, the order is:



Using this sequence, colour the components on the illustration below and fill in the label in the empty box.



2.6 Factors Affecting Muscular Strength

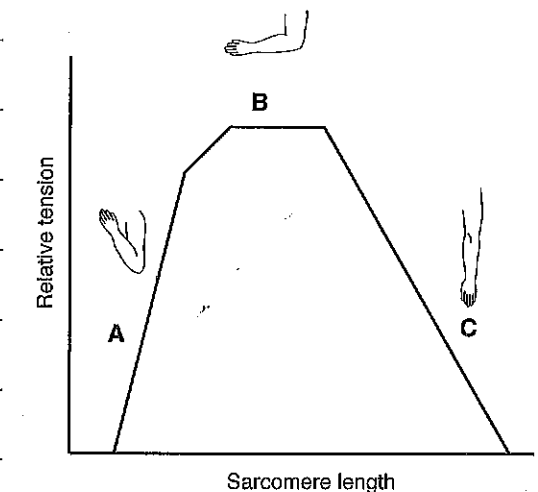
There are many factors that affect the amount of muscular strength we have. Some are alterable as a result of training, some are not.

Using your textbook, or with guidance from the teacher, complete the explanations below.

1. Cross Sectional Area:

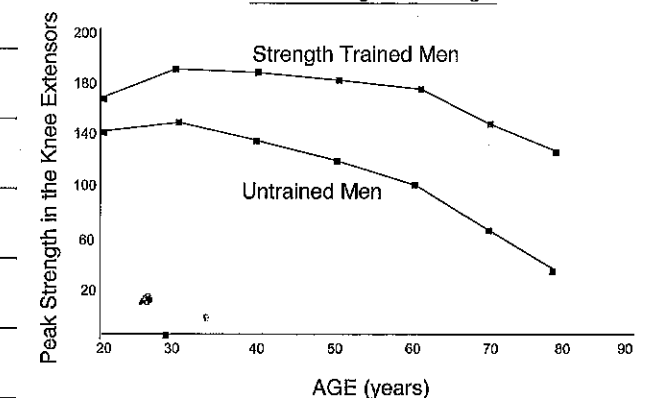
2. Muscle Length:

Effect of Arm Position on tension Developed



3. Age:

Effects of Age on Strength



4. Sex:

5. Fibre Types:

Read the following article and complete the table that follows regarding the features of fibre types.

Have you ever sat down for dinner and found yourself wondering why chicken has some dark meat and some white meat?

The explanation for the color differences is pretty simple and has a basis in physiology. The dark meat of chicken, is “red” or slow-twitch muscle. The white meat is “white” or fast twitch muscle. Most animals have some combination of these two fibre types, though the distinctions may be less obvious.

Why are they differently colored? The slow muscles have more blood cells and blood vessels. This gives them a darker, reddish color. Humans also have dark and white meat. Some of our muscles, like the soleus in the lower leg are virtually all slow twitch fibres. Others such as those controlling eye movements are made up of only fast twitch fibres.

Function dictates form in these highly specialized muscles. The majority of human muscles contain a mixture of both slow and fast fibre types. From an evolutionary standpoint this makes sense. Daily survival sometimes dictated a long walk or jog in search of food. At other times, a fast sprint or jump may have kept one out of harm's way. The exact composition of each muscle is genetically determined. On average, we have about 50% slow and 50% fast fibres in most skeletal muscles, with variations between individuals and muscles. It is these variations that help make sports interesting!

If you want to win an Olympic medal in the 100 metres, you had better be born with about 80% fast twitch fibres! Want to win the Olympic marathon? Put in an order for 80% slow twitch fibres in your quads. The fast twitch fibres benefit the absolute sprinter because they reach peak tension much faster than their slow twitch counterparts. Gram for gram, the two types are not different in the amount of force they produce, only the rate of force production. So, having a lot of fast twitch fibres only makes a difference when the time available for force production is very limited (milliseconds), like the brief time the foot is in contact with the ground during a sprint, or a long jump. For the pure endurance athlete, it is slow twitch fibres that are needed. These fibres give up lightning speed for fatigue resistance.

(modified from www.northeast.net/~hoffman/physio.htm)

**Summary of Fast and Slow Twitch Muscle Fibre Features**

TYPE I (SLOW TWITCH)	TYPE II (FAST TWITCH)

6. Contraction Speed:

If this is the case, how best should we move heavy objects such as push-starting a car?



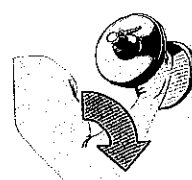
What are the applications of this in sport?

2.7 Types of Muscular Contraction

1. Contractions Defined

There are four basic types of muscular contraction.

Using the textbook, or with direction from your teacher, complete the table below:

CONTRACTION TYPE	DEFINITION	EXAMPLES
Isotonic (concentric or dynamic)		
Isometric (static)		
Isokinetic		Isokinetic exercises require special machines that adjust the tension throughout the movement in order to keep the muscle maximally contracted throughout the full range of motion. Such machines are very expensive e.g. Nautilus.
Eccentric		

2. Isometric versus Isotonic Training

There are distinct advantages and disadvantages of each of these two methods of training.

Using the information from the table (previous page), compile a list of advantages and disadvantages of each method of training.

METHOD	ADVANTAGES	DISADVANTAGES
Isometrics		
Isotonics		

2.8 Revision Questions

Question 1

Identify the three types of muscle cell, and indicate where you might find them.

1. _____
2. _____
3. _____

Question 2

Identify three features that are common to all muscle types.

1. _____
2. _____
3. _____

Question 3

A muscle sample of the quadriceps is taken from an athlete. After fibre typing, the following results come back:

Type I: 75%

Type II: 25%

Explain to this athlete what the results mean and what type of events they would be suited to.

Question 4

The load changes as the joint angle changes throughout the range of motion. This sentence defines which type of muscular contraction?

- a. Isometrics b. Isokinetics c. Isotonics d. Eccentric e. Concentric

Question 5

Weight training is an attempt to bring smaller muscle fibres up to the size of larger ones. This will result in improved strength because ...

- a. there are now more muscle fibres within the muscle belly so more force can be generated.
b. there is now a greater length of muscle so greater force can be produced.
c. there is now a greater cross sectional area of muscle so more force can be produced.
d. training will stimulate production of testosterone resulting in improved strength.
e. None of the above.

Question 6

What are the disadvantages of isometric training?
