

AQA Additional Applied Science - 11.4 Sports Science

The role of the sports scientist is to improve the performance of athletes competing in a wide variety of sporting competitions. Sports physiologists are interested in the health and fitness of the parts of the body involved during exercise. Nutritionists and dieticians help to optimise performance by controlling energy and nutrient intake.

Materials scientists develop new materials for clothing and sports equipment and study their properties and the effect of the forces that act upon them during exercise.

Success in sport depends on a wide range of factors, including:

- the fitness of the body in order to perform during stressful situations
- the energy and nutrient intake before exercise
- the effectiveness of sports equipment and clothing used for training and competing
- the skill level of the athlete
- the ability of an athlete to concentrate and focus in a competitive situation.

In this section you will learn about some of the science and techniques used by sports physiologists, nutritionists and materials scientists.

Exercise and the human body

Athletes are focused on improving their performance through fitness training. Sports physiologists have a detailed understanding of the organs and organ systems in the body; they help athletes to develop a personal fitness programme that meets their individual needs.

You need to be able to:

- describe the structure of the human cardiovascular system
- describe the function of the heart and lungs in providing glucose and oxygen to the muscles
- describe the physiological changes that occur during exercise (linked to breathing and heart rate)
- describe how the structure of the thorax enables ventilation of the lungs
- describe how respiration may be aerobic or anaerobic depending on the availability of oxygen, and that oxygen debt may occur in muscles
- describe how humans maintain a constant body temperature (by sweating and changing the diameter of capillaries)
- explain why humans need to maintain the correct amount of water in the body (water loss through urine and sweat)
- describe how the blood glucose levels are controlled (by the hormones insulin and glucagon)
- describe the antagonistic action of muscles (biceps and triceps).

Before sports physiologists can advise an athlete on an appropriate fitness programme they need to take baseline measurements of physiological changes that happen in the athlete's body before, during and after exercise.

You should be able to take baseline measurements of:

- *the heart rate (pulse) and the breathing rate at rest/during exercise and how to monitor the recovery rate immediately after exercise*
- *the vital capacity and tidal volume of the lungs using a spirometer*
- *the glucose content of blood and urine using a dip-stick method*
- *the strength of a muscle using the grip test method.*

You should be able to use data, theories and explanations to:

- suggest suitable measurements to take in order to monitor physiological changes during exercise

- explain the importance of taking accurate and reliable measurements
- calculate pulse and breathing rate.

Sports nutrition

The correct combination of carbohydrates, proteins, fats, vitamins, minerals and water is essential to optimise athletic performance.

Sports nutritionists and dieticians study the nutrient intakes of athletes and provide nutritional advice to maximise the performance of the body during exercise.

You need to be able to:

- describe how the daily energy requirements for an individual depend on the mass of the individual (weight) and that these requirements increase during exercise
- explain that Body Mass Index is an indicator of ideal weight
- describe methods used to record dietary habits of individuals (24 hour dietary recall and diet diaries)
- *calculate:*
 - *basic daily energy requirements (BER) (for every kg of body mass 1.3 Kcal are required every hour)*
 - *Body Mass Index (BMI)*
- explain why athletes increase their intake of complex carbohydrates (bread, pasta, rice) before competing (increase glycogen stores in the muscles)
- explain why some athletes eat a diet high in protein (build muscles)
- describe the composition of isotonic sports drinks (water, glucose and electrolytes).

You should be able to assess the applications and implications of science when:

- comparing and contrasting a normally balanced diet with that for a person competing in sport
- comparing and contrasting a range of different diets and suggest their suitability for an athlete.

Materials for sport

Materials scientists are constantly researching, developing and testing new materials to see if they can help to improve the performance of an athlete. They analyse the effect of forces such as friction and air resistance on the material used for clothing and the ability of the material to absorb excess moisture, to help maintain the temperature of the body or to encourage blood flow around the body. They design and test sports equipment made from materials that have the correct combination of properties.

You need to be able to:

- explain why sports clothing (including footwear) needs to be lightweight, durable and comfortable
- explain why friction is important in the design of sports equipment (grip on soles of shoes, aerodynamics of cycle helmet)
- give examples of materials (wood, metal, polymer, ceramic, composite) used to make sports equipment (eg clubs, racquets, bicycle frames, protective equipment)
- give the characteristic properties of metals (high tensile strength, thermal conductivity, flexibility, hardness)
- give the characteristic properties of polymers (low density, flexibility, low thermal conductivity)
- give the characteristic properties of ceramics (high melting point, low thermal conductivity)
- explain the properties of composites in terms of the properties of their components
- give examples of different types of materials (natural: cotton, leather) (synthetic: polyester, lycra) used for sports clothing
- describe the advantages and disadvantages of synthetic materials compared with natural materials

- *describe how different properties of materials are desirable for different clothing and equipment:*
 - *low density for increasing speed*
 - *smooth for aerodynamic shapes*
 - *high tensile strength for materials providing support*
 - *thermal insulation to help maintain body temperature*
 - *large surface area for cooling*
 - *flexibility for comfortable equipment and clothing*
 - *shock absorbent materials for footwear.*

You should be able to use data, theories and explanations to:

- select appropriate materials for sports clothing, equipment and footwear and be able to explain why the different properties are important.