Teaching Plan
Unit 7: The Physics of Sport

The following plan is based on 12 weeks at 5 hours per week (4 hours contact time + 1 hour directed study). The learning activities are suggestions only. Teachers may wish to develop alternative strategies. The plan should be read alongside the unit specification, and in particular the assessment evidence grid which for reference is reproduced at the end of this document.

Week number	Specification Unit Reference and Assessment Objectives	Suggested Learning Activities	Resources
1 and 2	7.2.1:Measurement (AO1) • Know the SI units of mass, length, time, temperature, pressure, force, and weight, and their multiples and submultiples; the practical units used for measurement in sport, such as mm Hg, °C, calories, and how they relate to the SI units; and carry out calculations and conversions using SI and other units; • know about devices and techniques for making measurements in sport: and explain the need for calibration and the limitation of these devices: - manual clockwork and electronic clocks/stopwatches; - mechanical and optical timing gates; - rules and tape measures; - manometers and pressure cells - mercury/glass thermometers, thermistors; - clip-on pulse monitors;	Circus of measurement activities recording measurement of each type, e.g. mass of shot for shot putting, length of long jump, time to run 100m using light gates compared to stop watch, air temperature, force and pressure under blade of ice skate, weight of body, air pressure. Investigation of calories in breakfast cereals and sports drinks. Use of clip-on pulse monitor Microwave simulation of radar speed measurement. Data logging of physiological measurement e.g. pulse rate, blood pressure.	Balance Measuring tape Stop watch Light gates and electronic timer Thermometer/temperature sensor for datalogger Newton meter Ice skate blade or metal imitation blade Manometer Barometer Cereal packets Sport drink containers Computer with datalogging software and interface, e.g. Data Studio software with PAsco scientific Interface and transducers Physiological sensors

Week number	Specification Unit Reference and Assessment Objectives	Suggested Learning Activities	Resources
	- radar, - data logging; • carry out and record measurements using sports equipment or lab equivalent.		
3	7.2.1: Measurement (AO1) Guidance leaflet 1, '*Measurement in Sport*'.	Research and write first leaflet.	Tables of Physical and Chemical Constants, Kaye and Laby, definitions of units, Internet and library access See also exemplar candidate material ASci_unit7_exemplar1.pdf.
4	7.2.2 Physics of the Body (AO1) • Describe the formation of a real image with a convex lens and relate this to the eye; • describe the optical function of each of the parts of the eye listed above; • describe the effects of colour filters on white/day/flood light and explain how the use of coloured contact/spectacle lenses may help sports players, e.g. tennis, aviation.	Use convex lens to form real image on screen. Simulate focusing of eye by investigation forming image at fixed distance from lens (simulating position of retina) with a variety of object distances by substituting a range lenses with various focal lengths. Investigate ray diagrams for convex lens on computer. Draw diagram of eye from model. Investigate effects of coloured filters using diffraction grating to produce spectrum	Set of lenses Lens holder screen Lamp as object Software to draw ray diagrams e.g. http://webphysics.davidson.edu/alumni/MiLee/java/Final_Optics/optics.htm Model of eye Coloured filters Diffraction grating White light source
5	7.2.2: Physics of the Body (AO1) Guidance leaflet 2 '*Seeing in Sport*'	Research and write second leaflet.	Internet and library access

Week number	Specification Unit Reference and Assessment Objectives	Suggested Learning Activities	Resources
6	7.2.2: Physics of the Body (AO1) • State the principle of conservation of energy; • state that muscles are not very efficient at converting chemical energy to mechanical work done. • apply the principle of moments to bone/muscle joints, calculate in/output forces, mechanical advantage, velocity ratio, and show how the angle between the bone and the muscle affects the forces involved; • explain why exercise produces heat and its implications in endurance events such as marathon running. Guidance leaflet 3, '*Movement in Sport*'.	Discussion of energy transfer chain in sports context. (Breakfast – chemical changes in body – work done by muscles – heat kinetic/potential energy gained etc.) Practical exercise with model arm and leg. Research on respiration in muscle tissues Research and write third leaflet.	Model may consist of beams and strings, force meters, masses, protractor. Internet and library access
7	7.2.3: Physics of Equipment and Techniques (AO1 and AO2) • Describe the typical properties of metals, ceramics, polymers and 'old' composites such as wood and leather; • explain what is meant by a composite material.	Research and presentation to group by class members Construction and testing of GRP model	Source material to assist presentations Glass fibre Resin Force meter and masses to test

Week number	Specification Unit Reference and Assessment Objectives	Suggested Learning Activities	Resources
8	7.2.3: Physics of Equipment and Techniques (AO1 and AO2) • Research the use of new materials in a range of sporting applications and show why a particular material was used for a particular a job and Explain the advantage to the player; • design and carry out a safe experiment to determine the coefficient of restitution for a ball of your choice.	Candidates select examples from sports of their choice and obtain manufacturers specifications and sports governing body rules governing equipment.	Internet Sports shops Letters to manufacturers
9	7.2.3: Physics of Equipment and Techniques (AO1, AO2, AO3a) Guidance leaflets: 4 '*Choice of Ball Material*' 5 '*Equipment in Sport*'	Research and write fourth and fifth leaflets. Plan experimental investigation	Internet and library access See also exemplar candidate material ASci unit7 exemplar2.pdf.
10	7.2.3: Physics of Equipment and Techniques (AO1, AO2, AO3b) • Calculate the energy and momentum involved in diverse examples of sports; • apply conservation of energy and momentum to simple sporting examples such as the collision of snooker balls, rugby players, bats and balls.	Carry out set of calculations of progressively increasing complexity. Carry out experimental investigation, e.g. using tennis racket and ball.	Teacher-produced worksheet of questions Calculator

Week number	Specification Unit Reference and Assessment Objectives	Suggested Learning Activities	Resources
11	7.2.3: Physics of Equipment and Techniques • Explain the effects of spin on the trajectory and bounce of a ball; • show that rotating objects have both kinetic energy and momentum, and explain how a change in shape may lead to a change in rate of rotation and apply this to various sporting examples; • explain how sails and wings produce forces for motion and lift.	'A' stands on turntable platform and extends arms. 'B' standing on floor pushes 'A' to start rotation. 'A' drops arms. Rate of rotation increases. Test models near blower.	Tennis racket and ball Credit card sized CD *The Physics of Spin,* Cambridge University Cavendish Laboratory, sponsored by IOP Turntable Model wing and sail Air blower
12	7.2.3: Physics of Equipment and Techniques (AO1, AO2, AO3c) Guidance leaflet 6, '*Technique in Sport'*	Research and write sixth leaflet Draw conclusions form experimental investigation and link these to appropriate leaflet.	Internet and library access

The assessment evidence grid from the unit specification is reproduced on the following pages.

Unit 7: The physics of sport

What you need to do:

You need to produce a series of **six** short guidance leaflets for the coaches at a sport and recreation centre to help them answer questions of a technical nature from their trainees:

- A *'Measurement in Sport'* leaflet which will include the units, devices and techniques used for making measurements of **five** different quantities in specified sports of your choice;
- A '*Seeing in Sport'* leaflet which will include the structure of the eye and how it forms an image, related to **one** chosen sport where good vision is of critical importance;
- A '*Movement in Sport'* leaflet which will include an account of how chemical energy is most efficiently converted into useful mechanical work using the muscles, bones and joints of **one** or more limbs and related to **one** chosen sport where efficient movement is of critical importance;
- A '*Choice of Ball Material'* leaflet which will include the required material properties and how these are achieved in **one** specified type of ball;
- An '*Equipment in Sport'* leaflet which will include the required material properties and how these are achieved in **one** or more other chosen item of sports equipment;
- A '*Technique in Sport'* leaflet which will include **one** example related to a specified sport of your choice of either collisions, trajectories of moving objects or lift, e.g. in aerofoils.

Please note: **One** of the leaflets *'Movement in Sport'* or *'Technique in Sport'* needs to include examples of relevant calculations.

You also need to produce evidence that you have obtained information by experimental investigation relating to **one** or more of your leaflets [**50** marks].

How you will be assessed:

Assessment Objective	Mark Band 1	Mark Band 2	Mark Band 3	Mark Awarded
AO1	You will demonstrate some knowledge and understanding of the facts, phenomena and principles involved in the unit in your: • *'Measurement in Sport'* leaflet **[0 1]** • *'Seeing in Sport'* leaflet **[0 1]** • *'Movement in Sport'* leaflet **[0 1]** • *'Choice of Ball Material'* leaflet **[0 1]** • *'Equipment in Sport'* leaflet **[0 1]** • *'Technique in Sport'* leaflet **[0 1]**	you will demonstrate an extensive knowledge and understanding of the facts, phenomena and principles in your leaflets; there may be minor omissions but there are no serious scientific errors in your: • *'Measurement in Sport'* leaflet **[2]** • *'Seeing in Sport'* leaflet **[2]** • *'Movement in Sport'* leaflet **[2 3]** • *'Choice of Ball Material'* leaflet **[2]** • *'Equipment in Sport'* leaflet **[2]** • *'Technique in Sport'* leaflet **[2 3]**	you will demonstrate comprehensive and detailed knowledge and understanding of the facts, phenomena and principles in your: • *'Measurement in Sport'* leaflet **[3]** • *'Seeing in Sport'* leaflet **[3]** • *'Movement in Sport'* leaflet **[4]** • *'Choice of Ball Material'* leaflet **[3]** • *'Equipment in Sport'* leaflet **[3]** • *'Technique in Sport'* leaflet **[4 5]**	**/21**

Unit 7: The physics of sport (continued)				
Assessment Objective	**Mark Band 1**	**Mark Band 2**	**Mark Band 3**	**Mark Awarded**
AO2	You will show that you sometimes select the relevant principles relating to the selections and that you have some success in using them in the explanation in your: • *'Choice of Ball Material'* leaflet **[0 1]** • *'Equipment in Sport'* leaflet **[0 1]**	you will show that you usually identify the underlying principles relating to the selections; although there may be minor errors and omissions, your explanations will be clear and accurate in your: • *'Choice of Ball Material'* leaflet **[2]** • *'Equipment in Sport'* leaflet **[2]**	you will show that you accurately identify the underlying principles relating to the selections and you will correctly use the principles to give a clear, accurate and thorough explanation in your: • *'Choice of Ball Material'* leaflet **[3]** • *'Equipment in Sport'* leaflet **[3]**	
	You will show that you can perform basic calculations correctly but you rarely apply mathematical techniques in an appropriate way in your: • *'Movement in Sport'* or *'Technique in Sport'* leaflet **[0 1]**	you will show that your use of mathematics is generally accurate and appropriate in your: • *'Movement in Sport'* or *'Technique in Sport'* leaflet **[2 3]**	you will show that you use mathematical techniques confidently, accurately and appropriately and where relevant to enhance the explanations in your: • *'Movement in Sport'* or *'Technique in Sport'* leaflet **[4]**	**/10**
AO3	You will show that you can plan a simple experiment and conduct it safely; **[0 1 2]**	you will show that you can plan an experiment and conduct it safely; you produce and follow a risk assessment which covers the majority of safety issues; **[3 4]**	you will show that you can plan and conduct an experiment safely in accordance with your risk assessment which is comprehensive and realistic. **[5 6]**	
	You will show that you have used a range of equipment and conduct the investigation safely to obtain some valid data; **[0 1 2]**	you will show that you have used a range of equipment and techniques and conduct the investigation safely to obtain adequate valid data and repeat measurements; you record data in a suitable form and usually to an appropriate degree of precision; **[3 4]**	you will show that you have used a wide range of techniques and equipment and conduct the investigation safely to obtain ample valid data and repeat measurements; you record data clearly and to an appropriate level of precision. **[5 6]**	
	You will give some interpretation of the results, and relate these to the investigation; **[0 1 2 3]**	you will interpret the results and draw basic conclusions relating to the investigation; **[4 5]**	you will interpret the results in detail and draw conclusions, discussing their significance to the investigation. **[6 7]**	**/19**
			Total mark awarded:	**/50**