

MODULE CONTENT

Module Title: **SCIENCE FROM CONTEXTS**

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Module Description: Science does not occur in isolation. It plays an integral role in helping us interpret and understand our world. Science learning also does not occur in isolation. Students bring to science relevant experiences and ideas that may be overlooked in the science classroom. This module explores teaching science through meaningful contexts that are very much a part of the “real world” encompassing science, technology and society. The module activities are linked with the context of sport, although the principles and processes of the module can be used in other contexts.

Summary of Activities:	Title	Min
1	The Sporting Context	10
2	Physics and Sport – Biomechanics.	50
3	Biology and Sport.	50
4	Sporting Contexts and the CSF II.	30
5	Technology and Sport/Contexts other than Sport.	20
	Total	160

Module Outcomes:

- To encourage participants to reflect on their views about what it means to teach within a *context*.
- To consider teaching science embedded within, and leading from, a societal framework.
- To provide an example of using a context for a cross-disciplinary approach to teaching science.
- To consider the relationship between science, technology and society.
- To become aware of a range of appropriate contexts and approaches to working in them.

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Resources and Materials:

- Paper for participants to write on.
- All Attachments and OHTs as required
- Butcher's Paper.
- Glue and/or clear tape
- Textas (3 – 4 per group).
- White Board Markers.
- Playdough or Plasticine – in three different colours
- Scissors.
- Sports magazines, or articles/advertisements involving sport, from newspapers and magazines (if required)
- Jigsaw 1a: Copies of Centre of Mass worksheet on card; several pairs of sharp scissors; long pins or needles; large safety pin (for making holes); cotton thread or light cord; light weights to make plumb line.
- Jigsaw 1b: Spring balances with varying maxima – 100g, 250g, 500g, range of surfaces, footwear.
- Jigsaw 1c: If activity planned – wooden blackboard protractor or equivalent, metre ruler, plastic tube (or hose) for tap attachment, glass tubing (or similar) to create jet

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Activity 1: Introduction

Purpose: To introduce and discuss ideas for science content through the context of sport.

Teaching Procedures: Brainstorming – Group Overview

Time allocation: 10 minutes

What to do	FACILITATOR	PARTICIPANT
	1.1 Make the point that the approach in this module will be to examine and use contexts that lead into relevant science. This is in contrast to starting with and teaching the science first, and then considering applications of the science to ‘real world’ situations or contexts. Compare differences in the approach for possible implications in teaching/learning. (OHT 1.1). Don’t get bogged down in discussion during this activity which is aimed at quickly gaining an overview. Ask who has used this approach in their science teaching.	
	1.2 Set the scene with coaching and sporting performance as the big idea, and within it, aspects that can provide contexts for science, technology and society, (OHT 1.1): - Personal skill development - Fitness, training, and body shape - Nutrition for sporting performance - Selection of suitable sporting equipment/technology	1.2 Individually consider these contexts.
	1.3 Conduct a quick, very open, brainstorming session with the group by asking them to suggest any aspects of science that could be tackled through the context of sport. Use board or OHT 1.3.	1.3 Contribute to brainstorming.
	1.4 Categorise suggestions – there may be several ways to do this - and briefly discuss their possibilities. There may be many good suggestions and ideas that complement the activities in this module, so the range of suggestions may act as a referent and a resource for later use.	1.4 Discuss groupings, linkage between ideas and possibilities for coherence.
	1.5 Explain the approach planned using the activities in this module, without discounting the value of ideas provided. Stress that the approach here is designed to be an example of a process, so the content has been selected from a range of possibilities. (OHT 1.5 gives an eg.)	

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Activity 2: Physical Science and Sport

Purpose: To use sporting contexts as a stimulus to engage concepts and skills from the Physical Science strand of CSF II.

Teaching Procedures: Jigsaw method.

Time allocation: 50 minutes

What to do	FACILITATOR	PARTICIPANT
	<p>The principles of physics play a large part in the mechanics of all sports, although sports people may not be consciously aware of them during sports activity. Consider the technique used by a spin bowler: the position of the body during the run up, the manipulation of the ball in the hand prior to release, the movement of the ball through the air during the bowling phase, and the forces imparted by the ball onto the bat. Many sports activities can be analysed using some basic (and not so basic) principles of physics. Biomechanics is the area of study where the knowledge and methods of mechanics are applied to the structure and function of the living human system (and sometimes its interaction with equipment). Some basic sporting movements that are analysed through biomechanics include walking, running, jumping, throwing, striking (eg. cricket) and swimming.</p> <p>Three aspects of sport in which the principles of physics can become important considerations that influence technique, equipment, and hence performance, are:</p> <ol style="list-style-type: none"> 1. Centre of mass and stability; 2. Frictional forces; 3. Forces on equipment and bodies. 	
	<p>2.1 Introduce the jigsaw method, explaining how it works. Emphasise the importance of returning to the home groups and explaining what was done in the expert (activity) group . There will be three activity groups, so if possible, have home groups of 3. Each activity group to work from one of the Attachments 1a, 1b, or 1c. Ensure that the necessary materials and equipment are available for each activity.</p> <p>2.2 Monitor work in the groups and provide support, direction as required. Be aware of the relative rates of progress of the three groups</p>	<p>2.1 Participants are initially in home groups of three; each person in the home group takes a number, 1, 2 or 3 (or letter A, B, C). Three activity groups are formed (all 1s, all 2s, all 3s), and each group does one of the three activities, (in this case A, B, C). After completing the activities, participants return to their home groups to share experiences (teach each other), link the activities, and discuss any curriculum ideas.</p> <p>2.2 Use Attachment notes to self organise and undertake activities.</p>

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<p>2.3 At an appropriate time (after 25-30 mins) call activity groups to wind-up and return to home groups. Emphasise the importance of each home group member explaining to others the purposes/activities of the activity groups. Then home groups consider the bigger picture*, and how the activities link.</p> <p>2.4 Draw the activity together with whole group discussion of both the context and the potential of the JigSaw approach in science classes. Remain in home groups for this (brief) discussion, as next activity will be in the same groups.</p>	<p>2.3 Activity group members explain nature/purpose of their activities (about 5 mins each). Group discusses how the activities link and may be synthesised for a purpose, (5-10 mins).</p> <p>2.4 Stay in home groups, join discussion.</p>
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Discuss/Consider:

* The bigger context (picture) could be that of a sport's coach, developing ideas for a program to improve performance.

- Possible links with the school Health and Phys Ed program.
- How some of the strategies from Science Learning and Teaching 1 and 2 may be incorporated into this context, eg Sweller questions on a videoclip, photo, or article; POE; interpretive discussion around why knee injuries are so prevalent in football.
- The possibility of once having established a fruitful context to then conduct more traditional science practical work (eg. in levers, CoG, balance) to reinforce science concepts before returning to address issues and problems raised from the contexts.

- Tips and Tricks:**
- The jigsaw method ensures that each group member is an expert at one aspect of the group task. She/he then teaches the other members of the original group, so reinforcing learning. Thus there is **no need** to summarise the 'content' learning for the groups at the end of the task. Do not re-tell the groups what they have just learned from colleagues (or already know). However discussion about how the method could be used with science classes working from a 'context' perspective can be valuable.

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Activity 3.0: Biological Science and Sport

Purpose: For participants to explore and use some science concepts in the area of biology (and perhaps chemistry) for an understanding of sporting and personal fitness, sporting practices and issues.

Teaching Procedures: Group work
 Interpreting data and information
 Translation task
 Modelling

Time allocation: 50 minutes

- Possible Contextual Questions:**
- What are some of the aspects of fitness and its development?
 - How are fitness and technique related in performance?
 - What does it mean when we say our muscles ‘turn to jelly’?
 - What is ‘carbohydrate stacking’ before an endurance event?
 - What is ‘blood doping’ and why can it improve performance?

What to do	FACILITATOR	PARTICIPANT
	3.1 Introduce the basic context of coaching an athlete or a team and then move to the possible contextual questions. From Attachment 3.1-2 and initiate activity 1 “Knowing Your Body”. Work in groups of four, which will be maintained.	3.1 In groups of 4, prepare one body drawing. This assumes some understanding of the digestive and circulatory systems
	3.2 Ask Participants to read Attachment 3.1-2 Energy Sources for Human Bodies. Activity 1: Working in pairs, ask participants to describe to their partner what the diagram of energy uses in cells means to them. Then organise to do Activity 2: Model Building. Draw the first two activities together and briefly discuss them as the basis for the next sections. Prepare for next attachment.	3.2 Activity 1: Read Attachment 3.1-2: Energy Sources for Human Bodies. Verbally describe an interpretation of the diagram ‘energy cycles in cells’. Do Activity 2: Model Building
	3.3 Reform in original groups (of 4). Introduce Attachment 3.3-4, which focuses on Energy for Physical Activity. Sum-up, seek feedback, discuss the context questions. Prepare to move to next section.	3.3 Work through questions and add new information to the body map. Link knowledge from the activities and relate to context questions.

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<p>3.4 Introduce Attachment 3.5-6, which focuses on food and training. Remain in groups of 4.</p>	<p>3.4 Work through questions and add new information to the body map. Link knowledge from the activities and relate to context questions.</p>
<p>3.5 Review whole process with group and spend some time looking at the body maps and discussing their relevance for class work and how the strategy may be improved.</p>	<p>3.5 Contribute ideas on basis of experience with the activity.</p>

Discuss/Consider:

- The possible ways of moving from the context into the science, and back to the context.
- How an engaging real world context can generate a 'need to know' of quite sophisticated science.
- The potential for 'messy' science (eg. much deeper in some areas than others, and perhaps not covering all areas that might normally be taught), that may emerge from this activity and ideas about how it may be dealt with.

- Tips and Tricks:**
- It is important to move around the groups to ensure that they have an understanding of the purpose, and are heading in fruitful directions – not stuck in basic ways. Some input may be required if appropriate.
 - The order of Attachments 3-4 and 5-6 could be reversed, or the activity could be drawn to a close after doing one of them if time is short. Alternatively, some groups do 3-4 and others 5-6 then link in discussion. Time will be the key factor here.

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Activity 4: The Context and CSF II

Purpose: To examine CSF II outcomes in relation to the experience of the module and the general sports context. To discuss if some outcomes have been addressed, and how others may be approached.

Teaching Procedures: Discussion in small groups.

Time allocation: 30 minutes

What to do	FACILITATOR	PARTICIPANT
	It is important to ensure that this activity is done in a focussed and fairly quick manner. A time limit is necessary, with an understanding of an output to be shared with the group.	
	4.1 Work in small groups (maybe Activity 1 home groups, and use Attachment 4.1 (pages 1 & 2) to analyse and interpret CSF II Science outcomes from three perspectives, the first more generic, and the second and third more specific (see OHT 4.1): <ol style="list-style-type: none"> 1. What outcomes/capabilities could be approached from the sports context? 2. Which of these examples provide a 'need to know' the associated science, ie. a realistic context to stimulate exploration of the relevant science for a purpose? 3. In the process of considering 1&2, above, how can Activities like 2 & 3 contribute to outcomes? 	4.1 Make notes on Att 4.1, and summarize on A3 or butchers paper, as time allows.
	4.2 Ask groups to pin summary sheets on wall, and allow a few minutes for perusal and discussion.	4.2 Share with group.

Discuss/Consider:

- Some examples if needed to get started could be:
 - 5.1 sports clothing (eg sportwool) in heating/cooling of the body
 - 5.2 gears on bikes, lever systems in rowing, pulleys in gym equipment.
 - 5.3 training practices.
 - 5.4 diet and nutrition.
- Consideration of the Skills, Processes and Procedures, as well as the Goals described in the Science CSF II is a valid and worthwhile component of a contextual approach to science. This can be done next.

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FACILITATOR	PARTICIPANT
Although the skills, processes and procedures are not listed as outcomes in the CSF II strands they are given significant recognition in the 'Structure of the Science CSF II'. And the Goals of Science CSF II are also relevant in this contextual approach.	
<p>4.3 Use Att 4.3 (and OHT 4.1) in a whole group discussion to consider how the sporting context may be relevant to</p> <ol style="list-style-type: none"> 1. Ethical/social aspects of either society and/or Science, that can be informed by science knowledge. 2. The relationship of technology to science. <p>4.4 Draw comments to a conclusion, and if time allows, use this discussion as the basis for moving into the Technology/Other Contexts activity.</p>	<p>4.3 Contribute to whole group discussion.</p>

- Tips and Tricks:**
- Some familiarity with the ideas in the chapter Reading from 'Technology's Challenge to Science Education,' is useful for the latter part of this activity, and the next.

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Activity 5a: Technology and Sport

Purpose: In the context of technological sporting contexts for science, to develop an understanding of the relationship between science and technology and their interactions with society.

Teaching Procedures: Group work

Time allocation: 20 minutes

- Possible Contextual Questions:**
- What design of swimming goggles produces the least drag through water?
 - How does the drug testing technology work in its basics?
 - What sort of specialist exercise equipment can help an athlete recover as quickly as possible from a (knee) injury.
 - Equipment has been developed to quickly dry water from around a cricket wicket. How does it work, and at what cost?
 - How can Technology be employed to enhance sporting performance through its role in developing and testing new equipment, new clothing and gear, and new training aids?

What to do	FACILITATOR	PARTICIPANT
	5.1 Using OHT 5.1 introduce the contexts within which the role of technology in sport can be considered.	
	5.2 Using Attachment 5.2 consider as a group the meaning of Technology and the relationships and comparisons between Technology and Science	5.1 Read Attachment 5.2 and contribute to an introductory discussion on Technology and Science.
	5.3 Organise participants into three/four groups. Each group will consider one of the broad technological contexts and seek appropriate science that may lead from a need to examine/understand aspects of the technology. This is explained in Attachment 5.2	5.2 Work in groups according to Attachment 5.2
	5.4 Ask each group to briefly report back to the whole group. Pool ideas as a possible resource.	5.3 Report back.

- Discuss/Consider:**
- The relationship between technology, science and society.
 - Links with the Technology KLA/CSF.

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Activity 5b: Contexts other than Sport

Purpose: To reflect on the module, its concepts and principles, and investigate other possible contexts that may provide interesting and useful ways into science.

Teaching Procedures: Directed reflection
Think, pair, share

Time allocation: 20 minutes

What to do	FACILITATOR	PARTICIPANT
	5.1 Explain that the planned outcome of this activity is a compilation of the experience and ideas of participants about other contexts and approaches suitable for secondary science.	5.1 Individually prepare list of possibilities with CSF links.
	5.2 Ask participants to individually read Attachment 5.3 and list possible appropriate contexts/approaches, and link these with the CSF.	5.2 Pair with another, discuss ideas, and continue development.
	5.3 Continue with pair-share to groups of four.	5.3 Two pairs join and share outlines developed. Refine (and synthesise) these.
	5.4 Take feedback from each group of four and consider compilation of ideas for all participants to take with them or collect next session.	5.4 Contribute outcomes to whole group.

Discuss/Consider:

- The increased emphasis on science processes in CSF II.
- Participants' experience in implementing the contexts approach.

Tips and Tricks:

- The aim is for participants to provide ideas and feedback to the group so that the group wisdom is shared. The idea of a formal summary of suggestions and references may help focus this activity.

Resources:*Publications and Journals*

Sports Medicine

The Australian Journal of Science and Medicine in Sport

Websites

Australian Sports Commission

<http://www.ausport.gov.au/>

Human Kinetics Publications

<http://www.humankinetics.com/>

Sportscience Exchange

<http://www.gssiweb.com/>

National Standards Commission – For ‘Measurement in Sport’

<http://www.nsc.gov.au/>

Texts

Bloomfield, J, Fricker, P, and Fitch, K, Eds (1992). Textbook of Science and Medicine in Sport. Blackwell Scientific Publications

Bowers, R. and Foss, M. (1993), The Physiological Basis for Exercise and Sport (5th Edition), Brown and Benchmark Publications

Cross, M, Gibbs, N, Gray, J, (1991), The Sporting Body. McGraw-Hill

Kreighbaum, E. and Barthels, K. (1990). Biomechanics(3rd Edition), Macmillan, New York.

National Standards Commission (1996). Measurement in Sport: Student booklet and Teachers manual. See Attachment SciCtxtsAttMIS for contents page and order form.