



Unit Guide

Biomechanics I

SSS-1-994

Faculty of Engineering,
Science and the Built
Environment

2009

Become what you want to be

1.0 UNIT DETAILS

Unit Title:	Biomechanics I
Unit Level:	Level 1
Unit Reference Number:	SSS-1-994
Credit Value:	1
Student Study Hours:	150
Contact Hours:	39
Private Study Hours:	111
Pre-requisite Learning (If applicable):	N.A.
Course(s):	B.Sc. (Hons) Sport and Exercise Science B.Sc. (Hons) Sport Product Design
Year and Semester	Year 1, Semester 2
Unit Coordinator:	Dr David Cook
UC Contact Details (Tel, Email, Room)	Tel. 020-7815-7992 Email: cookdp@lsbu.ac.uk Room: B323
Summary of Assessment Method:	100% Examination The pass mark for the unit is 40%

This guide is designed to help you structure your learning by providing an indicative structure and content for the unit. It is a guide and not a definitive statement of what you will be taught. We will try to follow this published schedule as far as possible, but there may be some variation as the unit develops and as we try to match the pace and content of our teaching to student needs.

2.0 SHORT DESCRIPTION

The focus of this unit is to introduce basic concepts in biomechanics and their applications in sports science. The unit includes linear and angular kinematics, linear and angular kinetics and fluid mechanics and provides an opportunity to learn these and other mechanical principles and appreciate their applications in sports events.

**SATISFACTORY ATTENDANCE AT ALL SESSIONS IS REQUIRED.
UNSATISFACTORY ATTENDANCE IS A VIOLATION OF THE SCHOOL POLICY AND
WILL BE DEALT WITH BY THE EXAMINATION BOARD.**

3.0 AIMS OF THE UNIT

- To establish a sound understanding of basic concepts of kinematics and kinetics in sports biomechanics.
- To apply mechanical principles and Newton's laws to the analysis, explanation, comparison and development of sports techniques.
- To develop the ability to process and interpret data from a coaching perspective by a biomechanical analysis of sports techniques.

4.0 LEARNING OUTCOMES

On completion of this unit, the student will be able to:

1. Identify biomechanical methods applied to the study of sports technique.
2. Explain the application of linear and angular kinematics in sports techniques.
3. Use Newton's laws to explain and calculate kinetics in sports techniques.
4. Recognise the influence of fluid environments when explaining sports technique.

5.0 Key and Cognitive Skills

During the course of the unit, students will develop the following skills:

Within the taught programme, staff will utilise different learning techniques, many of them student centred, to engender a wide learning experience for the students.

Exam technique and revision strategies will be focused upon in the assessment of the unit. In continuance of the mathematical skills introduced in the skills for sports sciences module, students will be taught the basic calculation skills necessary for the biomechanical evaluation of sport. The structure of the tutorial programme will focus upon the student being able to practice and develop the theoretical issues outlined in the lecture in practical sporting situations. It is envisaged that the structure of the unit in this manner will allow students to improve analytical skills, and begin to formulate conclusions about the biomechanical influences upon sports performance.

Throughout the unit, students will be encouraged to utilise individual study skills, and there are opportunities for evaluation of progress built into the lecture and tutorial programme.

6.0 THE PROGRAMME OF TEACHING, LEARNING AND ASSESSMENT

Week 1 Week beginning 26th Jan 2009

An Introduction to Biomechanics

Week 2 Week beginning 2nd Feb 2009

Article review

Describing Motion

Week 3 Week beginning 10th Feb 2009

Article review

Forms of Motion: Linear Kinematics

Week 4 Week beginning 17th Feb 2009

Article Review

Angular Kinematics

Week 5 Week beginning 24th Feb 2009

Article Review

Linear Kinetics: Newton's Laws

Week 6 Week beginning 2nd March 2009

Article Review

Angular Kinetics

Week 7 Week beginning 9th March 2009

Article Review

Problems and Issues associated to Kinematics and Kinetics

Week 8 Week beginning 16th March 2009

Article Review

Fundamentals of Biofluid Mechanics

Week 9 Week beginning 23rd March 2009

Debate

Week 10 Week beginning 30th March 2009

Article Review

Locomotion

Easter Break

Week 11 Week beginning 27th April 2009

Article Review

Biomechanics of Throwing and Jumping

Week 12 Week beginning 4th April 2009

Group presentation of biomechanics topic

Week 13 Week beginning 11th May 2007

Revision

The content of these lectures may change.

End of Unit Review – your feedback is valuable.

It is University policy to obtain student feedback at the end of each unit. This is carried out using a standard form that should be completed and returned in a way that should maintain your anonymity. The results of the tick-box responses and any additional commentary are presented and discussed at the Subject Area Review & Planning Meetings that are held twice per year. Should it be required, members of staff at these meetings agree to modify aspects of unit delivery and assessment for the next time that the unit will be presented (usually for the following year).

7.0 ASSESSMENT OF THE UNIT

The unit assessment will consist of a 2 hour end of unit examination (100%). Examination will be based on short answers and brief essay-style questions. The examination will cover all learning outcomes.

See also Award of marks criteria – Appendix A.

8.0 LEARNING RESOURCES

8.1 CORE MATERIALS

Bartlett, R. (1997). *Introduction to Sports Biomechanics*. London: E& FN Spon.

Hay, J.G. (1994). *Biomechanics of Sports Techniques (4th edition)*. Englewood cliffs, New Jersey: Prentice Hall.

Lutgens, K. and Hamilton, N. (1997). *Kinesiology: Scientific basis of human motion*. Dubuque IA: Brown & Benchmark Publishers.

8.2 OPTIONAL MATERIALS

Adrian, M.J. and Cooper, J.M. (1995). *Biomechanics of Human Movement (2nd edition)*. Dubuque, Iowa: Brown and Benchmark.

Grabiner, M.D. (1993). *Current Issues in Biomechanics*. Leeds: Human Kinetics Ltd.

Hamill, J. and Knutzen, K.M. (1995). *Biomechanical Basis of Human Movement*. Williams and Williams.

Tips for success:

- * **Plan your work schedules in advance** (use this unit guide to help)
- * **Attend all sessions**
- * **Be punctual** (As a matter of courtesy) Any student more than 15 minutes late will not be allowed into the lecture room until the first break.
- * **Use time efficiently**
- * **Make effective notes** (Use key words, flow charts, diagrams and personal shorthand)
- * **Review material** (Re-read lecture notes following each session; this will aid learning)
- * **Carry out directed reading. Remember that you must make an effort!**

LECTURES ARE THERE FOR OVERVIEW AND GUIDELINES. LEARNING MUST COME FROM YOUR OWN READING AND STUDY ACTIVITIES.

- * **Private Study.** You are expected to contribute to your learning by participating in the designated private study time associated with this unit. You will not pass the unit by simply attending sessions.
- * **Ask for help** (don't be afraid to ask!!)

APPENDIX A

Award of marks

Most units offered within the programme contain more than one type of assessment. Each type of assessment is called an element of assessment. You will normally be required to achieve a minimum threshold mark of 30% in each element of assessment as well as an overall aggregate, based on the weighting of the elements, of a minimum of 40%. Ensure that you prepare well for assessment; it is not good practice to merely achieve the minimum mark. A good performance in other units may enable the Examination Board to decide in your favour on the basis of overall performance if you have performed less well in other areas.

As a general guide, marks are awarded for the following levels of achievement:

>70%	Comprehensive and competent answer. Well communicated. Evidence of additional reading and original thinking. Good analysis of the problem and logical solutions. Factually correct.
60 - 70 %	Overall competent and logical insight into the problem. Largely factually correct. Coverage not extensive but original thinking.
40 - 60%	Generally competent. Some factual errors. Overall understanding but lack of convincing answer
below 40%	A lack of understanding of the problem. Superficial answer. Factual errors. Poor communication skills.

Criteria used in assessing essay assignments and essay-type examination questions

Guidance only.

A more specific guide to the assessment of essay assignments and essay-type examination questions is given below. These criteria are intended to provide a benchmark against which marks allocated to an essay-type question can be compared, in order to see if they give a reasonable assessment of the quality of an answer.

1st Class (70-100%)

An excellent answer displaying complete understanding of the question. It presents all, or virtually all, the relevant 'given' information. Furthermore it will normally, where relevant, contain significant '**non-given**' (not presented within the taught unit programme) information displaying evidence of wider reading and an ability to synthesise information from diverse sources. The answer will be logically organised and well presented, it should be substantially error-free. It may well, if appropriate, show originality of thought or approach and will display insight.

2(i) - Upper 2nd Class (60-69%)

A very good answer showing a sound understanding of the question. It will contain all, or nearly all, the relevant 'given' information. It should normally display evidence of wider reading or contain 'non-given' information. It will have a low error level and will not contain any serious errors. The answer should be logically presented. Better answers in this category may display originality or 'synthetic' ability.

2(ii) - Lower 2nd Class (50-59%)

A sound satisfactory answer, containing most of the 'given' information but will probably display little or no evidence of wider reading or originality. It will normally have a low error level. Some answers in this category may display some attributes of a 2(i) answer but with a higher level of error, however, and less logical presentation.

3rd Class (40-49%)

Although displaying some understanding of the question the answer will be incomplete and show a poor appreciation of the subject. It will contain relevant 'given' information but may have a high level of errors or irrelevancies. Important points will not be addressed. Presentation may be poor.

FAIL (<40%)

An inadequate answer lacking substance and understanding, it may not represent a serious attempt. Where the question has been understood the answer will be very limited and probably contain many errors. Where the student has answered the wrong question, marks may still be given if relevant information is presented.

ACADEMIC MISCONDUCT

Students are referred to the University's Student Handbook Section 10.12 Academic misconduct, which summarises Chapter 13 of the academic regulations. The full version of the regulations is available from the registry (situated in the Technopark building).

Sections taken from 10.12 Academic misconduct section of student handbook:

Academic misconduct is defined as 'any attempt to gain unfair advantage in assessment, or to help another student gain unfair advantage, by deception or fraudulent means.'

Some examples of academic misconduct include:

Assisting another student to gain unfair advantage - for example by allowing another student to copy your work, or use an electronic copy of your work.

Syndication: The submission of pieces of work, which are substantially similar, by two or more students. This may apply within the same institution or in a number of institutions, either at the same time or at different times.

Plagiarism: To 'take and use another person's thoughts, writings, inventions as one's own.' Representing another person's work as your own, without acknowledging the source. Examples of this are provided in your student handbook (10.12, d).

Collusion: Representing as your own piece of work which two or more students have undertaken together, without permission to do so.

Bribery: Offering payment or other inducement to another person in order to gain improper advantage in assessment or to falsify the result of assessment.

Commission: Commissioning another person to undertake all or part of an assignment presented as your own work, or knowingly undertaking work for another student to present as his or her own work.

N.B. Students are referred to Appendix C of the unit guide for guidance on Journal of Sports Sciences' format.

REFERENCING

- referring to sources of information in academic text

We, the humble representatives of the future generations, have at our disposal the accumulated knowledge and experience of all past generations to build our thoughts.

George Jackson

Referencing may look complicated. It isn't. Most of the time you will use simple references that refer to a single journal article or a book. This guide gives you examples for that case and also for the more elaborate cases.

THE BACKGROUND

The purpose of referencing

Academic work is about arguing from evidence - or at least making clear when the statements change from being evidence-based to being speculative. Academic coursework therefore involves reference to valued sources of information. It should always be possible to link statements to evidence and so it is necessary to point to a source of evidence using a **text reference**.

Using references in an assignment is a **crucial academic technique**. If you aren't referencing your work, it is isolated from expertise in the subject and your writing is a set of undifferentiated statements. For some statements there may be excellent evidence, for others there may be no evidence at all. But, without referencing, how can the reader know what is reliable and what is unreliable?

Rate of referencing

References in academic papers commonly occur at a rate of between one and two per sentence. This doesn't mean that each sentence has a reference in it. Some sentences may have a number of references all to themselves then you may read several sentences without a reference. The **average** rate is one reference per sentence. This is the **academic rate**, for someone who has read a lot of papers on the subject over a period of time. We expect you to read around the subject ... but not so extensively. Aim to have approximately one reference for every four sentences.

The referencing convention

If you want to make direct contact with a person, you make use of their address. If you want to make direct contact with information, you make use of a reference. There are conventions for recording an address; there are similar conventions for recording a reference. We use **the Harvard system** as specified in the *Journal of Sports Sciences*. This system refers to papers by the **names of the authors**, not by numbers in a list of references.

Referencing coursework

Referencing occurs in two sections of a piece of coursework: in the body of the writing and in a list of sources at the end. Any reference in the body of the writing should be present in the final list and vice versa. There should be an exact match – **with no exceptions**.

This guide

There are various ways in which the names of authors can be incorporated into writing and the exact form of the reference will depend on the number of authors involved. Also the form of the reference in the list at the end of the writing will depend on what type of reference it is. For these reasons, it is not possible to specify exactly what every reference will look like. This guide is based on **examples**. Whether for the main body of your writing or for the list at the end, you should select an example that suits your particular case (a journal article with two authors, for example) and then **carefully match your writing and punctuation to the example**.

DOING IT

IN THE BODY OF THE WRITING

1. The form of the reference will depend on the number of authors who have produced the work.

One author

... Smith (1975) made measurements of ...
... derived from careful measurements (Smith, 1975) ...

Two authors

... Brown and Green (1976) made measurements of ...
... derived from careful measurements (Brown and Green, 1976) ...

More than two authors

... Jones *et al.* (1980) made measurements of ...
... derived from careful measurements (Jones *et al.*, 1980) ...

2. There are **complications** if you want to give **multiple references at a particular point in the text**.

Multiple references are listed in **ascending date order**. Within a year, they are organised in alphabetical order of the first author.

... Smith (1995), Brown and Green (1996), Jones *et al.* (1996) made measurements of ...
... derived from careful measurements (Smith, 1995; Brown and Green, 1996; Jones *et al.*, 1996) ...
... Smith (1991, 1995), Brown and Green (1992, 1993), Jones *et al.* (1993, 1996a,b) made measurements of ...
... derived from careful measurements (Smith, 1991, 1995; Brown and Green, 1992, 1993; Jones *et al.*, 1993, 1996a,b) ...

Note the use of semi-colons in the second form of each of the examples.

3. There are **complications** if the author/authors have written **more than one paper in a particular year**.

The publications are distinguished from each other by addition of a, b, c etc. to the year.

... Brown and Green (1976a) made measurements of ...
... derived from careful measurements (Brown and Green, 1976a) ...
... Jones *et al.* (1980b) made measurements of ...
... derived from careful measurements (Jones *et al.* , 1980b) ...

The a, b, c etc. are normally given in the order of citation in the text.

2. There are **complications** also if you wish to reference materials that are not the standard academic types of publication such as papers or books. For example, you may wish to refer to **reports by government or professional bodies** or **Internet pages**. For reports, use the name of the author/authors or, if the former is not available, the name of the professional body or government agency, as above. For Internet pages, refer to the author or to the section (*e.g.* lab, unit) and institution responsible for writing the pages. See below for a detailed specification of the entry in the reference list.

... Brown and Green (1984) reported that ... (report)
... derived from a report (Department of Health, 1984) ... (report)
... Hemminga (19.9.1997) recorded measurements of ... (Internet)
... through analytical measurements (Orthopaedic Biomechanics Laboratory, University of Iowa, 20.6.1998) ... (Internet)

3. Note the correct form of *et al.*

✓	<i>et al.</i>
✓	<u>et al.</u>
✗	<i>et al</i>
✗	et al.
<i>i.e.</i> italics or underline <u>and</u> the full-stop	

IN THE REFERENCE LIST AT THE END OF THE WRITING

1. There are four main types of reference (books, articles in journals, articles in books, conference proceedings). Each type is specified separately below.

Reference to a book

Zatsiorsky, V.M. (1995). *Science and Practice of Strength Training*. 2nd edn. Champaign, IL: Human Kinetics.

Reference to a journal article

Elliott, B., Marshall, R. and Noffal, G. (1996). The role of upper limb segment rotations in the development of racket-head speed in the squash forehand. *Journal of Sports Sciences*, **14**, 159-165.

Reference to an article/chapter in a book

Stephenson, D.G., Lamb, G.D., Stephenson, G.M.M. and Fryer, M.W. (1996).

Mechanisms of excitation-contraction coupling relevant to skeletal muscle fatigue. In *Fatigue: Neural and Muscular Mechanisms* (edited by S.C. Gandevia, R.M. Enoka, A.J. McManus, D.G. Stuart and C.K. Thomas), pp. 45-56. New York: Plenum Press.

(Note specification of the publisher's location – for the particular book – as well as the publisher.)

Reference to chapters in published books of conference proceedings or abstracts

Howe, B.L. and Bell, G.J. (1986). Mood states and motivations of triathletes. In *Sports Science: Proceedings of the VIII Commonwealth and International Conference on Sport, Physical Education, Dance, Recreation and Health* (edited by J. Watkins, T. Reilly and L. Burwitz), pp. 273-78. London: E & FN Spon.

(Again note the specification of the publisher's location as well as the publisher.)

Cited

If you have not read a work for yourself, you should indicate the source of your information by using the term “cited”, as given below. **It is poor practice to rely heavily on cited information.**

Zatsiorsky, V.M. (1995). *Science and Practice of Strength Training*. 2nd edn. Champaign, IL: Human Kinetics
cited in
Elliott, B., Marshall, R. and Noffal, G. (1996). The role of upper limb segment rotations in the development of racket-head speed in the squash forehand. *Journal of Sports Sciences*, **14**, 159-165.

2. Non-academic sources

Reports

Department of Health. (1991). *The Health of the Nation*. London: HMSO.

This closely matches the above *Journal of Sports Sciences* specification for a book. It may not always be possible to provide all the information in this way. The principle is to provide information that allows the reader to get access to the original.

Internet pages

Sokal, A (22.9.98). Papers by Alan Sokal.
<http://www.physics.nyu.edu/faculty/sokal/index.html#papers>. New York: New York University

The Guardian. (22.9.98). Leicester City.
<http://football.guardian.co.uk/football/clubs/clubs.html>. London.
(No need to repeat the “institution” (*The Guardian* here) if it is the same as the publishers of the web pages.

Biomechanics Research Laboratory, Johns Hopkins University. (23.9.98). Pre-operative planning of femoral and pelvic osteotomies.

<http://www.biomech.jhu.edu/projects/vr/fempel.html>. Baltimore.

Give the author of the page or, if there is no obvious author, the section and institution/organisation (*e.g.* Nutrition Research Centre, South Bank University). For the Internet, both the material and the locations can change. It is therefore useful to quote the date on which material was viewed or downloaded. If the web pages are at a site which is not owned by the organisation/institution (*i.e.* if they are located on “someone else’s” server), give the name of the organisation/institution running the site as the “publisher”. Because of the fluidity of the Internet, you are advised to include photocopies of Internet text etc. with your assignments.

3. It is important to pay attention to:

bold vs normal text

italics vs normal text

details of punctuation (commas and full-stops)

4. The list of cited references at the end of the writing should be collected in alphabetical order by, in the first instant, the first author’s surname. Where the name of the first author appears more than once, the order is determined by: firstly, the number of co-authors (zero, one, more than two); secondly, for one co-author, the co-author’s surname then the year; for two or more co-authors, the year then order as determined by the use of 1990a, b, c (for example) in the citations in the text.

Brown, A.B. (1980) ...
Brown, A.B. (1990) ...
Brown, A.B. and Jones, C.D. (1977) ...
Brown, A.B. and Smith, E.F. (1973) ...
Brown, A.B. and Smith, E.F. (1975) ...
Brown, A.B., Smith, E.F. and Jones, C.D. (1990a) ...
Brown, A.B., Jones, C.D., Smith, E.F., Black, G.H. and Green, I.J. (1990b) ...
Brown, A.B., Jones, C.D. and Smith, E.F. (1990c) ...

Note that the last three examples would all have been cited as Brown *et al.* in the text with the a, b, c relating to the order of citation.

MORE EXAMPLES - for the body of the writing

<i>Example</i>	<i>Commentary</i>
✓ Pattini <i>et al.</i> (1990) found that prolonged exercise increased the rate of iron metabolism.	<i>Start of sentence</i>
✓ Wright and Sherman (1989) have reported that a 350 g feeding of maltodextrins 3 h before exercise dramatically improves performance.	<i>Start of sentence</i>
✓ Carbohydrate feedings during exercise will delay fatigue by 30-60 min (Coyle <i>et al.</i> , 1983; Coyle <i>et al.</i> , 1986; Coggan and Coyle, 1987).	<i>Multiple references</i> <i>In date order;</i> <i>Semi-colons between references</i>
✓ The effect of parenteral vitamin B-12 administration on aerobic power and physical fitness test scores in 36 male students was investigated by Tin-May Than <i>et al.</i> (1978).	<i>Middle of sentence</i>
✓ Similar results were found by Kreider <i>et al.</i> (1990) in a well controlled study that examined phosphate loading in seven competitive runners.	<i>Middle of sentence</i>
✓ One study did find that copper was present in sweat collected after exercise (Gutteridge <i>et al.</i> , 1985) and this could contribute to a loss in body copper in athletes.	<i>Middle of sentence</i>
✓ The early work of Christensen and Hansen (1939a) demonstrated the important influence of diet on exercise metabolism and performance.	<i>Middle of sentence</i>
✓ This is a function of the gastric emptying time (Mourot <i>et al.</i> , 1988) and the physical availability of the sugar or starch to glycolytic enzymes.	<i>Middle of sentence</i>
✓ Eating approximately 150 g of carbohydrate (<i>i.e.</i> bread and juice) 4 h before exercise does not produce a marked elevation of muscle glycogen, blood glucose or carbohydrate oxidation after 105 min of exercise (Coyle <i>et al.</i> , 1985), which may explain	<i>Middle of sentence</i>

	why Sherman <i>et al.</i> (1989) did not observe an improvement in performance with this amount.	
✓	On this basis, chromium has been suggested to be an alternative to steroids (Evans, 1989).	<i>End of sentence</i>
✓	Humans with low serum zinc levels tend to be more susceptible to a variety of infectious diseases (Keen and Gershwin, 1990).	<i>End of sentence</i>
✓	During prolonged exercise lasting several hours, hepatic glucose output may fall behind peripheral glucose utilisation resulting in hypoglycaemia (Felig et al., 1982).	<i>End of sentence</i>

COMMON MISTAKES

✖	Carbohydrate feedings during exercise will delay fatigue by 30-60 min (Coggan and Coyle, 1987 Coyle <i>et al.</i> , 1983 Coyle <i>et al.</i> , 1986).	<i>Not in date order</i> <i>No semi-colons between references</i>
✖	Pattini <i>et al.</i> (1990) finds that prolonged exercise increases the rate of iron metabolism.	<i>Read "Pattini and others" so "find that"</i>
✖	Humans with low serum zinc levels tend to be more susceptible to a variety of infectious diseases. (Keen and Gershwin, 1990)	<i>Final full-stop in wrong place</i>
✖	During prolonged exercise lasting several hours, hepatic glucose output may fall behind peripheral glucose utilization resulting in hypoglycaemia (Felig <i>et al</i> 1982).	<i>Missing comma in reference</i> <i>Missing full-stop in et al.</i>
✖	Wright and Sherman, (1989) have reported that a 350 g feeding of maltodextrins 3 h before exercise dramatically improves performance.	<i>Extra comma before year in reference</i>