

## TEACHING GUIDE

### Biochemistry of Physical Activity and Sport Science of Physical Activity and Sport Grade (2<sup>nd</sup> course)

#### 1. SUBJECT DESCRIPTION

<b>Grade:</b>	Science of Physical Activity and Sport
<b>Double Grade:</b>	
<b>Subject:</b>	Biochemistry of Physical Activity and Sport
<b>Module:</b>	I, Scientific Basis of Human Movement
<b>Department:</b>	Fisiología, Anatomía y Biología Celular
<b>Semester:</b>	Second semester
<b>Total Credits:</b>	6
<b>Course:</b>	2
<b>Character:</b>	Compulsory
<b>Teaching &amp; Learning language:</b>	English

<b>Teaching Model:</b>	C1	
<b>a. Basic Teaching (EB):</b>		50%
<b>b. Practice and Development Teaching (EPD):</b>		50%
<b>c. Guided Activities (AD):</b>		NO

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### 2. HEAD OF THE SUBJECT

<b>Head of the subject</b>	
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<b>Center:</b>	Faculty of Sport
<b>Department:</b>	Fisiología, Anatomía y Biología Celular
<b>Area:</b>	Biología Celular (Cell Biology)
<b>Category:</b>	Associate Professor
<b>Tutoring Hours:</b>	Appointment by email
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### 3. CONTEXT IN THE TRAINING PLAN

#### 3.1. Description of the objectives

Our main objective with this course is to provide students with an overview of Energy Metabolism and the integration of metabolic activities in the human body in motion, as well as modulation under new energy demands ascribed to Physical Activity.

#### 3.2. Contributions to the training plan

The subject will primarily focus on bioenergy and Biological bases of sport that has already been introduced in previous subjects such as "Human Physiology" and "Motor System Functional Anatomy". We will underline the metabolic and energetic factors that influence Sport and Physical Activity practice, focusing on the effects that physical exercise has on the structure and function of the human body. We are also introducing several aspects that shall subsequently be applied in other subjects, such as "Physiology of sports training", "Nutrition of the sportsman" and "Sport training related to physical health"

#### 3.3. Recommendations or previous knowledge required

English language: correct expression both oral and written, competent understanding and reading.  
Basic knowledge of biology.

Having passed the subjects "Motor System Functional Anatomy" and "Human Physiology"  
User-level knowledge of virtual teaching platform WebCT

### 4. COMPETENCES

#### 4.1 Degree competences that will be developed in the subject

- a) Instrumental: From the beginning we will heighten both analysis and synthesis skills. Our subject has mainly an applied approach, we do not want our students to memorize concepts and formulas, but to understand and integrate the acquired knowledge. We will also exercise the ability to organize and plan during the laboratory practices. We will also work with basic computing tools and solve problems related to sport training from a scientific point of view.
- b) Systemic: Practical and Development teaching classes and tutorials have among its objectives to promote independent learning under the teacher guidance, also to promote creativity and active involvement in all the academic activities. We will assert on boosting your initiative to resolve the challenges, complete assignments and empower your curiosity and encouragement for the application of scientific and technical knowledge.
- c) Personal: During the course we will promote teamwork through group assignments both in the classroom and outside.

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### 4.2. Module Competences that will be developed in the subject

- a) To acquire the scientific foundations related to the branch of knowledge of the Health Sciences, relevant to the Sport and Physical Activity.
- b) To become more familiar, understand and be able to apply physiological and mechanical factors that influence the practice of Physical Activity and Sport.
- c) To identify the effects that physical exercise has on the structure and function of the human body.

### 4.3. Specific competences that will be developed in the subject

- a) To acquire basic scientific training in the field of biochemistry that the future sport professional could put to use into physical activity and sport training.
- b) To know and understand the biological, bioenergetics and metabolic aspects related to sport practice and physical activity as well as the diverse indicators of human movement.
- c) To know and understand the effects of physical exercise on bioenergetics and metabolism of human body

## 5. CONTENTS OF THE SUBJECT (CURRICULUM)

### 5.1 BASIC TEACHINGS (EB)

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The Curriculum consists of 3 Thematic Units to be developed in the sessions of Basic Teachings:

#### UNIT I: FUNDAMENTALS

In this thematic unit we will address basic aspects of biochemistry as an introduction to Sport and Physical Activity applied Biochemistry. These topics are:

1. Biomolecules.
2. Introduction to Metabolism and Bioenergetics.
3. Protein dynamics
4. Enzymes. Regulation of enzyme activity.
5. Biochemical aspects of Oxygen Transport.

#### UNIT II: ENERGY METABOLISM

In this thematic unit we will address energy metabolism applied to human physical activity. These topics are:

1. ATP consumption in muscle and the biochemical mechanism of muscular contraction
2. Biochemical Mechanisms of rapid ATP recovery systems: The Creatine Phosphate System and ADP Regeneration (Myokinase)
3. An overview of Carbohydrate metabolism and relevance to Physical Activity.
4. Mobilization of reserves Glucose storage: The Glycogen. Control of Blood Glucose Levels.
5. Glycolysis: Inputs, outputs and final balance. The different stages of glycolysis. Energy Strategy.
6. Lactic Fermentation. Lactate regeneration and Cori cycle.
7. Regulation of Carbohydrates metabolism during Physical Activity and Sport.
8. Overview of Lipid metabolism and relevance to Physical Activity.
9. Lipid (fat, triglycerid) mobilization associated to Physical Activity
10. Energy use of fatty acids during exercise
11. Protein Metabolism related to Sport and Physical Activity: The Urea Cycle
12. Aerobic System overview and importance during physical activity

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13. Mitochondria in muscle fibers: Structure and Function.
14. The citric acid cycle (Krebs cycle) and oxidative phosphorylation
15. Energy Balance of the Aerobic metabolism.

### UNIT III: METABOLIC INTEGRATION.

In this thematic unit we will integrate the different subjects we have learned during the course in order to apply them to Sport and Physical Activity real scenarios. These topics are:

1. Energy Metabolism and Sports: An Overview.
2. Contribution of the different Energy systems and energy substrates during human physical activity connected to:
  - 2.1. The intensity of the exercise
  - 2.2. Duration of the exercise
  - 2.3. Training Regime
  - 2.4. Composition of muscle fibers
  - 2.5. Nutritional & Dietary Factors.
3. Metabolic and biochemical factors associated to fatigue
4. Baseline recovery of Energetic status after Sport Training.

### 5.2 PRACTICE AND DEVELOPMENT TEACHINGS (EPD)

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EPD activities are directly related to Basic Teaching Curriculum and will focus to explore both practical and applied aspects. EPD sessions will focus on the following topics:

- Fundamentals of Biochemical Techniques: Equipment, reagents and analysis of results.
- Analytical Methodologies: Biochemical blood & urine parameters and anti-doping checks.
- Biopsies, enzymatic activities and practical applications.
- Metabolic effects of Sports Practice: Metabolic adaptations, health and fitness
- Metabolic integration applied to Sport Training.

Students will have more information on these activities in the "Specific Teaching Guide", which will be provided in the virtual classroom from the month of January 2014.

## 6. METHODOLOGY AND RESOURCES

### 6.1 Student Workload

NÚMERO TOTAL DE HORAS DE TRABAJO DEL ALUMNO: 150 horas.

In-class hours: 53

- Basic Teachings (Attendance at lectures): 22.5
- Practices and development Teachings (Assistance to Practice): 22.5
- Specialised tutorials (face to face and/or online): 8
- Final Exam 2

Individual (autonomous) learning: 97

- Hours of study and preparation for basic teachings: 45
- Hours of study and preparation of practice and of development teachings, including team-work task: 45

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-Performing assessment tests and / or exams: 7

### 6.2. Teaching Techniques

#### 6.2.1. Theoretical Lessons (EB)

Lectures will be taught in weekly sessions of an hour and a half, according to the schedule given by the Faculty of Sport.

In general, teachers will summarize the main aspects of each theory topics and focus on those aspects that are either most important or difficult to students, showing the proper way to work and learn from each of the topics. Our script of the lectures is as follows:

- Overview of the subject matter and importance within the overall framework of the subject.
- Development of the main points and questions.
- Debate.

#### 6.2.2. Practices and development sessions (EPD)

The distribution of groups and schedules for each group will be held at the beginning of the academic year.

The Training and Development sessions of this course will last for one and a half hour every week at the assigned time by the Faculty of Sport.

The practical classes will focus on practical cases, problem support classes and presentations by students of assigned topics.

#### 6.2.3. Tutoring Sessions

Each faculty member will establish office and tutoring times during the presentation in the first class.

Students will also have the opportunity to participate in online mentoring through participation in the forums of the virtual platform. Students can also request a personal appointment to the Professor if they deem it necessary.

#### 6.2.4. Online Teaching

Online Teaching organized in our virtual campus (WebCT-platform) is a key support for our subject.

Teachers shall use this online platform for regular communication with students.

On this online platform, students can find:

- Teaching support of theory topics with summaries, presentations and self-assessment exercises.
- Information regarding practices: Registration, schedules, scripts, rules, calendars and tutorials.
- Virtual tutorials and Forums.
- Email service
- Educational Links.
- Agenda and course's curriculum.
- Teaching Guide
- Detailed learning resources, both bibliographic and virtual.

## 7. EVALUATION

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In general, we can say that we will take into account attendance and use of both theoretical and practical sessions and tutorials, as well as the implementation of continuous assessment activities which will be held during the course, and finally a written test for both Basic and Practices and Development activities. Likewise, students will be able to make a single final examination involving the total grade for the course.

### 7.1. ORDINARY EXAMINATION

#### Criteria and Resources for Evaluation

The evaluation criteria are:

- Self-assessment questionnaires and continuous evaluation exercises for both EB & EPD: 50% of the final grade.  
The self-assessment questionnaires will be held in the online classroom and weekly deliveries **CAN NOT BE RECOVERED** if not delivered within the deadline. Also, continuous assessment activities carried out during the classroom sessions can not be recovered if the student does not attend, unless excused absence (labor, medical or sports competition). In this case the student has to submit written proof to the teacher within one week, in which case the exercise will be recovered during a tutoring session.
- Written examination test (CONTROL). There are two types of control trials, the "EB-control" for Theory topics (25% of the final grade) and the "EPD-control" for Practice and Development topics (25% of the final grade). They will be held in June.  
The control is a written test of short duration (60 minutes max) and consist of a series of short questions reflecting clearly and concisely the acquired knowledge during the course by solving a metabolic problem or a specific biochemical situation applied for Sport and Physical Activity, in which the student must justify their answers. These questions will be based on the tasks and questionnaires performed throughout the course. Our approach for this type of test is as follows: Students who regularly attend classroom activities, conduct continuous assessment tasks and have taken advantage of the tutorials (face and / or online) should have not mayor difficulties in performing this examination .

In the computation for the final grade by continuous evaluation shall not be considered those activities whose score is below 4 out of 10, whether they are self assessment questionnaires, exercises or written exam.

### 7.2. EXTRAORDINARY EXAMINATION (Recovery of July)

Students who do not pass the ordinary examination may be submitted to the extraordinary call of July. According to university regulations in force, "students who attend to a 2nd call or following should have the option to get 100% of the grade, either because they have been considered the same activities during the regular course or because new evaluation tests are implemented". Applying this standard, we can find two different cases:

#### 1. Students who have undergone continuous evaluation throughout the course:

Students who have completed self-assessment questionnaires and other exercises through weekly continuous evaluation during the course will keep these grades except the written control test. They shall also have the following possibilities to pass the course:

- Students with failed Basic Teachings (EB): They must be submitted to a single control type written test covering all Basic Teachings topics.
- Students with failed Practice and Development Teachings (EPD): They must be submitted to a single control type written test covering all Practice and Development

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topics.

- Students with both EB and EPD failed: Will hold both controls.

Since both controls compute with 50% of the final grade for the course, students should take into account the marks obtained along the course by continuous evaluation activities.

### **2. Students who have not made continuous evaluation activities throughout the course or openly renounce the grades obtained:**

Students may submit to a final exam encompassing the curriculum of both Basic and Practices & Development Teachings. Students who choose this option will be evaluated by a test that shall cover all the competences and abilities listed in this guide. Thereby, such a test may be made in written, oral, or both at the discretion of the teacher (according to rules of June 29, 2012 of the Vice Rector of Teaching and Planning and Vice Rector for Student, Sport and Environment). The score on this test will be the final grade for the course (100% of the grade) and the student will pass the grade after reaching a minimum of 50 points out of 100.

Students who choose this option must inform the coordinator teacher at least two weeks before the date of the announcement.

## **8. GENERAL BIBLIOGRAPHY**

In principle, there is no a fully comprehensive text covering all the topics to be covered in this course. The following are the current and recommended books, all available in the Library.

### General Bibliography:

- Alberts, B. et al. Essential cell biology : an introduction to the molecular biology of the cell. New York [etc.] : Garland Publishing, cop. 1998.
- Berg, Jeremy "Biochemistry". New York : W. H. Freeman and Company, cop. 2002 M., Lubert. Bioquímica. Reverté, D.L. 1998.
- Elliott, William H. "Biochemistry and molecular biology". Oxford [etc.] : Oxford University Press, 2002.

### Specific Bibliography:

- Hargreaves, Mark. Exercise metabolism. Champaign, IL : Human Kinetics, cop. 2006.
- Maughan, Ron. Biochemistry of exercise and training. Oxford : Oxford University Press, 2008
- Mougios, Vassilis. Exercise biochemistry Champaign, IL : Human Kinetics, cop. 2006.
- Wilmore, Jack H. "Physiology of sport and exercise" Champaign (Illinois) : Human Kinetics, 2004

### Journals available at the Library:

- International Journal of Sports Medicine
- Journal of Science and Medicine in Sport