

## BIO 361 Biochemistry

### Course Description

This biochemistry course is designed to be taught over one semester. This implies that design is not intended to teach all current biochemistry with an extreme detail. Better, the idea is to draw attention to essential and fundamental aspects of biochemistry. That does not mean that the level of the course was limited; on contrary the course will pay attention in deep to the most relevant aspects of biochemistry that will allow students to understand in the future, if their career requires it, the most complex aspects of biochemistry and also of specialized fields related with biochemistry as genetics, cell biology, microbiology or molecular biology.

The course begins providing students with some tools related to chemistry and thermodynamics that are essential for understanding the properties of biomolecules, which are studied with a great detail. Following, we are going to afford a major study of enzymes as responsible for chemical reactions developed in the cell, ending with the study of metabolism based on the regulation of enzyme activity.

In the course, theory and practice are linked and coordinated so that both are complementary. The practical sessions are synchronized with the lectures and are designed so that they are a common project aimed at understanding how biochemistry is integrated into the normal life of people.

### Prerequisites

Students should have knowledge or have taken a course related to:

- Chemistry
- Biology
- Cell Biology

In order to check the level of previous knowledge of the students, it will be performed a preliminary exam on basic aspects of biology and chemistry without influence in the final grade.

### Course Goals and Methodology

In general, the aim of the course is introduce students to the main topics of cell metabolism taking into account the relationship between these processes and the physiology, medicine, health and ecology, in order to show that all questions are linked in one: life

## Goals

1. Understand how weak chemical interactions are responsible of the biological activity through the generation of specific structures.
2. Know how cells harness and transfer energy
3. Know how enzymes work
4. Understand the architecture of biochemical networks and how can produce specific phenotypes

## Methodology

At the beginning of the course, students will have a course package that will comprise:

- Syllabus
- List of learning objectives for every lesson
- Slide shows for every lesson, in PDF
- List of problems for every lesson
- A summary of the main topics of the lesson named "To remember"
- Protocols for every lab session

The course is divided into nine lessons that usually require two days of class. Each lesson must be prepared in this way:

- Before the first day of class students should read the class material indicated by the teacher: list of learning objectives, biochemistry book selections, and the slide show.
- During the class, the teacher uses a slide show to explain the most important aspects of the lesson. The slide show is provided to students in advanced and it is very useful to write notes during the class. Student must participate asking questions not completely addressed and also must answer questions proposed by the teacher. These question can be answered directly in class or may be a small homework for the next class.
- When the lesson is over, students must try to solve a list of problems proposed by the teacher and must perform an online exam about the lesson. Students should solve the problem list and hand in to the teacher using the Blackboard e-learning platform (<https://campusvirtual.upo.es>) according to the dates indicated in the calendar. If the assignment was handed in advanced, is possible a review by the teacher and also a second opportunity to hand in the assignment to improve the grade. After the scheduled date, the assignment will count a 20% less the first week and a 10% less the next weeks. Online exams are made using the Blackboard e-learning platform. Exams must be done according to the dates indicated in the calendar and after the scheduled date, the assignment will count a 25% less.

The practice sessions will be devoted to carry out several biochemical and molecular analyses related with the lessons explained in class but together constitutes a small research project. Students must prepare and hand using the Blackboard e-learning platform an individual report about each lab session.

## Learning Objectives

1. Describe and analyze the structure, origin and function of biomolecules.
2. Describe and differentiate the molecular forces that allow the interaction between biomolecules

3. Interpret and calculate how pH changes affect the stability of molecular interactions
4. Analyze thermodynamics laws in order to explain the biochemical reactions
5. Analyze the structure and properties of enzymes in order to explain its function as catalyst
6. Describe and interpret the regulatory processes of enzymes and its role in metabolism
7. Solve problems about pH, chemical equilibrium, thermodynamics, bioenergetics and enzyme kinetics.
8. Practice laboratory skills to transfer theoretical knowledge to experimental work

A detailed list of learning objectives specific for each lesson is provided to students in the course package

### **Required Texts**

- Biochemistry 4th By David L. Nelson, Marcy Osgood, Michael M. Cox, Karen Ocorr - W H Freeman & Co (2004) - ISBN 071676203X

The graphic materials used in slides come from the book indicated in the bibliography list. Materials that do not come from bibliography are indicated its origin in the corresponding slide.

### **General Course Policies**

Please keep your cell phones turned off during class.

It is strictly prohibited consume food in class.

It is possible use computer or tablets only to follow the class.

Any questions about exams, theory or practical classes can be communicated to the teacher via email, directly in class, tutoring sessions or by participating in the forum of the e-learning platform.

### **Course Requirements and Grading**

#### **Requirements**

##### **- Exams.**

Two exams (Midterm and Final exams) composed of 30 questions of which 1 is a problem. The rest are multiple choice questions where only one is correct. The examination will be conducted in a computer room using the Blackboard platform.

##### **- Homework. (List of problems).**

The homework corresponds to a list of problems related with every lesson that must be handed at the indicated dates. The list will be graded up to 100% and also will contain an extra problem, optional. It will be graded as participation if the homework is sent on time.

##### **- Online exams.**

After each lesson, students can perform an online exam composed by 15 questions similar to the Midterm and Final exams and can be repeated three times. This activity is optional and will be graded up to extra 5% of the final grade.

##### **- Lab reports.**

At the end of the lab sessions, students must submit a report about the work performed in the practice where must answer some questions about the topic of the practice, calculations and the results interpretation.

- **Class forum**

The forum should be used to answer the questions of other students, ask class doubts to the teacher and to answer questions posed by the teacher. The activity of students in the forum will be evaluated and will be used to qualify the participation section.

- **Class questions**

During class, the teacher can pose students questions that must be answered in writing or handed in the next class. It will be assessed in the section on participation.

**Grading**

1. Midterm Exam, 25%
2. Final Exam, 30%
3. Online Exams, Extra 5%
4. Participation 10% (Extra problems, Forum and Class questions)
5. Problems 25%
6. Lab report 10%

Assignments dates are indicated in the calendar included below

A good final grade (A) may be obtained by timely delivery of all proposed tasks (mandatory and optional) and participating in class whenever note tests exceeds 70%. Additional activities not included in this syllabus will not be accepted to improve the final grade. They are included in the course optional activities for this purpose.

**Attendance and Punctuality**

Attendance is mandatory. More than 3 unexcused absences will result in the lowering of the final grade. Students with more than 2 such absences may not challenge the final grade received. Punctuality is required.

Missed classes will mean a decrease in class participation grade.

**Missed or Late Work**

Assignments submitted after the deadline will be graded with a progressive decrease of the grade that is a loss of 20% for the first week of delay and a loss of 10% per week after the second week. The last option to send the assignments will be the date of the Mid-Term exam in the case of lessons 1-4 and the date of the Final exam in the case of lessons 5-9. After this date the grade will be zero.

**Academic Dishonesty**

Academic integrity is a guiding principle for all academic activity at Pablo de Olavide University. Cheating on exams and plagiarism (which includes copying from the internet) are clear violations of academic honesty. A student is guilty of plagiarism when he or she presents another person's intellectual property as his or her own. The penalty for plagiarism and cheating is a failing grade for the assignment/exam and a failing grade for the course. Avoid plagiarism by citing sources properly (using footnotes or endnotes and a bibliography).

**Students with Disabilities**

If you have a disability that requires special academic accommodation, please speak to your professor within the first three (3) weeks of the semester in order to discuss any adjustments. It is the student's responsibility to provide the International Center with

documentation confirming the disability and the accommodations required (if you have provided this to your study abroad organization, they have most likely informed the International Center already but please confirm).

### **Behavior Policy**

Students are expected to show integrity and act in a professional and respectful manner at all times. A student's attitude in class may influence his/her participation grade. The professor has a right to ask a student to leave the classroom if the student is unruly or appears intoxicated. If a student is asked to leave the classroom, that day will count as an absence regardless of how long the student has been in class.

### **Class Schedule**

#### A. Bioenergetics

1. Biomolecules and weak interactions
2. The energy and the living cells
  - 2.1. Relationship life and energy
  - 2.2. The thermodynamics laws
  - 2.3. Free energy and entropy
  - 2.4. Energy capture
  - 2.5. Energy storing
3. Water and buffers.

#### B. Biomolecules

4. Nucleic acids
5. Carbohydrates
6. Lipids
7. Amino acids and proteins

#### C. Enzymology

8. Enzymes as catalysts
  - 8.1 Characteristics of enzymes
  - 8.2 Parameters of enzymatic kinetic
  - 8.3 Biochemical reactions and equilibrium
  - 8.4 Enzymatic inhibition

#### D. Metabolism

9. Metabolic regulation
  - 9.1. Energetic coupling of reactions
  - 9.2 Regulation by enzymatic activity modulation
  - 9.3. Regulation models
  - 9.4. Metabolic pathways

- 9.5. Models of coupling of metabolic regulation and cell signaling
- 9.6. Overview of biochemical pathways

**Laboratory work**

- 1. Mutation detection by PCR in the human COQ4 gene
- 2. The effect of COQ4 mutations in the yeast growth in glucose and glycerol
- 3. Extraction, separation and quantification of coenzyme Q<sub>6</sub> from yeast mitochondria
- 4. Determination of mitochondrial respiratory activities from yeast

**CALENDAR:**

Midterm Exam

Final Exam

**Holidays:**

Holy Week

Seville's April Fair

## CALENDAR

<b>Class</b>	<b>Location</b>	<b>Activity</b>
1	B25 S105	Course Presentation
2	B25 S105	Lesson 1 A: Biomolecules and weak interactions
3	B25 S105	Lesson 1 B
4	B25 S105	Lesson 2 A: The energy and the living cells
5	Computer	Blackboard Day
6	B25 S105	Lesson 2 B
7	B25 S105	Lesson 3 A: Water and buffers
8	B25 S105	Lesson 3 B
9	B25 S105	Lesson 4 A: Nucleic acids
10	B25 S105	Lesson 4 B:
11	B25 S105	Lesson 5 A: Carbohydrates
12	B23 Lab4	Lab Session 1
13	B25 S105	Lesson 5 B
14	Computer	Mid-Term Exam
15	B23 Lab5	Lab Session 2
16	B25 S105	Lecture 6 A: Lipids
17	B25 S105	Lecture 6 B
18	B25 S105	Lecture 7 A: Amino acids and proteins
19	B25 S105	Lecture 7 B
20	B23 Lab4	Lab Session 3
21	B25 S105	Lecture 7 C
22	B25 S105	Lecture 8 A: Enzymes as catalysts
23	B25 S105	Lecture 8 B
24	B23 Lab4	Lab Session 4
25	B25 S105	Lecture 8 C
26	B25 S105	Lecture 9: Metabolic regulation