

## Biochemistry in Morocco: Review of the state of teaching

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### HEADLINES

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Students enrolments and Statistics?

What kind of Diploma? Methods of teaching?

Teaching aids?

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Recommendations

Annex I: main Elements of Biochemistry Syllabus

Which category of students get the Biochemistry education?

Graduate level at the university

Faculties of Sciences (Master degree in Biology)

- \* 2<sup>nd</sup> year of the Four years of the master Biology (obligatory module)
- \* 3<sup>rd</sup> year of the Four years of the master in Biology (obligatory module)
- \* 4<sup>th</sup> year of the Four years of the master in Biology (obligatory)

Faculties of Applied Sciences (Master degree in Applied Biology)

This included Biotechnology, Molecular Biology, Food Technology, Environment, and related education where biochemistry is tool for this kind of education.

Faculty of Medicine et de Pharmacy

- \* 1<sup>st</sup> year of the Seven years of the Doctorate in Medicine (obligatory module)
- \* 2<sup>nd</sup> year of the Seven years of the Doctorate in Medicine (obligatory module)

Which category of students get the Biochemistry education ?

Graduate level at the Institutes of Engineering (Max 5 years of education)

- \* Engineer of chemistry
- \* Food and agriculture technology

Graduate level at the Institutes of professional Education (Max 2 years of education)

- \* Laboratory technicians and assistants
- \* Food technology technicians

### Students enrolments and Statistics?

#### 15 Schools of engineering

2453 students in 1999 — 210 students are graduated as engineers in fields where Biochemistry is involved.

#### 15 Universities

44691 students in 1999, this included all the specializations: human sciences, Economy, ..... and Sciences ..... 5000 students were studying in fields where Biochemistry is involved

**Source:** Ministere de l'Enseignement Superieur et de la Recherche Scientific, Maroc

### What kind of Diploma ?

Graduate level

- Bachelor Degree in Biology and Biochemistry
- Diploma of Engineer in Biotechnology and Food technology, agriculture, veterinary.
- Diploma of technician of laboratory
- Diploma of industrial technician

Post-graduate level

- Master degree in Biochemistry
- PhD in Sciences and applied Sciences

**Methods of teaching ?****Main courses and Complement Exercises**

- \* Biochemistry I: Structural Biochemistry\*
- \* Biochemistry II: Metabolic Biochemistry\*
- \* Biochemistry III: Enzymology
- \* Biochemistry IV: Genetics

(See details in annex I)

**Auxiliary disciplines**

- \* Organic Chemistry

**Practical Training**

- \* Technique of Chromatography
- \* Technique of Electrophoresis
- \* Dosage of Carbohydrates
- \* Dosage of Proteins\* Enzymology

**Teaching facilities:**

- \* Mostly using classic approach
- \* Blackboard, Overhead projector; slide projector;
- \* ppt projector (rarely)

**Laboratory facilities:**

- \* Big difference in the equipment according to:
  - 1 - The age and the location of the educational institution, and
  - 2 - the sector of activity that to which belong the educational institution

\* The main equipment: Centrifuges, Thin Couche Chromatography, Spectrophotometer...

**Constraints ?**

Absence of ideal methods for the education of the Bioc

- \* No typical approach is user in biochemistry education ——— big difficulties to explain by the description of multiple experiences outside the laboratory
- \* The absence of education of the Latin and the Greek ——— huge effort required to learn the special vocabulary to the biochemistry

Lack of the education of modern biochemistry due to :

- \* Difficult acquisition of concepts of structures in the space ——— difficult understanding of the real structure of molecules and the definition of their implication in the different biological and cellular processes.

\* Existence of methodological frontiers between the biochemistry, and the other disciplines (molecular biology, physiology, biophysics, histology ....) ——— Lack of integration of the biochemistry in the global understanding of the functioning of the human beings.

**Recommendations**

- \* Enough means should be allowed for biochemistry education
- \* Exchange with different external and friends departments
- \* Participate to the training sessions and educational courses that dedicated to specific research project.
- \* Increase the equipment of the labs in order to cover all the needs in biochemistry education

**Annex I****Main Elements of Biochemistry Syllabus****Biochemistry I****Matériaux biologiques de base en biochimie**

Lipides, détergents et membranes biologiques  
Oses, osides et glucides  
Acides amines peptides et protéines Bases azotées et acides nucléiques  
Transporteurs d'électrons  
Transporteurs de groupements...  
Vitamines et molécules essentielles

**2. Organisation des molécules dans les cellules**

- 2.1 Paroi cellulaire
- 2.2 Membrane plasmique
- 2.3 Cytoplasme
- 2.4 Noyau cellulaire
- 2.5 Reticulum endoplasmique
- 2.6 Appareil de Golgi
- 2.7 Mitochondrie
- 2.8 Chloroplaste
- 2.9 Inclusions, lysosome et peroxyosome

**Biochemistry II**

1. Structure des lipides
2. Structure des glucides
3. Structures des protéines

- 3.1 Niveaux d'organisation structurelle des proteins et classification
- 3.2 Acides amines. Structures et proprietes physico-chimiques
- 3.3 Polypeptides et hormones peptidiques
- 3.4 Sequencage d'une proteins et evolution
  - 3.5 Structures secondaires des chaines peptidiques. Helice alph et feuillet beta
  - 3.6 Structure tertiaire des proteins
  - 3.7 Structure quaternaire des proteins
- 4. Structure des acides nucleiques
  - 4.1 Mononucleotides, oligonucleotides et polynucleotides (AND et ARN)
  - 4.2 Nucleosomes, chromatine, chromosome et genome
  - 4.3 Replication du AND
  - 4.4 Reaction de polymerisation en chaine (PCR)
  - 4.5 Transcription et regulation des genes
  - 4.6 Maturation des ARN
  - 4.7 Traduction, chargement des ARNt, code genetique, traduction du ARNm par les ribosomes
  - 4.8 Maturation et transport des proteins

### **Biochemistry III**

- 1. Enzymes. Catalyseurs biologiques
- 2. Metabolisme des lipids
- 3. Metabolisme des glucides
- 4. Metabolisme des proteins
- 5. Metabolisme des acides nucleiques

### **Biochemistry IV**

- 1. Regulation des genes et transmission de signaux
  - 1.1 Regulation des genes chez les procaryotes
  - 1.2 Regulation des genes chez les eucaryotes
    - 1.2.1 Interactions proteins-acides nucleiques
    - 1.2.2 Modification de la chromatine
    - 1.2.3 Complexe d'initiation
    - 1.2.4 Promoteur
    - 1.2.5 Facteurs de transcription
  - 1.3 Maturation des messagers et controles post-transcriptionnels
  - 1.4 Perception et transmission de signaux
- 2. Biologie moleculaire et genie genetique