## GEOLOGY APPLIED TO THE PHARMACY (GEOPHARMACY): Biocrystallography and Mineral Raw Materials

<table>
<thead>
<tr>
<th>MODULE</th>
<th>CONTENT</th>
<th>YEAR</th>
<th>TERM</th>
<th>CREDITS</th>
<th>TYPE</th>
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<tbody>
<tr>
<td>Pharmacy</td>
<td>Geopharmacy</td>
<td>2º, 3º, 4º</td>
<td>1º</td>
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</table>

### LECTURER(S)

- Rafael Delgado Calvo Flores
- Jesús Párraga Martínez
- Gabriel Delgado Calvo-Flores
- Juan Manuel Martín García

### POSTAL ADDRESS, TELEPHON Nº, E-MAIL

Department of Pedology and Agricultural Chemistry  
First floor, School of Pharmacy  
Office 183, 184, 185 y 186.  
E-mail: rdelgado@ugr.es, jparraga@ugr.es, gdelgado@ugr.es, jmmartingarcia@ugr.es

### TUTORSHIPS HOURS

- R. Delgado: Tuesday, Thursday 11,30 to 13,30and Friday from 10,30, to 12.30 (F. Pharmacy)  
- J. Parraga: Tuesday and Thursday from 11,30 to 13,30; Wednesday from 10.30 to 12.30 (F. Pharmacy)  
- G. Delgado: Monday, Wednesday and Friday from 10.30 to 12.30 (F. Pharmacy)  
- J. M. Martin: Monday, Tuesday from 11,30 to 13,30 and Friday from 10,30 to 12,30 (F. Pharmacy)

### DEGREE WITHIN WHICH THE SUBJECT IS TAUGHT

Pharmacy

### OTHER DEGREES THAT COULD TEACH THE SUBJECT

Environmental Sciences, Chemical Sciences, Biochemistry, Medicine and Life Sciences

### PREREQUISITES and/or RECOMENDATIONS (if applicable)

Appropriate knowledge of Mathematics, Physics, Chemistry, Physical Chemistry. Some basic knowledge of the Natural Environment.

### BRIEF DESCRIPTION OF CONTENT (ACCORDING TO THE DEGREE)


### GENERAL AND SPECIFIC ABILITIES
General abilities: CG1, CG4, CG12 y CG15. 
Specific abilities: CEM1.1, CEM1.2, CEM1.3, CEM1.4, CEM1.5, CEM1.9, CEM1.10, CEM1.11, CEM3.1, CEM4.2, CEM4.5, CEM5.14, CEM5.15, CEM6.1, CEM6.4, CEM6.6, CEM6.7.

OBJECTIVES (EXPRESSED AS EXPECTED RESULTS OF THE TEACHING)

2. Polymorphism: influence of the crystal structure and the physical, chemical and physico-chemical properties in the bioavailability of substances (crystalline/minerals) used in pharmaceutical formulations.
4. Human Biominerals: not pathological (bones, teeth, etc) and pathological (calculus)

TOPICS OF THE SUBJECT

THEORETICAL PROGRAM

PART 1.- Concept. Fundamentals of Biocrystallography.

Theme 1.- Concept of the subject

Theme 2.- Fundamentals of Biocrystallography

PART 2.- Crystallization, properties, and methods of study specific for crystalline solids

Theme 3. - Basic principles of crystallization

Theme 4.- Pharmaceutical and cosmetic properties of crystalline solids

Theme 5.- Pharmaceutical polymorphism

Theme 6.- Specific methods of study for crystalline solids

PART 3.- Crystallization of biological macromolecules

Theme 7.- History of the Crystallography of Biological Macromolecules

Theme 8.- Crystallization of macromolecules

Theme 9.- Structure of macromolecular crystals


Theme 10.- Mineral classification applied to Pharmacy and Cosmetics. Species not silicate of interest in Pharmacy and

Theme 11.- Silicates of interest in Pharmacy and Cosmetics I

Theme 12.- Silicates of interest in Pharmacy and Cosmetics II: Fillosilicates

Theme 13.- Cariogenic fiber in Pharmacy. Other toxic minerals
PART 5.- Aptitude in Pharmacy of mineral materials

Theme 14.- Minerals as active principles

Theme 15.- Minerals as excipients. Cosmetic uses

PART 6.- Human biominerals. Relations of minerals with life. Minerals, environment and human health

Theme 16.- Main human phosphate biominerals

Theme 17.- Other human biominerals

Theme 18.- Mineral origin of life

Theme 19.- Minerals, environment and human health (Geomedicine)

PRACTICAL PROGRAM

Practice 1

Practice 2
Formation of “Crystal Gardens”: an experiment about the mineral origin of life.

Practice 3
Assays of Pharmacopoeia for minerals of pharmaceutical and cosmetic uses.

Practice 4
Recognition and quantification of mineral species and other crystalline substances of pharmaceutic and cosmetic uses using X-ray diffraction techniques. Internal structure of crystalline material. Study of the crystal lattice and symmetry.

Practice 5
Recognition and analysis of mineral species and other crystalline substances of pharmaceutic and cosmetic uses using scanning electronic microscopy techniques.

PROGRAM OF SEMINARS. ORAL EXPOSITION OF PAPERS

Seminar 1
Search for knowledge: books, journals, reports; computer search. Processing of the information. Drafting of a bibliographic paper.

Seminar 2
Oral exposition of paper. Scientific criticism and debate.

BIBLIOGRAPHY

BASIC BIBLIOGRAPHY:

Fundamentals of Crystallography
Year of publication: 2002
Editorial: Oxford Science Publications
Crystal Growth. Principles and Progress
Authors: A. W. Vere
Year of publication: 1998
Editorial: Plenum Press

Métodos de Difracción de Rayos-X. Principios y Aplicaciones
Authors: Joaquín Bermúdez Polonio
Year of publication: 1981
Editorial: Pirámide

Manual de Mineralogía de DANA
Authors: Comelius. S. Hulburt Jr.: Cornelis Klein
Year of publication: 2003
Editorial: Reverte, S.A.

Mineralogy for Students
Authors: M. H. Battey
Year of publication: 1997
Editorial: Longman Scientific & Technical

Mineralogie des Argiles. I, Structure et Propriétés Physico-chimiques
Authors: S. Caillère S. Hénin M. Rautureau
Year of publication: 1997
Editorial: INRA Actualités Scientifiques et Agronomiques

Modern Crystallography, I. Symmetry of Crystals, Methods of Structural Crystallography
Authors: B.K. Vainshtein
Year of publication: 1994
Editorial: Springer Verlag.

Modern Crystallography II. Structure of Crystals
Authors: S.K. Vainshtein: V.M. Fridkin: V.L. Indebommm
Year of publication: 2000
Editorial: Springer Verlag.

An Introduction to the rock forming minerals
Authors: W.A. Deer, R.A. Howie, J. Zussman
Year of publication: 1992
Editorial: Longman Scientific & Technical

Mineralogía Aplicada. Salud y Medio Ambiente
Authors: M.I. Carretero, M. Pozo
Año de publicación: 2007
Editorial: Thomson

Geomedicine
Authors: Lág J
Year of publication: 1990
Editorial: CRC Press, USA.

Medical Mineralogy and Geochemistry.
Authors: Nita S. Schoonen MAA (Eds.)
Year of publication: 2006
Editorial: Reviews in Mineralogy and Geochemistry Volume 64. Geochemical Society and Mineralogical Society, USA

Essentials of Medical Geology
SUPPLEMENTARY BIBLIOGRAPHY:

RECOMMENDED LINKS
-Geology 114 Lecture Notes: http://www.geol.ucsb.edu/faculty/hacker/geo114A/lectureNotes.htm
-The Crystal Structure of Proteins: http://images.google.es/imgres?imgurl=http://supfam.mrc-lmb.cam.ac.uk/elevy/perso/images/image_02.png&imgrefurl=http://supfam.mrc-lmb.cam.ac.uk/elevy/perso/elevyArt.html&usg=__clp9lMH6nondroQINBJDhr4Tvko=&h=618&w=680&sz=369&hl=es&start=37&tbmid=SxYFe2WWQwc9M.&tbvn=126&tbvw=139&prev=images%3fq%3Dcrystal%2Bs symmetry%2B.gif%2Ba nimation%26gbv%3D2%26ndsp%3D18%26hl%3Des%26sa%3DN%26start%3D36
-Mineralogy Database: http://webmineral.com/
-Some Fundamentals of Mineralogy and Geochemistry:
http://images.google.es/imgres?imgurl=http://www.gly.uga.edu/railsback/Fundamentals/Phyllosilicates%26gen%26species%26html&usg=__KjShsJ758jq9mJP5M_v3B1BqKGA=&hl=es&start=37
TEACHING METHODOLOGY

Theoretical academic sessions, this teaching technique is based on the lectures. Approximate duration of one hour; in it the teacher will explain the theoretical foundations of the subject. It will stimulate the active participation of the student.

Practical academic sessions. They will be in the laboratory of crystallography, mineralogy and radiocristalography. The number of students is 25 and the teacher will direct the work of each individual. The day-to-day of each student will be valued even if at the end a test, oral and written, will be made to estimate the degree of learning of these practical sessions.

Seminars, oral exposition of papers and debate. In these sessions will discuss and clarify issues related to the theoretical sessions. Also, some of these sessions will be used for the oral presentation of the students of academic activities directed by the teacher. These sessions will be accompanied by a debate.

PROGRAMME OF ACTIVITIES

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<tr>
<th>First semester</th>
<th>Themes</th>
<th>Class activities</th>
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EVALUATION (EVALUATION INSTRUMENTS, EVALUATION CRITERIA AND PERCENTAGE ON THE FINAL QUALIFICATION, ETC.)

1.- Exam written about the contents of the program. It may be test type, questions of application of theoretical concepts or problems.
2.- Exam of practices and seminars: oral and written. Seek to be scrutiny which apply the theoretical and practical knowledge through problem solving.
3.- Realization and presentation of a collective paper on specific aspects of the subject.
4.- Assistance to academic activities organised and accepted by the Faculty of Pharmacy or the University of Granada, related with the subject.

The approved practices and seminars is *sine qua non* for the overcoming of the subject.

To overcome any exams of the subject, it is necessary to get a score higher than the average between the null value and the highest possible rating. Scores below average, but close to it, will be evaluated taking into account all the work done during the course.

The theoretical-practical sessions and seminars are mandatory. Assistance to the theoretical activities will be assessed positively.

Exposure of the collective paper will be assessed based on the level of knowledge, clarity in the exposition and defence of the knowledge exposed.

The assistance to other academic activities, whose theme is related to the subject, will be valued if the student presents a summary of the exposed in such activity and officially justified its assistance.

THE ONLY FINAL EVALUATION

According to the Regulation of Evaluation and of Qualification of the Students of the University of Granada (Approved by Advice of Government in his extraordinary session of May 20, 2013), contemplates the accomplishment of the only final evaluation in which there will be able to take refuge those students who could not expire with the method of continuous assessment for labor motives, bill of health, disability or any other due well-taken reason that prevents them from following the regime of continuous assessment. To take refuge in the only final evaluation, the student, in the first two weeks of after registering of the subject, it will request it the Director of the Department who will give movement to the corresponding professorship, invoking and accrediting the reasons that they attend him.

ADITIONAL INFORMATION

Not necessary