LSC Use Only:
Number: _____
Submission Date: _____
Action Date: _____

UWUCC Use Only:
Number: 00-47a
Submission Date: _____
Action Date: UWUCC App 3/20/01
Senate App 4/3/01

CURRICULUM PROPOSAL COVER SHEET
University-Wide Undergraduate Curriculum Committee

I. CONTACT
Contact Person Keith Putirka Phone x5627
Department Geoscience

II. PROPOSAL TYPE (Check All Appropriate Lines)
X COURSE Mineralogy
Suggested 20 character title

_____ New Course* _____
Course Number and Full Title

X Course Revision GEOS 220. Mineralogy
Course Number and Full Title

_____ Liberal Studies Approval
for new or existing course _____
Course Number and Full Title

_____ Course Deletion _____
Course Number and Full Title

X Number and/or Title
Change GEOS 321. Mineralogy
Old Number and/or Full Old Title
GEOS 220. Mineralogy
New Number and/or Full New Title

_____ Course or Catalog Description Change _____
Course Number and Full Title

_____ PROGRAM: _____ Major _____ Minor _Track

_____ New Program* _____
Program Name

_____ Program Revision _____
Program Name

_____ Program Deletion* _____
Program Name

_____ Title Change _____
Old Program Name

_____
New Program Name

RECEIVED DEC 18 2000 LIBERAL STUDIES
RECEIVED APR 12 2001 LIBERAL STUDIES

III. Approvals (signatures and date)
Darlene Richard
Department Curriculum Committee

Darlene Richard 12/14/00
Department Chair

12/15/00
College Curriculum Committee

John D. Eck 12/17/00
College Dean

_____
Director of Liberal Studies (where applicable)

_____
*Provost (where applicable)

Rev.

Part II

1. Description of the Curriculum Change

A. Catalog Description

GEOS 220: Mineralogy

2 lecture hours
3 lab hours
3 credits
(2c-3l-3sh)

Prerequisite: GEOS 121
Prerequisite or Corequisite: CHEM 111 or 113; or permission of instructor
An introduction to crystallography, crystal chemistry, optical properties, and mineral associations and phase equilibria. Emphasis is on minerals pertinent to geology, Earth resources, and technology. Laboratory topics emphasize mineral identification in hand specimen, use of the petrographic microscope, and x-ray diffraction techniques. Includes field trips, which may occur on weekends.

B. Course Objectives
Students will:
1a. examine crystal symmetry and the relationships of symmetry to optical properties.
b. use the petrographic microscope for mineral identification.

2. apply quantitative x-ray methods for mineral identification.

3a. understand mineral chemistry, and the relationships of chemical bonds to physical properties.
b. apply Pauling's rules and principles of stoichiometry to predict the stability of atomic groupings and substitutions.

4. be able to identify rock-forming silicate minerals, and a subset of non-silicates that are important from a geologic, economic and/or environmental standpoint.

5. be introduced to elementary phase equilibria, and will apply Gibbs free energy diagrams and the phase rule to quantitatively predict and interpret mineral assemblages.

C. Course Outline

I. Course Outline - Lecture (page numbers refer to Klein and Hurlbut, 21st ed., (1999).

1. **Introduction (2 hours)**
   Definitions; Saturation /Crystallization; Symmetry elements (without translation) (Ch. 2, p. 18-20)

2. **Crystallography: External Form (3 hours)**
   Symmetry elements (without translation) (Ch. 2 p. 21-32)
   Crystal morphology, crystallographic axes, ratios (Ch. 2 p. 32-42)
   Faces, Miller indices, forms, zones (Ch. 2 p. 42-53)
   Crystal Systems; The 32 crystal classes, point groups (Ch. 2 p. 63-100)
   Intergrowths, twins (Ch. 2 p. 100-105)

3. **Introduction to X-Ray methods (2 hours)**
   Bragg reflection (Ch. 7, p. 276-279)
   Laue Diffraction (Ch. 7, p. 279-280) XRD, XRF (Ch. 5, p. 227-228)

4. **Crystallography: Internal Order and Symmetry (3 hours)**
   Translations; plane lattices (Ch. 3, p. 108-122)
   3D lattices; Bravais Lattices; Unit cells (Ch. 3, p. 123-128)
   Screw axes, glide planes (Ch. 3, p. 129-133)
   Space groups (Ch. 3, p. 134-139)

Exam 1 (1 hour)

5. **Crystallography: Intergrowths (2 hours)**
   Isostructuralism, polymorphism, polytpism (Ch. 3, p. 150-159)
   Pseudomorphs, metamict minerals, defects (Ch. 3, p. 159-164)
   Origins of twinning (Ch. 3, p. 164-168)

6. **Crystal and Mineral Chemistry (9 hours)**
   Quantum principles (Ch. 4, p. 170-175; 177-183)
   Ions & ionic radii; Pauling's rules, examples of electrostatic valency principle (Ch. 3, p. 186-200)
   Volumes and density (Ch. 6, p. 256-260)
   Bonding forces in crystals (Ch. 4, p. 201-210)
   Structural types (Ch. 4, p. 210-216)
   Chemical analytical methods (Ch. 5, p. 224-225, p. 229-231)
   Solid solution (Ch. 5, p. 233-240)
   Projections schemes (Ch. 5, p. 241-249)

Exam 2 (1 hour)

7. **Introduction to Physical properties (1 hour)**
   Fluorescence; Phosphorescence (Ch. 6, p. 268-270)
   Magnetic, electrical, and acoustical properties (Ch. 6, p. 270-274)

8. **Introduction to Geochemical Thermodynamics (4 hours)**
   Mineral stability diagrams; Zeroth, first, second and third laws of thermodyanmics Ch. 9, p. 309-315)
   One component systems, P-T diagrams (Ch. 9, p. 315-318)

Phase rule (Ch. 9, p. 314)
Binary phase diagrams, Gibbs free energy diagrams (Ch. 9, p. 313, p. 318-320)
Ternary phase diagrams (Ch. 9, p. 324-328)

II. Course Outline - Laboratory

1. **Optical Mineralogy (9 hours)**
   Optical methods for mineral identification:
   Refractive Indices; Isotropic crystals; Becke line method (Ch. 8, p. 289-295)
   Uniaxial crystals (Ch. 8, p. 295-302)
   Biaxial crystals (Ch. 8, p. 302-308)

1. **X-Ray Techniques for mineral identification (6 hours)**
   Identify unknowns using XRF lab at IUP

2. **Systematic Mineralogy: Silicates (21 hours)**
   Identify and understand genesis of:
   Independent tetrahedra (neso- and sorosilicates) (Ch. 13, p. 444-468)
   Cyclosilicates and Chain silicates (inosilicates) (Ch. 13, p. 468-498)
   Sheet silicates (phyllosilicates) (Ch. 13, p.498-524)
   Framework silicates (tectosilicates) (Ch. 13, p. 524-557)

3. **Systematic Mineralogy: Non-Silicates (6 hours)**
   Identify and understand genesis of:
   Oxides, hydroxides, halides (Ch. 11, p. 372-402)
   Carbonates, sulfates, phosphates, tungstates (Ch. 12, p. 403-439)
   Native elements; ore-forming minerals (Ch. 10, p. 334-371)

D. Evaluation Methods

The final grade for this course will be determined as follows:
20% Laboratory write-ups
20% Quizzes
40% Exams (Three exams total; two exams during the term, and a final exam, each equally weighted. Exams will cover both lecture and laboratory material)
20% Homework

Grading Scale: A = 90-100%; B = 80-89%; C = 70-79%; D = 60-69%; F = 0-59%.

E. Required Textbooks, Supplemental Books and Readings

Lecture Text:
Klein, C. and Hurlbut Jr., C. S., 1999, Manual of mineralogy, 21st ed.: John Wiley and Sons, New York, NY, 681 p.

Lab text:
Perkins, D. and Henke, K. R., 2000, Minerals in thin section: Prentice-Hall, Upper Saddle River, NJ, 125 p.

Optional text:
Deer, W. A., Howie, R. A., and Zussman, J., 1997, The rock-forming minerals: Addison Wesley Longman Ltd., Essex, UK, 696p.

F. Special Resource Requirements

Mineral specimens and petrographic slides and microscopes are available in the Geoscience Department.

G. Bibliography

Blackburn, W. H., and Dennen, W. H., 1994, Principles of mineralogy: William C. Brown Publishers, Oxford, UK, 413 p.
Bloss, F. D., 1994, Crystallography and crystal chemistry: Mineralogical Society of America, Washington DC, 545 p.
Cepeda, J. C., 1994, Introduction to minerals and rocks: MacMillan College Publishing Company, New York, NY, 217 p.
Kerr, P. F., 1977, Optical mineralogy: McGraw-Hill, New York, NY, 492 p.
Klein, C., and Hurlbut Jr., C. S., 1999, Manual of mineralogy, 21st ed.: John Wiley and Sons, New York, NY, 681 p.
MacKenzie, W. S., and Guilford, C., 1980, Atlas of rock-forming minerals in thin section: John Wiley and Sons, New York, NY, 98 p.
Nesse, W. D., 2000, Introduction to mineralogy: Oxford University Press, New York, NY, 442 p.
Perkins, D., 1998, Mineralogy: Simon and Schuster, Upper Saddle River, NJ, 484 p.
Putnis, A., 1992, An Introduciton to the Mineralogical Sciences: Cambridge University Press, NY, NY, 479 p.

2. Summary of Proposed Revisions

A. Comparison of Catalog Descriptions

Current Catalog Description:
GEOS 321: Mineralogy

2 lecture hours
3 lab hours
3 credits
(2c-3l-3sh)

Prerequisites: GEOS 121 or CHEM 111

Concerned with properties of minerals; introduction to crystallography and chemistry of crystals, followed by a determination of minerals and their probable genesis. Includes field trips which may occur on weekends.

Proposed Catalog Description:

GEOS 220: Mineralogy

2 lecture hours
3 lab hours
3 credits
(2c-3l-3sh)

Prerequisite: GEOS 121
Prerequisite or Corequisite: CHEM 111 or 113; or permission of instructor An introduction to crystallography, crystal chemistry, optical properties, and mineral associations and phase equilibria. Emphasis is on minerals pertinent to geology, Earth resources, and technology. Laboratory topics emphasize mineral identification in hand specimen, use of the petrographic microscope, and x-ray diffraction techniques. Includes field trips, which may occur on weekends.

B. Summary of revisions

The content of the course has been updated to meet the current needs of the Geoscience community. The course description and prerequisites have been revised to better reflect the nature and content of the course. The course number has been changed to better reflect course progression in the Geoscience program.

3. Justification for Revision:

GEOS 321 has not been updated since 1987; the existing syllabus-of-record contains few details regarding the nature and content of the course, and lacks certain quantitative elements that are an integral part of modern mineralogic practice and research. The current listing of Mineralogy as an upper division course is also unusual, and unrepresentative of course context and content.

In this revision Mineralogy is renumbered to GEOS 220. Mineralogy is the most fundamental course in the Earth sciences—an understanding of mineralogy is central to all aspects of the Earth sciences and is, indeed, essential for success in genuine upper division course work. The present re-numbering better reflects course content, and further emphasizes the proper course sequence for geoscience majors. Mineralogy is furthermore a 200-level course at practically all other universities in the country (that use a comparable numbering system), including, for example, Penn State, the University of Pennsylvania, Bucknell, Oberlin, Carleton, Columbia, Yale and the California State Universities at Los Angeles and Northridge, just to name a few. Universities that use alternative numbering systems, for example the Massachusetts Institute of Technology, Harvard and the University of California, Santa Barbara similarly list their Mineralogy equivalent as a lower division course.

It is impossible to undertake a serious study of minerals without having some exposure to chemistry, and so a chemistry pre/co-requisite is added. This strategy is not novel, and

follows standard practice in most Geoscience Departments. With regard to our own curriculum in the Geoscience department, students must take either CHEM 111 or 113, and we usually suggest that students enroll in one or the other course in their second year. Students that procrastinate tend not to perform as well as students who have taken, or are concurrently enrolled in, either CHEM 111 or 113. Most students will not be affected, but students with a tendency to delay their CHEM sequence will now be unable to do so - to their benefit in Mineralogy, and the rest of the Geoscience curriculum. The new syllabus details the aspects of crystallography, crystal chemistry and systematic mineralogy covered in the course. The new course objectives emphasize the quantitative nature of the material. The addition of quantitative material represents part of a larger effort to include mathematics in all Geoscience courses, as well as the crucial need to modernize our treatment of Mineralogy. This movement in the curriculum is crucial as the Earth sciences are no long a descriptive discipline; the mathematical skills developed in the MATH and GEOS courses within our program are essential for students to meet with success in graduate school, and within the practice of their various professional sub-disciplines.

4. Old Syllabus of record

Part III - Letters of Support (in appendix)

Not applicable

Course Syllabus

Geoscience Department

MINERALOGY

Course Title: Mineralogy
Course Number: GS 321
Credit Hours: 3 credits
Pre-requisite: General Geology I and General Chemistry I

A. Catalog Description: The student will be introduced to the minerals forming the crust of the earth as typical crystalline solids having limited occurrences and special uses. The lab will include identification of individual minerals by appearance and physical properties.
Two hours lecture and 3 hours lab per week.

B. Rationale: The relationship between volumetric, geometric, chemical, and physical properties of minerals will be examined as typical of crystalline solids.

C. The lectures will be two one hour periods per week and the laboratory will be one three hour period. One extended or weekend field trip will be part of the course curriculum.

D. Textbook: Mineralogy by Berry and Mason published by Freemon. Laboratory materials will be given to the students by the instructor.

E. Approximate time allotment by topics:

Lecture:	Introduction and Testing	2 1/2 hrs.
	Crystalline Geometry	5 hrs.
	Symmetry Concepts	3 hrs.
	Internal Structure	3 hrs.
	External Morphology	2 hrs.
	Classes of Minerals	1 hr.
	Chemical Relationships	5 1/2 hrs.
	Physical Relationships	1 hr.
	Occurrences	3 hrs.
	Instrumentation	2 hrs.
Laboratory:	Crystal Geometry	1 lab
	2 Dimensional Symmetry	2 labs
	3 Dimensional Symmetry	3 labs
	Phase Diagrams	1 lab
	Nonsilicate Minerals	3 labs
	Silicate Minerals	3 labs
	Testing	1 lab

Revised 11/20/87 FRP

GEOLOGY/EARTH SCIENCE

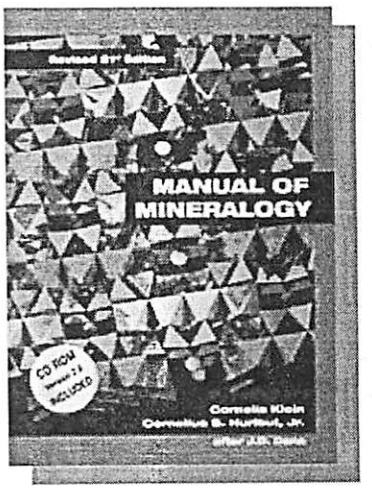
About the Book | Features | Supplements | Table of Contents | Review Copy

Cornelis Klein, The University of New Mexico
Cornelius S. Hurlbut, Jr., Harvard University

Manual of Mineralogy 21st Edition Revised with Mineralogy Tutorials, Version 2.0

0-471-31266-5

Intended for the undergraduate Mineralogy/Materials Science course, this classic and definitive text now includes a copy of *Mineralogy Tutorials: Interactive Instruction on CD-ROM, Version 2.0* with each copy of the text. What's more, the text has been updated to include references to appropriate sections on the CD-ROM, providing students with a complete learning experience in Mineralogy/Materials Science.



Keith Putirka

MANUAL OF MINERALOGY

(after JAMES D. DANA)

TWENTY-FIRST EDITION, REVISED

Cornelis Klein
The University of New Mexico

Cornelius S. Hurlbut, Jr.
Harvard University

JOHN WILEY & SONS, INC.
New York Chichester Weinheim Brisbane Singapore Toronto

CONTENTS