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### Curriculum Proposal Cover Sheet - University-Wide Undergraduate Curriculum Committee

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Proposing Department/Unit <b>Geoscience Department</b>	Phone <b>724-357-7650</b>

Check all appropriate lines and complete all information. Use a separate cover sheet for each course proposal and/or program proposal.

**1. Course Proposals (check all that apply)**

New Course                       Course Prefix Change                       Course Deletion  
 Course Revision                       Course Number and/or Title Change                       Catalog Description Change

Current course prefix, number and full title: \_\_\_\_\_

Proposed course prefix, number and full title, if changing: \_\_\_\_\_

**2. Liberal Studies Course Designations, as appropriate**

This course is also proposed as a Liberal Studies Course (please mark the appropriate categories below)

Learning Skills     Knowledge Area     Global and Multicultural Awareness     Writing Intensive (include W cover sheet)

Liberal Studies Elective (please mark the designation(s) that applies – must meet at least one)

Global Citizenship                       Information Literacy                       Oral Communication  
 Quantitative Reasoning                       Scientific Literacy                       Technological Literacy

Received  
 NOV 18 2014  
 Received  
 OCT 23 2014  
 Liberal Studies

**3. Other Designations, as appropriate**

Honors College Course                       Other: (e.g. Women's Studies, Pan African)

**4. Program Proposals**

Catalog Description Change     Program Revision     Program Title Change     New Track  
 New Degree Program     New Minor Program     Liberal Studies Requirement Changes     Other

Current program name:    **B.S. in Geology / Energy Resources Track**

Proposed program name, if changing: \_\_\_\_\_

5. Approvals	Signature	Date
Department Curriculum Committee Chair(s)	<i>Kenneth S. Coler</i>	4/17/2014
Department Chairperson(s)	<i>Sam A. A.</i>	4/24/14
College Curriculum Committee Chair	<i>Karen Rose</i>	10/17/14
College Dean	<i>Dana Surf</i>	10/20/14
Director of Liberal Studies (as needed)		
Director of Honors College (as needed)		
Provost (as needed)	<i>Thomas S. Marshall (am)</i>	12/31/14
Additional signature (with title) as appropriate		
UWUCC Co-Chairs	<i>Gail Schmitt</i>	11/18/14

## **Geoscience Department: Program Revision for B.S. in Geology/Energy Resources Track**

### **Part II. Description of Curriculum Change**

#### **1. Catalog Description**

Note: This catalog description applies to the Geoscience Department's B.S. in Geology/Geology Track, B.S. in Geology/Environmental Track, B.S. in Geology/Energy Resources Track, B.S. in Education-Earth and Space Science, and Minor in Geology.

The catalog will be revised to read as follows:

Geology is the broad science that encompasses all aspects of the Earth system. In addition to the solid Earth, this system includes the oceans and atmosphere, climate change, and most aspects of our immediate environment. Professional geologists are thus engaged in a wide range of activities, depending on their interests. Scientific questions addressed by geologists include the evolution of life, the origin of volcanic activity, the assessment of volcanic and earthquake hazards, the evolution of our planetary neighbors, climate change, mineral and energy resources, and the human impact on our environment.

The Geoscience Department offers a BS degree with a major in geology that is divided into three tracks: geology, environmental, and energy resources. All tracks give students the necessary foundation to pursue a wide variety of career goals. In addition, we offer a BSEd degree with a major in Earth and space science education for students who are interested in teaching. The degrees and courses in our program emphasize hands-on learning, including outdoor instruction, student-oriented research, and professional experiential learning opportunities. In addition to on-campus instruction and class-related field trips, the department also offers several regional geology field workshops, which take place in Newfoundland, the northern Rockies region, Florida and the Bahamas, and the American Southwest.

The **BS—Geology/Geology Track** is designed for students who are interested in pursuing many of the various subdisciplines in geology, including oceanography/marine geology, climate change, volcanology, paleontology, and geophysics. There is also considerable overlap between geology and astronomy, as geologists study the evolution of other planetary bodies, such as the Moon, Mars and Venus; our curriculum reflects this link and provides the groundwork for planetary studies. The geology track thus provides students with the foundation needed to pursue a wide variety of careers, including research and graduate studies, or working as professional geologists for energy resource companies, environmental consulting firms, or federal and state regulatory agencies.

The **BS—Geology/Environmental Track** is designed for students who wish to pursue careers in the environmental field. In addition to air and water quality issues, pollution often affects the subsurface in ways that are difficult to detect and remediate. Geologists therefore play a key role in dealing with complex environmental issues; the environmental track prepares students to solve a variety of environmental problems. Graduates from this track will be prepared for direct entry into jobs with federal or state agencies and private environmental consulting firms, as well as graduate studies.

The **BS—Geology/Energy Resources Track** is designed for students who wish to pursue careers in the energy sector. As the world's energy demands continue to grow, nations face the challenge of maintaining reliable energy supplies. Conventional oil, coal, and natural gas continue as mainstays of the energy industry, but renewable and/or carbon-neutral energy sources are gaining attention in response to growing concerns about climate change and finite reserves of fossil fuels. Western

Pennsylvania is a historic coal and natural gas producing region with the potential for significant growth in the natural gas industry due to development of the Marcellus shale. The energy resources track will prepare students for direct entry into the energy industry with a focus on the discovery and development of energy resources and geophysical exploration techniques.

The **BSEd—Earth and Space Science** prepares students to become certified middle and high school teachers in Pennsylvania and other states. Earth and space science teachers in grades 7 to 12 teach subjects that require a broad and solid foundation in science. Course work includes study of geology, meteorology, oceanography, and astronomy. A basic understanding of the cognate sciences, biology, chemistry, and physics, and mathematics is also an essential part of the major. Courses in the foundations of education and pedagogy complement the subject matter studies. Students create and present lessons, first in their courses and then in school classrooms, culminating in the student teaching experience in the final semester.

The minor in geology is designed for students who want a background in geology in conjunction with their main area of study. This minor may be particularly appropriate for students pursuing degrees in business or one of the social or physical sciences.

*(program description appears on next page)*

**List of courses and credits for the proposed revised program:**

**Bachelor of Science - Geology/Energy Resources Track**

**Liberal Studies Requirements:** 46

As outlined in Liberal Studies section with the following specifications:

**Natural Science:** CHEM 111-112 or CHEM 113-114

**Mathematics:** MATH 121

**Liberal Studies Electives:** MATH 122, no courses with GEOS prefix

**Major:** 58

**Required Courses:**

GEOS 201 Foundations of Geology 4 cr

GEOS 202 Quantitative Methods in the Geosciences 2 cr

GEOS 203 Surficial Processes 4 cr

GEOS 204 Historical Geology 4 cr

GEOS 301 Mineralogy 4 cr

One of the following: GEOS 303, GEOS 401-402, 403-404, 405-406, 407-408 <sup>(1)</sup> 4 cr

GEOS 470 Research Methods in the Geosciences 2 cr

GEOS 480 Geoscience Seminar 2 cr

**Energy Resources Track:**

Two of the following: GEOS 302 Structural Geology, GEOS 323 Geophysics,  
or GEOS 324 Geology of Oil & Gas 8 cr

Two of the following: GEOS 352 Sedimentation &  
Stratigraphy, GEOS 353 Paleontology,  
GEOS 355 Sedimentary Petrology, or  
GEOS 362 Plate Tectonics 8 cr

**Ancillary Sciences:** 6 cr

Two of the following: PHYS 111 Physics I or PHYS 131 Physics I with Calculus,  
PHYS 112 Physics II or 132 Physics II with Calculus,  
or MATH 216 Statistics for Natural Science

**Controlled Electives <sup>(2)</sup>** 10 cr

One 100-level GEOS course <sup>(3)</sup>

Any 300-level GEOS course(s)

Any 400-level GEOS course(s)

Foreign Language Intermediate Level

BIOL 201, 202

CHEM 112 or 114, 231, 232, 325, 326, 341

GEOG 314, 335, 341, 343, 415, 419

MATH 216 or 217<sup>(4)</sup>, 241

PHYS 121 or 141, 122 or 142, 342

COSC 110, 210, 250, 310, 362

**Free Electives:** 16

**Total Degree Requirements:** 120

*(1) Up to 4cr of a summer field camp, internship, field research study, or independent study, all of which must be approved by the department, may substitute for GEOS 303 Field Geology or a Geoscience Field Workshop.*

*(2) Any course not applied to the geology track may count as a controlled elective if taken in addition to track requirements. Only one Geoscience Field Workshop (including prerequisite 1cr Seminar) may be applied toward controlled electives. Six credits of foreign language may count toward controlled electives provided intermediate level is successfully obtained.*

*(3) When taken before declaring the major or when specifically recommended during freshmen orientation/transfer advising for students who must take remedial math courses before enrolling in GEOS 201 and 202.*

*(4) Cannot be counted as a controlled elective if MATH 216 is applied toward ancillary science requirements.*

recommended during freshmen orientation/transfer advising for students who must take remedial math courses before enrolling in GEOS 201 and 202.

(4) Cannot be counted as a controlled elective if MATH 216 is applied toward ancillary science requirements.

## 2 (b). List of Associated Course Changes

### Course Proposals Associated with Program Revisions

<b>Course #</b>	<b>Old #</b>	<b>Name</b>	<b>Format</b>	<b>Summary of Change</b>
GEOS 204	351	Historical Geology	3c-3l-4cr	Renumbered from GEOS 351
GEOS 301	301	Mineralogy	3c-3l-4cr	Renamed; petrology content moved to GEOS 345
GEOS 312	312	Hydrogeology	3c-3l-4cr	Added lab section; increased from 3 to 4 cr
GEOS 342	342	Stellar Astronomy	3c-3l-4cr	Changed MATH 121 and PHYS 111 from prerequisites to corequisites
GEOS 345	322	Igneous & Metamorphic Petrology	3c-3l-4cr	New Course*
GEOS 355	355	Sedimentary Petrology	3c-3l-4cr	Added lecture hour; increased from 3 to 4 cr; prerequisite changed to GEOS 301
GEOS 362	362	Plate Tectonics	3c-3l-4cr	Added lecture hour; increased from 3 to 4 cr
GEOS 354	354	Geomorphology	3c-3l-4cr	Added lecture hour; increased from 3 to 4 cr
GEOS 363	NA	Volcanology	3c-3l-4cr	New Course
GEOS 483	NA	Honors Thesis	var-1-3cr	New Course
GEOS 490	NA	Field Studies in Geology	var-1-4cr	New Course

**\*Note:** there used to be a IUP course named GEOS 322 Igneous and Metamorphic Petrology, but it was discontinued (deleted) in 2009. To reactivate it, the UWUCC and registrar require a new course proposal to be submitted. We are renumbering the course to GEOS 345 to maintain consistency with our current program numbering system.

**Complete List of Geoscience Major\* Courses under the Proposed Revision (BOLD items are new or revised)**

<b>Course Title</b>	<b>Format</b>	<b>Prerequisites</b>
GEOS 201 Foundations of Geology	3c-3l-4cr	Geoscience majors and minors, Science or Science Education majors/minors, Anthropology, Geography and Regional Planning majors, or instructor permission
GEOS 202 Quantitative Methods in the Geosciences	2c-0l-2cr	Geoscience majors and minors only, or permission of instructor; must be taken after or concurrently with GEOS 201
GEOS 203 Surficial Processes	3c-3l-4cr	GEOS 201
<b>GEOS 204 Historical Geology</b>	<b>3c-3l-4cr</b>	<b>GEOS 201</b>
<b>GEOS 301 Mineralogy</b>	<b>3c-3l-4cr</b>	<b>GEOS 201, 202</b>
GEOS 302 Structural Geology	3c-3l-4cr	GEOS 201, 202
GEOS 303 Field Geology	3c-3l-4cr	GEOS 201, 202
GEOS 310 Environmental Geology	3c-3l-4cr	GEOS 202, 203
GEOS 311 Geochemistry	3c-3l-4cr	GEOS 201, 202
<b>GEOS 312 Hydrogeology</b>	<b>3c-3l-4cr</b>	<b>GEOS 201, 202</b>
GEOS 313 Soils and Soil Geochemistry	2c-3l-3cr	GEOS 201, 202
GEOS 341 Planetary Geology	3c-3l-4cr	MATH 121, PHYS 111 (Co-requisites)
<b>GEOS 342 Stellar Astronomy</b>	<b>3c-3l-4cr</b>	<b>MATH 121, PHYS 111 (Co-requisites)</b>
<b>GEOS 345 Igneous and Metamorphic Petrology</b>	<b>3c-3l-4cr</b>	<b>GEOS 301</b>
GEOS 352 Sedimentation and Stratigraphy	3c-3l-4cr	GEOS 202, 203
GEOS 353 Paleontology	3c-3l-4cr	GEOS 201, 202
<b>GEOS 354 Geomorphology</b>	<b>3c-3l-4cr</b>	<b>GEOS 202, 203</b>
<b>GEOS 355 Sedimentary Petrology</b>	<b>3c-3l-4cr</b>	<b>GEOS 301</b>
<b>GEOS 362 Plate Tectonics</b>	<b>3c-3l-4cr</b>	<b>PHYS 111-112; 20cr of geology</b>
<b>GEOS 363 Volcanology</b>	<b>3c-3l-4cr</b>	<b>GEOS 345</b>
GEOS 370 Oceanography	3c-3l-4cr	GEOS 201, 202
GEOS 371 Meteorology	2c-3l-3cr	GEOS 201, 202
GEOS 401 Northern Rockies Seminar	1c-0l-1cr	GEOS 201, 202
GEOS 402 Northern Rockies Field Workshop	var-3cr	GEOS 401 and instructor permission
GEOS 403 Newfoundland Seminar	1c-0l-1cr	GEOS 201, 202
GEOS 404 Newfoundland Field Workshop	var-3cr	GEOS 403 and instructor permission
GEOS 405 American Southwest Seminar	1c-0l-1cr	GEOS 201, 202
GEOS 406 American Southwest Field Workshop	var-3cr	GEOS 405 and instructor permission
GEOS 407 Carbonate Geology Seminar	1c-0l-1cr	GEOS 201, 202
GEOS 408 Carbonate Geology Field Workshop	var-3cr	GEOS 407 and instructor permission
GEOS 470 Research Methods in the Geosciences	2c-0l-2cr	75cr or instructor permission
GEOS 480 Geoscience Seminar	2c-0l-2cr	GEOS 470, Senior standing
GEOS 481 Special Topics	var-1-3cr	As appropriate to course content
GEOS 482 Independent Study	var-1-3cr	Prior approval through advisor, faculty member
<b>GEOS 483 Honors Thesis</b>	<b>var-1-3cr</b>	<b>Prior approval through advisor, faculty member</b>
<b>GEOS 490 Field Studies in Geology</b>	<b>var-1-4cr</b>	<b>Prior approval through advisor, faculty member</b>
GEOS 493 Geoscience Internship	var-1-12cr	None

**\*Non-major courses at the 100-level will not be impacted by this program revision.**

### 3. Rationale for Changes

#### Rationale for Geoscience Department Programmatic Changes

**Note:** This section applies wholly or in part to proposed program revisions for the Geoscience Department's B.S. in Geology/Geology Track, B.S. in Geology/Environmental Track and the B.S. in Geology/Energy Resources Track. As such, this text will be repeated in the revision proposals for all these programs.

Since our last Middle States re-accreditation in 2005, IUP has promoted a strong culture of assessment in its academic programs, both in terms of strategic planning and better monitoring of student learning outcomes. In our 2009-10 academic program review, the Geoscience Department identified program specific learning goals (professional competencies) for all of our BS program tracks\* and adopted a strategic action plan to monitor them. These learning goals represent our vision of what a geologist with a B.S. degree from IUP should be able to do when they graduate and enter the workforce.

**Table 1 – Summary of Geoscience Learning Goals**

<b>Geoscience Mission</b>	<b>Geoscience Learning Goal</b>	<b>Liberal Studies EUSLO</b>
All students in the Geoscience Department will learn how to <b>think critically</b> and <b>solve problems</b> in a research-rich environment that exposes them to the major issues and unsolved questions in earth science.	Students will be able to analyze and solve earth science problems using <b>critical thinking skills</b> .	<b>Empowered Learners</b> can apply critical thinking to transform their knowledge of concepts into analysis, judgment and action.
	Students will be able to analyze and solve earth science problems using <b>quantitative tools</b> .	<b>Empowered Learners</b> can attack real world problems using discipline-specific skills, methods and tools.
Our majors will develop the <b>knowledge</b> and <b>skills</b> needed to excel as professional geologists or earth science educators.	Students will master three <b>foundational content areas</b> in geoscience: <ol style="list-style-type: none"> <li>1. plate tectonic theory</li> <li>2. organic evolution</li> <li>3. environmental change</li> </ol>	<b>Informed Learners</b> can demonstrate both knowledge and understanding of core concepts in the discipline.
	Students will develop <b>professional skills</b> in: <ol style="list-style-type: none"> <li>1. rock and mineral identification and interpretation</li> <li>2. spatial data analysis and map interpretation</li> <li>3. computer spreadsheet analysis, statistics and mathematical modeling</li> </ol>	<b>Empowered Learners</b> can attack real world problems using discipline-specific skills, methods and tools.
Our majors will learn how to <b>communicate</b> their knowledge effectively to others.	Students will develop the <b>oral and written skills</b> needed for effective scientific communication.	<b>Empowered Learners</b> can use oral, written, visual or other methods to communicate effectively in the discipline.



*\*Note: the BSED in Earth & Space Science Education creates and monitors its own student learning outcomes as part of its national accreditation through NSTA and NCATE.*

The Geoscience Department assesses student learning outcomes with a combination of faculty surveys, class assignments, concept inventory instruments, and capstone project rubrics (for more details, see the Student Learning Outcome Assessment Annual Report included in this revision package). This process has allowed us to determine if students are achieving our expected learning outcomes at the levels of success we desire. When we see unsatisfactory outcomes (IE, less than 60% correct on a particular concept question at all class levels, or a decrease in correct answers from entering freshman to graduating senior), we analyze our curriculum to determine why students were not able master or retain the use of that particular content knowledge or skill.

The table below summarizes our analysis of student learning by mapping goal progress throughout the current curriculum. Note that three gaps have been found where a particular learning goal is not fully supported from the introductory freshman-sophomore experience (GEOS 201, 202, 203, 301 and Liberal Studies courses) through upper-level majors classes to our capstone coursework (GEOS 470, 480 and required field experience).

**Table 2 – Curriculum Map of Student Learning Goals and Gaps in Current Programs**

<b>Student Learning Goal</b> (Bloom's Taxonomy)	<b>Introductory Classes</b> (knowledge and understanding)	<b>Upper-Level Classes</b> (application and analysis)	<b>Capstone Classes</b> (synthesis and evaluation)
<b>I. Students will develop the tools needed to analyze and solve problems in earth science.</b>			
A. Quantitative tools	LS Math, Quantitative Methods in Geoscience	All quantitative 300-level and 400-level classes	Research Methods, Geoscience Seminar
B. Critical thinking	Foundations of Geology, Quantitative Methods, Surficial Processes	All 300-level and 400-level classes	Research Methods, Field Experience Geoscience Seminar
<b>II. Students will master these foundational content areas in geoscience.</b>			
A. Plate tectonic theory	Foundations of Geology	Structure, Plate Tectonics	Field Experience
B. Organic evolution	<b>Curricular gap identified</b>	Paleontology, Historical Geology	Field Experience
C. Environmental change	Surficial Processes	Environmental Geology, Coastal Processes	Field Experience
<b>III. Students will develop specific professional skills needed for field and lab research.</b>			
A. Rock & mineral identification/interpretation	Foundations of Geology, Mineralogy & Petrology	<b>Curricular gap identified</b>	Field Experience, Geoscience Seminar
B. Spatial data analysis and map interpretation	Foundations of Geology, Surficial Processes	Structural Geology, Geology of Oil and Gas, Hydrogeology	Field Experience, Geoscience Seminar
C. Computer spreadsheet analysis, statistics and mathematical modeling	Quantitative Methods in Geoscience	Geology of Oil & Gas, Geophysics, Hydrogeology	Field Experience, Geoscience Seminar

IV. Students will develop effective scientific communication skills.			
A. Oral communication	Foundations of Geology, Surficial Processes	<i>Curricular gap identified</i>	Research Methods, Geoscience Seminar
B. Written communication	LS English	All /W courses (in and out of department)	Research Methods, Geoscience Seminar

The conclusions drawn by our department Assessment Committee are quoted below:

1. The Geoscience Department should revise our major programs of study to incorporate historical geology as a required rather than elective course for all students.

2. The Department should consider reducing the broad range of non-geology coursework that students may currently elect to take to fulfill their Controlled Electives, as it may be contributing to lower learning outcomes for some degree programs.

The Geoscience Department discussed and endorsed these findings during a series of summer curriculum meetings as well as during our most recent semi-annual retreat. Working as a curriculum committee of the whole, we also added two additional objectives to our program revision:

3. Based on feedback from alumni and employers in the geologic work force, we should add more rock and mineral identification and analysis at both the introductory and upper levels of our programs. This will give our students the skills they need for success in the energy, environmental and academic research fields.

4. Based on instructor experience with the use of high-impact practices in courses like GEOS 201 and 203, we should ensure that all courses used as core or program track options have the time available to focus on student-centered class-work and team projects that require critical thinking skills and competence in oral communication. This can be achieved by transforming all track courses with 2-hour lectures to 3-hour lectures.

This curriculum revision represents our attempt to 'close the assessment loop' by making curriculum changes based on the findings from our student learning outcome data, alumni and employer feedback and instructor experience. At the same time, we wish to preserve the strategic goals of our 2009 curriculum revision: increased flexibility in student scheduling, fewer curriculum bottlenecks due to pre-requisite stacking, and more ease for students transferring into the program and/or switching program tracks. These aspects of our current curriculum have had a significant positive impact on growing our enrollments and helping students to graduate on time over the past five years.

The specific curriculum changes being made to improve student learning outcomes are summarized in Table 3. Note that we have included SLO justifications for all elements of our curriculum, both those that are currently working as intended and have been retained from our present program as well as those that are in need of improvement and are being proposed for revision in this proposal.

**Table 3: Summary and Justification for proposed B.S. in Geology / Energy Resources Track**

<b>Liberal Studies Requirements (46 credits)</b>	
<i>Summary of Program Requirements</i>	<i>Rationale for Choices</i>
<p>The following specifications by the Geoscience Department:</p> <ul style="list-style-type: none"> <li>• <i>Mathematics</i> : MATH 121: Calculus I</li> <li>• <i>Liberal Studies Elective</i>: MATH 122: Calculus II</li> <li>• <i>Natural Science (8 cr)</i>: CHEM 111 General Chemistry I (or CHEM 113 Advanced General Chemistry I) and CHEM 112 General Chemistry II (or CHEM 114 Advanced General Chemistry II)</li> </ul>	<ol style="list-style-type: none"> <li>1. All students will take a full year of math and a full year of chemistry. This will prepare them for the increasingly interdisciplinary needs of the workforce and for entry into graduate school.</li> <li>2. All tracks will have the same LS science specifications, allowing for easier track transfers with no delay in graduation.</li> </ol>
<b>Geoscience Common Core (Identical for all tracks) (26 credits)</b>	
<ul style="list-style-type: none"> <li>• GEOS 201 Foundations of Geology (4 cr)</li> <li>• GEOS 202 Quantitative Methods in the Geosciences (2cr)</li> <li>• GEOS 203 Surficial Processes (4 cr)</li> <li>• GEOS 204 Historical Geology (4 cr)</li> </ul>	<ol style="list-style-type: none"> <li>1. The GEOS 201-GEOS 204 sequence introduces students to all department learning goals at a foundational level. Initial student learning outcomes are measured in all of them. We expect these courses to be taken during the first three program semesters.</li> </ol>
<ul style="list-style-type: none"> <li>• GEOS 301 Mineralogy (4 cr)</li> <li>• Field Experience – one of the following:            GEOS 303 Field Geology (4 cr), Any Geoscience Field Workshop (4 cr – GEOS 401-402, 403-404, 405-406, 407-408), Up to four credits of field camp, internship, REU or independent study by department approval.</li> </ul>	<ol style="list-style-type: none"> <li>2. Mineralogy is an essential field of knowledge for all tracks, therefore it was placed in the core. We expect this course to occur during the fourth program semester.</li> <li>3. A field-oriented class or equivalent experiential learning opportunity is important for all tracks, therefore it was placed in the core. We expect this field experience to occur after the introductory courses are done.</li> </ol>
<ul style="list-style-type: none"> <li>• GEOS 470 Research Methods in the Geosciences (2 cr)</li> <li>• GEOS 480 Geoscience Seminar (2 cr)</li> </ul>	<ol style="list-style-type: none"> <li>4. These two courses initiate and complete the junior - senior research experience. Final learning outcomes are measured in them.</li> </ol>

(Table Three continues onto next page → )

**Table 3: Summary and Justification for proposed B.S. in Geology / Energy Resources Track**

<b>Energy Resources Track Requirements (16 credits)</b>	
<p><b>Two of the following:</b></p> <ul style="list-style-type: none"> <li>• GEOS 302 Structural Geology (4 cr)</li> <li>• GEOS 323 Geophysics (4 cr)</li> <li>• GEOS 324 Geology of Oil &amp; Gas (4 cr)</li> </ul>	<p>1. These courses give students an understanding of subsurface structures and hydrocarbon generation processes. They also teach specific professional skills (such as well log interpretation) required by the oil and gas workforce.</p>
<p><b>Two of the following:</b></p> <ul style="list-style-type: none"> <li>• GEOS 330 Paleontology (4 cr)</li> <li>• GEOS 352 Sedimentation &amp; Stratigraphy (4 cr)</li> <li>• GEOS 355 Sedimentary Petrology (4 cr)</li> <li>• GEOS 362 Plate Tectonics (4 cr)</li> </ul>	<p>2. These courses give students advanced experience with identifying and analyzing sedimentary rocks, fossil assemblages and basin development, all of which help them better understand the environment in which oil and gas deposits form.</p>
<b>Ancillary Sciences (6 credits)</b>	
<p><b>Two of the following:</b></p> <ul style="list-style-type: none"> <li>• Physics 111 Physics I (or Physics 131 Physics I with Calculus) (3 cr)</li> <li>• Physics 112 Physics II (or Physics 132 Physics II with Calculus) (3 cr)</li> <li>• MATH 216 Statistics for Natural Science (3 cr)</li> </ul>	<p>3. Students will take either a full year of physics or a semester of physics and an additional semester of math. This will prepare them for the increasingly interdisciplinary needs of the workforce. The accompanying labs (PHYS 121 or 141 and PHYS 122 or 142) can count as controlled electives (see below).</p>
<b>Controlled Electives (10 credits)</b>	
<p>Select courses from the following list. Students going on to post-graduate study will be encouraged to take both physics labs (PHYS 121/141 and PHYS 122/142) as electives.</p>	
<ul style="list-style-type: none"> <li>• One 100-level GEOS course (must have been taken before GEOS 201)</li> </ul>	<p>1. Accepting one non-major geology course as an elective helps recruit new majors and allows majors taking remedial math courses to learn introductory geology.</p>
<ul style="list-style-type: none"> <li>• Any 300-level GEOS course</li> <li>• Any 400-level GEOS course</li> </ul>	<p>2. Students can follow their interests in selecting upper-level geology classes, as most have 200-level pre-requisites</p>
<ul style="list-style-type: none"> <li>• Foreign-language intermediate level</li> </ul>	<p>3. This allows students with interests in language acquisition to make that valuable skill a part of their major.</p>
<ul style="list-style-type: none"> <li>• GEOG 314 Map and Photo Interpretation</li> <li>• GEOG 316, 419 Intro to GIS</li> <li>• GEOG 335 Geography of Energy</li> <li>• GEOG 343 Geography of Fresh-Water Res.</li> <li>• GEOG 415 Remote Sensing</li> <li>• GEOG 419 Environmental Applic. Of GIS</li> </ul>	<p>4. Many geographic skills, particularly those that relate to computer mapping systems, are in high demand by geologic employers. Students who minor in geography can use several of their minor classes as part of their major.</p>
<ul style="list-style-type: none"> <li>• BIOL 201, 202</li> <li>• CHEM 112 or 114, 231, 232, 325, 326, 341</li> <li>• MATH 216 or 217, 241</li> <li>• PHYS 112/122 or 132/142, 342</li> <li>• COSC 110, 210, 250, 310, 362</li> </ul>	<p>5. These courses allow students with interests or minors in other sciences to apply relevant courses (including the second semester of introductory chemistry and/or physics) to their major.</p>

We believe this change can be justified in four ways: improved student learning outcomes, increased ability to switch between tracks, maintained flexibility of scheduling and ease of access, and reasonable time-to-degree for both traditional and transfer students.

### Improved Student Learning Outcomes

1) To improve student learning outcomes in earth science and evolution, and at the same time accommodate students entering the program in the spring, we plan to move Historical Geology into the sophomore introductory sequence as a fall course. This will fill the curricular gap that currently exists and improve learning outcomes in the areas of earth history and organic evolution. This is a simple change to make, because Historical Geology used to be part of the freshman experience prior to 2009 and is generally treated as an introductory course by most geology programs across the nation. Introductory level textbooks, field exercises and other materials are abundantly available and two faculty members in the department (Taylor & Cercone) have many years of experience teaching the course at the introductory level.

2) To improve student learning outcomes in rock and mineral identification and analysis, we plan to transform Mineralogy & Petrology into a one-semester Mineralogy course that will be offered as the spring part of the sophomore-level introductory sequence. This course will focus on mineral identification and interpretation, improving student outcomes in this area through more extensive training in both hand and microscope identification techniques. This change will make our program more consistent with other programs across the country where Mineralogy is the focus of a required stand-alone semester or year-long course, rather than just part of a broader survey course.

3) To improve student learning outcomes in terms of content knowledge and professional skills required for the geologic workforce, we plan to move 16 credits from the current core and controlled elective categories into specific program tracks for all B.S. degrees. Our current program gives our students the choice to select courses from a very broad suite of controlled electives. While some students make thoughtful choices that result in effective learning sequences, others do not. Recent examples include an Energy Resource student who used Stellar Astronomy as a controlled elective, and an Environmental Track student who used Paleontology as a controlled elective, simply because these courses were offered at a time or during a semester that the student preferred. This change takes the most relevant and useful upper-level elective courses and groups them into two sets from which students can choose those that they prefer or that help them graduate on time. In this way, we retain some flexibility in scheduling to help students transfer into the department or between tracks and still graduate on time, but we can now ensure that all of our learning outcomes are adequately addressed in each track.

4) To improve student learning outcomes for critical thinking and oral communication, all classes required as part of each track will be brought up to three lecture hours and three lab hours so that there is adequate time for weekly student-centered learning activities and informal or formal class presentations. Most courses used as track requirements are already in this format. Three (Plate Tectonics, Sedimentary Petrology and Geomorphology) will have an hour of lecture added and one (Hydrogeology) will have a lab section added.

#### *Increased Ability To Switch Between Tracks*

We have found that many students come to IUP with the intention to major in one aspect of the geosciences, but fall in love with a different field of study after being exposed to it in class or through cooperative research with a faculty mentor. With identical common core requirements adopted for all three of our B.S. program tracks, it will become much easier for students to switch from one program track to another during their first three years at IUP. Even if they have taken some upper-level courses from their program's required track, those can easily be used as Controlled Electives for another program (and vice versa).

To further this goal, we also plan to make the Liberal Studies requirements identical for all three tracks, following the model currently used for both the Geology and Environmental track. We will add identical Other Requirement for allied sciences in all three tracks which include two semesters of Physics lecture and a calculus-based statistics course as options.

#### *Flexibility in Scheduling and Ease of Access*

To preserve flexibility in scheduling, multiple course options are offered within tracks wherever there is sufficient overlap in terms of the desired learning goals. This will allow students to make the best use of our two-year course rotation. In addition, our proposed revision also preserves ease of access to most upper-level courses. As shown in Table 2, a large majority of upper level courses will continue to use only the freshman introductory sequence (GEOS 201, 202 and/or 203) as pre-requisites and will therefore be available to students after their first year in the program. A few courses have increased their pre-requisites now that all students are required to take courses in the common core, for example both Igneous and Metamorphic Petrology and Sedimentary Petrology can now build on Mineralogy as a pre-requisite. This will create more effective scaffolding of course content and professional skills than allowing in a mixture of students with and without a solid background in Mineralogy.

#### *Reasonable Time to Degree for Traditional and Transfer Students*

One of the signature achievements of our 2009 course revision was its positive impact on time-to-degree, particularly for transfer students. Our two-year upper level course rotation (required by the dean in order to minimize our instructional costs and maximize enrollments in both major and non-major courses) caused a great deal of delay and disruption in student schedules when all courses had stacked pre-requisites. By making most courses require only the freshman sequence, we created a much flatter curriculum and gave transfer students

the ability to jump into and complete their required upper-level courses in the final two years of their program. Our current proposal maintains this aspect of our program by keeping the ease of access and flexible scheduling (as noted above) and by giving equal instructional weight to track requirements (16 credits), allied sciences and other controlled electives (6 + 10 credits) and free electives (16 credits). We also have provided options within tracks wherever possible, so students are not delayed in completing their programs of study.

## **Rationale for Changes Specific to the B.S. in Geology/Energy Resources Track**

### *Liberal Studies*

The current Liberal Studies Natural Science requirement for this track combines a semester of chemistry with a semester of physics. Consultation with our colleagues in the Chemistry Department has convinced us that a full year of chemistry will serve all of our students better in terms of learning outcomes as well as allowing them to transfer between tracks if their interests change. Physics has now been placed in a list of ancillary sciences and controlled electives (see below) so that at least one semester of lecture must still be taken. Two semesters of both Physics lecture and lab will be strongly recommended to all students considering graduate study.

### *Major Classes*

- 1) GEOS 351 Historical Geology will move from being an upper-level controlled elective to a sophomore-level common core course (GEOS 204 Historical Geology). This change is designed to improve student learning outcomes in the areas of earth history and organic evolution.
  
- 2) GEOS 301 Mineralogy and Petrology will be split into GEOS 301 Mineralogy (required at the sophomore level in the common core) and GEOS 345 Igneous and Metamorphic Petrology (required at the junior/senior level as a track requirement). This change is designed to improve student learning outcomes in the areas of rock identification and analysis for students in both the geology and environmental tracks.
  
- 3) A common core will be created for all degree tracks. Most of this core will consist of the 18-credit freshman-sophomore introductory sequence: GEOS 201, 202, 203, 204, and 301. This will allow our students to change tracks easily as their scientific interests mature and change throughout their academic program. The remainder of the common core requirements will be minimal, consisting only of a 4-credit field course experience (GEOS 303, 401&402, 403&404, 405&406, 408&409 or equivalent) and a 4-credit junior-senior capstone sequence (GEOS 470 and GEOS 480).
  
- 4) A 16-credit degree track will be created to provide a solid grounding in basic geologic knowledge for all Geology track graduates. This track will consist of two groupings of similar classes (Group 1: 302 Structural Geology / GEOS 323 Geophysics / GEOS 324 Geology of Oil & Gas and Group 2: GEOS 330 Paleontology / GEOS 352 Sedimentation & Stratigraphy / GEOS 355 Sedimentary Petrology / GEOS 362 Plate Tectonics). Students will take two courses of their choosing from each group to fulfill their track requirements. Any course not used as a track requirement can still be taken and counted as a controlled elective.
  
- 5) GEOS 362 Plate Tectonics and GEOS 355 Sedimentary Petrology will be given an additional lecture hour to make them equivalent to the other courses in the degree track. This is required so that all the required track content courses can develop students' critical thinking and oral communication skills through student-centered learning activities such as chalk talks, jigsaw team exercises, small group work, and informal class presentations, while keeping the same depth of content pedagogy and hands-on laboratory work.



6) A new course, GEOS 363 Volcanology, will be offered to increase the diversity of upper-level controlled electives. This course has been identified by exit interviews and surveys of recent graduates as the elective they would have most wanted to take if it had been offered while they were at IUP.

7) A new course, GEOS 490 Field Studies in Geology, will be offered to increase the diversity of upper-level controlled electives and allow students to participate more effectively in new faculty research programs being developed in the department. This course will be offered for variable credit in the summer, allowing students to participate at their level of interest and commitment.

8) A new course, GEOS 483 Honors Thesis, will be offered in order to allow students to seek and earn a degree with departmental honors. This course will be similar in format and content to existing honors courses such as BIOL 483 and PSYCH 483.

9) Minor changes are being made to GEOS 342 Stellar Astronomy to make it similar to GEOS 341 Planetary Geology in terms of requiring Math and Physics as co-requisites rather than pre-requisites. This will allow more students to take it when it is offered.

#### *Ancillary Science Courses*

1) Students can choose to take Physics I and Physics II lectures (PHYS 111 or 131 and PHYS 112 or 132) or they can substitute a semester of statistics (MATH 216 Statistics for Natural Science) for one of the two physics lectures. We wished to make these allied sciences integral to our program, while still allowing enough flexibility included in this category to allow transfer students to graduate on time. This change will also make it easier for students to transfer from one track to another.

#### *Controlled Electives*

1) To make room for the new Geology Track and the ancillary sciences, the number of Controlled Elective credits is being decreased from 25 to 10. This change has been implemented in order to improve the professional competency of IUP geology graduates by focusing their academic efforts on the professional skills (rock and mineral identification and interpretation, spatial data analysis and map interpretation, computer spreadsheet analysis, statistics and mathematical modeling) needed for them to participate effectively in the modern geologic work-force. The range of courses allowed to count as Controlled Electives has been expanded to include additional choices in Geography which improve spatial data analysis and map interpretation skills. The one-credit lab sections for both Physics I (PHYS 121 or 141) and Physics II (PHYS 122 or 142) have been added to the list of electives and will be strongly recommended to all students planning to enter graduate school. We will continue to allow one 100-level or 200-level GEOS course to count toward controlled electives (if taken before GEOS 201) to accommodate students who choose to major in Geosciences after taking one of our liberal-studies course offerings.

2) CHEM 322 and 323 have been replaced with CHEM 325 and 325 in accordance with renumbering of courses by the Chemistry Department.

### *Free Electives*

1) The number of free electives in the proposed curriculum will rise from 15 to 16. This was a deliberate decision on our part because many of our majors come to us as transfers, and they often apply the courses taken in their previous majors toward their free electives. We wanted to ensure that the number of free electives in the new program remained at or above the previous program total.

### **Part III. Implementation**

#### **1. How will the proposed revision affect students already in the existing program?**

No classes required by current track programs are being deleted and all current required courses will continue to be offered in the same format under the new curriculum. Existing students should therefore have no problems completing their degree under their original course catalog requirements. The following accommodations will be made for existing students to account for the changes made by this program revision:

- a) For any existing student who has not yet taken GEOS 301 Mineralogy & Petrology, the department will accept the new GEOS 301 Mineralogy in its place. No additional course will be required, but students will be strongly advised to take either the new GEOS 345 Igneous & Metamorphic Petrology or the revised GEOS 355 Sedimentary Petrology or both as Controlled Electives, especially if they are planning to apply to graduate school.
- b) In order to promote better student learning outcomes, GEOS 204 Historical Geology will be allowed to count as a Controlled Elective for existing students under the old curriculum program.
- c) All of the new 4-credit versions of classes that used to be 3 credits simply count as Controlled Electives under the old program. Students can still use them that way and in fact will be able to complete their Controlled Elective credits with fewer courses.
- d) If a student has taken a course under the old program, that student may not take the same or correlative course again under the new program, even if the number of credits or course number has changed.

We hope that the new curriculum can be reviewed and approved in time to be implemented in the Fall of 2014. However, in the event that its inclusion in the course catalog is delayed until 2015, the cohort of students entering IUP in Fall of 2014 will be given the choice of using either the old or new curriculum, depending on their preference.

#### **2. Are faculty resources adequate? If you are not requesting or have not been authorized to hire additional faculty, demonstrate how this program will fit into the schedule(s) of current faculty.**

We have hired a new faculty member in the area of hydrogeology and aqueous geochemistry, Dr. Gregory Mount. Successful completion of this faculty search enables us to carry out the proposed schedule of classes. The courses listed as track requirements were previously all offered on an every-other-year basis as either required courses (Structural Geology) or Controlled Electives. As shown by the chart in Appendix 1, our upper-level courses can function effectively as program track requirements and controlled electives while still being offered on an every-other-year basis.

Two of the new courses (Igneous and Metamorphic Petrology and Volcanology) will take the place in the course rotation of Soil Geochemistry and Forensic Geology. These courses are no longer being regularly taught due to the departure of Dr. Michael Poage, who created them. We plan to keep both courses on the books for now, in case the successful candidate

from our current search is interested in teaching one of both. Another new course (Field Study in Geology) will be taught only during summer or winter sessions.

The change from three to four credits for Plate Tectonics, Geomorphology and Sedimentary Petrology will add one additional lecture hour to faculty work-load in some semesters. This will generally make an 11-hour load into a 12-hour load, without changing overall work-load for the academic year. The addition of a three-hour lab for Hydrogeology will have a bigger impact on work-load, but the addition of a new faculty member who can teach Hydrogeology has already addressed this need. Our geology track enrollments continue to increase each year, meaning that all upper-level elective courses should become more financially self-supporting than they were previously.

We do not anticipate offering any fewer 100-level Liberal Studies courses under the new curriculum than we currently offer under the old curriculum. Because of the recent change in Liberal Studies Natural Science requirement from 8 to 7 credits, we have shifted to offering larger sections of lecture in order to accommodate the current Liberal Studies student demand for lecture courses. We anticipate being able to still teach those large sections.

### **3. Are other resources adequate?**

There are no program changes that require additional facilities or resources on the IUP campus. The off-campus logistical costs of GEOS 490 Field Studies in Geology have already been underwritten by a generous grant from a department alumni, as detailed in that course proposal, and we anticipate continuing support from alumni and industry.

### **4. Do you expect an increase or decrease in the number of students as a result of these revisions? If so, how will the department adjust?**

Our current enrollments are increasing year-over-year due to the increased profile of the shale-gas industry in western Pennsylvania. Since the new curriculum simply transfers some courses from Controlled Electives to Track Requirements to ensure that professional competencies are met for the workforce, we do not anticipate either an increase or decrease due to the adoption of this proposal.

## **Part IV. Periodic Assessment**

### **1. Describe the evaluation plan. Include evaluation criteria. Specify how student input will be incorporated into the evaluation process.**

Our student learning outcomes assessment process is summarized along with the most recent year of data analysis in the attached annual report. It focuses on a nationally-benchmarked concept inventory instrument, to which we have added some critical thinking exercises and a rubric-based assessment of capstone senior projects. We have conducted similar student learning assessments each year since 2010-2011.

Student input is gathered in two ways. Our department faculty meetings include a monthly report from a student advisory board that gathers concerns and feedback from currently enrolled students for all major department decisions. In addition, our graduating seniors participate each year in a national exit survey of geoscience graduates, conducted by the American Geological Society.

Alumni input is gathered on a semi-annual basis using an alumni advisory council. Council members are graduates who care deeply about the education they received at IUP, and they often suggest useful curriculum changes or other initiatives. Our entire body of alumni are surveyed every five years as part of our academic program review.

## **2. Specify the frequency of the evaluations.**

Assessment data are collected every semester through concept inventory instruments given in GEOS 201, 203 and 480 as well as project-based rubrics and nationally-benchmarked exit interviews. A department assessment committee meets each summer to refine assessment instruments and analyze outcomes data. Their report is used by the entire faculty to review curricular effectiveness and (every few years) revise the curriculum for better learning outcomes. A full program assessment is performed during every 5-year departmental review; our next review is currently scheduled for 2015.

## **3. Identify the evaluating entity.**

Student learning outcomes are evaluated by a departmental assessment committee and by the department operating as a committee of the whole during semi-annual day-long retreats. Five-year reviews are evaluated by an external reviewer from a peer institution as well as by the college dean and the staff of the Provost's office before being submitted to PASSHE.

## **Part V. Course Proposals**

Attached are all required course proposals for the above changes.

## **Part VI. Letters of Support or Acknowledgement**

The Geoscience Department respects the need for other programs and departments affected by our proposed program revisions to be suitably informed of these revisions and given the opportunity to express support or lack of support for them. The letters of support or acknowledgement we requested and received are shown below.

## Anthropology Department

February 17, 2014: An email request was sent to the chair regarding changes that make GEOS 204 a possible LS elective for them.

March 7, 2014: A letter of support was received from the chair of the Anthropology Department.

<b>Subject: Letter of Acknowledgement or Support from Anthropology for Geoscience Curriculum Revision edited</b>	Full Headers Raw Message
<b>From:</b> Phil Neusius <phun@iup.edu>	
<b>Date:</b> 03/07/14 03:37 PM	
<b>To:</b> 'Karen Rose Cercone' <kcercone@iup.edu>	
<b>Cc:</b> 'Phillip D. Neusius' <phun@iup.edu>	

Dear Dr. Cercone,

The Anthropology Department fully supports these proposed curriculum revisions in Geoscience. In particular the change for Historical Geology will make this course more accessible to our Anthropology students. Once this new curriculum is approved we will make the necessary adjustments in advising.

Dr. Phil Neusius, Chair  
Anthropology Department  
Indiana University of Pennsylvania  
phun@iup.edu

## Biology Department

February 17, 2014: Email sent to chair regarding changes that make GEOS 204 a possible LS elective for them. A letter of support was requested for the movement of BIOL 201 to a list of controlled electives.

March 7, 2014: A letter of support was received from the chair of the Biology Department.

<b>Subject: Re: Request for Letter of Acknowledgement or Support from Biology for Geoscience Curriculum Change</b>	Full Headers Raw Message
<b>From:</b> Carl Luciano <luciano@iup.edu>	
<b>Date:</b> 03/07/14 12:27 PM	
<b>To:</b> Karen Rose Cercone <kcercone@iup.edu>	
<b>Cc:</b> Carl Luciano <luciano@iup.edu>	

Hi Karen

I officially, enthusiastically and unequivocally offer my unqualified support for the proposed curriculum changes in Geosciences!

Carl Luciano  
Professor and Chair  
Department of Biology  
Indiana University of Pennsylvania

## Chemistry Department

February 17, 2014: Email sent to chair regarding proposed changes in Liberal Studies requirements.

February 21, 2014: The Chemistry Department curriculum committee shared additional information with us about the topics covered in chemistry. As a result, our initial program proposal was revised to incorporate a full year of chemistry in all three B.S. in Geology program tracks in order to promote better student learning outcomes.

February 28, 2014: A second email was sent with a summary of the revised programs.

March 3, 2014: A letter of support was received from the chair of the Chemistry Department.

<b>Subject: Re: Request for Letter of Acknowledgement or Support from Chemistry for Geoscience Curriculum Change</b>	Full Headers
<b>From: George R. Long &lt;grlong@iup.edu&gt;</b>	Raw Message
<b>Date: 03/03/14 02:05 PM</b>	
<b>To: Karen Rose Cercone &lt;kcercone@iup.edu&gt;</b>	

Dear Dr. Cercone,

The Chemistry department wholeheartedly supports the proposed changes to the Geoscience curriculum.

Thank you for considering the questions about your revisions raised by our curriculum committee, and making several suggested changes.

George

--  
Dr. George R. Long  
Professor and Chair  
Department of Chemistry  
Indiana University of PA  
[grlong@iup.edu](mailto:grlong@iup.edu), (724)357-2360

### **Geography and Regional Planning Department**

February 17, 2014: Email sent to chair regarding changes that make GEOS 204 a possible LS elective for them. A letter of support was requested for inclusion of additional Geography classes in the list of controlled electives.

April 2, 2014: A letter of support was received from the chair of the Geography Department.

<b>Subject: Re: Request for Letter of Acknowledgement or Support from Geography for Geoscience Curriculum Revision</b>	Full Headers
<b>From: "John Benhart, Jr. &lt;jbenhart@iup.edu&gt;</b>	Raw Message
<b>Date: 04/02/14 04:49 PM</b>	
<b>To: Karen Rose Cercone &lt;kcercone@iup.edu&gt;</b>	

Karen,

The Department of Geography & Regional Planning supports your curriculum revision creating more Geography course options for your students to complete their Geology degree requirements. Thank you for making us aware of your proposal, and its potential impacts on our courses. John

John Benhart, Jr. Ph.D.  
Professor and Chair  
Department of Geography & Regional Planning  
Indiana University of Pennsylvania (IUP)  
421 North Walk, Rm 9 Leonard Hall  
Indiana, PA 15705-1087  
Email: [jbenhart@iup.edu](mailto:jbenhart@iup.edu)  
Phone: 724.357.7652

### **Mathematics Department**

March 3, 2014: Email sent to chair regarding proposed shift of MATH 216 from a controlled elective to an Ancillary Science option.

April 4, 2014: A letter of support was received from the chair of the Math Department.

▼ **Subject: RE: Reminder: Request for Letter of Support / Acknowledgement for Geoscience Curriculum Revision** Full Headers  
Raw Message  
**From:** Francisco E. Alarcón <falarcon@iup.edu>  
**Date:** 04/04/14 01:12 AM  
**To:** 'Karen Rose Carcone' <kcarcone@iup.edu>  
**Cc:** "Alarcon, Francisco E." <Francisco.Alarcon@iup.edu>

Karen,

Sorry for the delay, in principle we are supportive of the request. I do have to say that while we offer MATH 216 every semester (at least 3 sections per year) in the past few years every section offered has been full to the room capacity.

Francisco E. Alarcón, Ph. D.  
Chairperson and Professor  
Department of Mathematics  
233 Stright Hall  
Indiana University of PA

Indiana, PA 15705  
Phone: 724-357-2608

## Physics Department

February 17, 2014: Email sent to chair regarding proposed changes in Liberal Studies requirements.

February 17, 2014: A letter of support was received from the chair of the Physics Department.

February 28, 2014: After changes were made to the program which involved physics as well as chemistry, a second email was sent to the chair summarizing the revisions.

March 7, 2014: A final letter of support was received from the chair of the Physics Department.

▼ **Subject: Re: Request for Letter of Acknowledgement/Support from Physics for Geoscience Curriculum Revision** Full Headers  
Raw Message  
**From:** talwar@iup.edu  
**Date:** 03/07/14 08:45 AM  
**To:** Karen Rose Carcone <kcarcone@iup.edu>, Devki Talwar <Devki.Talwar@iup.edu>

Hello Karen,  
I support the Geoscience curriculum package and changes

Devki



**APPENDIX ONE: EXAMPLE OF A 4-YEAR ENERGY RESOURCES TRACK COURSE SEQUENCE**

(NOTE: This is the actual planned departmental course rotation including upcoming sabbaticals)

**Freshman Year Core Courses**

FALL 2014	SPRING 2015
	GEOS 201 Foundations of Geology (JCL)
GEOS 204 (351) Historical Geology (KRC)	GEOS 310 Environmental Geology /W (TBA)
GEOS 301 Mineralogy/Petrology (NDD)	GEOS 323 Geophysics (KSC)
GEOS 312 Hydrogeology (TBA)	GEOS 352 Sediment./Stratigraphy /W (JFT)
GEOS 341 Planetary Geology (KSC)	GEOS 363 Volcanology (NDD)
GEOS 355 Sedimentary Petrology (JFT)	GEOS 371 Meteorology /W (SAH)
	GEOS 470 Research Methods (ND)
	GEOS 480 Seminar (KRC)
	Summer 2015: Field Geology (JCL / others)

**Sophomore Year Core Courses**

FALL 2015	SPRING 2016
GEOS 201 Foundations of Geology (JFT/ND)	GEOS 201 Foundations of Geology (JFT)
GEOS 202 Quantitative Methods (KLF)	GEOS 203 Surficial Processes (KLF)
GEOS 311 Geochemistry (TBA)	GEOS 302 Structural Geology (JCL)
GEOS 345 Igneous & Met Petrology (NDD)	GEOS 370 Oceanography /W (SAH)
GEOS 354 Geomorphology (KLF)	GEOS 324 Geology of Oil & Gas
GEOS 342 Stellar Astronomy /W (KSC)	GEOS 470 Research Methods (KLF)
GEOS 353 Paleontology (JFT)	GEOS 480 Seminar (KRC)
Winter 2016: Carbonate Geology (KRC/TBA)	Summer 2016: Geology of the Pacific Northwest (KSC)

**Junior Year Track Requirements, Controlled Electives and Capstone Courses**

FALL 2016	SPRING 2017
GEOS 201 Foundations of Geology (JCL/ND)	GEOS 201 Foundations of Geology (JCL)
GEOS 202 Quantitative Methods (KLF)	GEOS 203 Surficial Processes (KLF)
GEOS 204 Historical Geology (KRC)	GEOS 301 Mineralogy (NDD)
GEOS 312 Hydrogeology (TBA)	GEOS 310 Environmental Geology /W (TBA)
GEOS 328 Coastal Geology (KLF)	GEOS 323 Geophysics (KSC)
GEOS 341 Planetary Geology (KSC)	GEOS 352 Sediment./Stratigraphy /W (JFT)
	GEOS 371 Meteorology /W (SAH)
	GEOS 470 Research Methods (TBA)
GEOS 363 Volcanology (NDD)	GEOS 480 Seminar (KRC)
	Summer 2017: Geology of Pacific NW (NDD)

**Senior Year Track Requirements, Controlled Electives and Capstone Courses**

FALL 2017	SPRING 2018
GEOS 201 Foundations of Geology (JCL/JFT)	GEOS 201 Foundations of Geology (JCL)
GEOS 202 Quantitative Methods (KLF)	GEOS 203 Surficial Processes (KLF)
GEOS 204 Historical Geology (KRC)	GEOS 301 Mineralogy (NDD)
GEOS 311 Geochemistry (TBA)	GEOS 302 Structural Geology (JCL)
GEOS 342 Stellar Astronomy /W (KSC)	GEOS 324 Geology of Oil & Gas (TBA)
GEOS 345 Igneous & Met Petrology (NDD)	GEOS 370 Oceanography /W (SAH) - Elective 3
	GEOS 470 Research Methods (KLF)
	GEOS 480 Seminar (KRC)
Winter 2018: Carbonate Geology (KRC/TBA)	Summer 2018: Field Geology (JCL / others)

Gray boxes denote courses which would fulfill all Energy Resource Track requirements. Many different courses could have been used as controlled electives, including courses offered by other departments which would add up to the minimum requirement of 10 credits (the total shown here is 11 credits).