Curriculum Proposal Cover Sheet – form is available on-line as an interactive PDF

LSC Use Only Proposal No: LSC Action-Date: App- 9/13/12	*UWUCC Use Only* Proposal No: 12-25b. UWUCC Action-Date: AP-10/16/12 Senate Action Date: App-11/6/12

Curriculum Proposal Cover Sheet - University-Wide Undergraduate Curriculum Committee

Contact Person(s) **Karen Rose Cercone**	Email Address **kcercone@iup.edu**
Proposing Department/Unit **Geoscience**	Phone **7- 7650**

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

__X__ Course Revision   _____ Course Number and/or Title Change   _____ Catalog Description Change

Current course prefix, number and full title: ***GEOS 102 The Dynamic Earth Lab***

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

2. Liberal Studies Course Designations, as appropriate

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

_____ Learning Skills __X__ 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
APR 20 2012
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:

Proposed program name, if changing:

5. Approvals	Signature	Date
Department Curriculum Committee Chair(s)	[signature]	4/13/12
Department Chairperson(s)	[signature]	4/13/12
College Curriculum Committee Chair	Anne Kondo	4/20/12
College Dean	[signature]	4/20/12
Director of Liberal Studies (as needed)	[signature]	9/14/12
Director of Honors College (as needed)		
Provost (as needed)		
Additional signature (with title) as appropriate		
UWUCC Co-Chairs	Gail S Sechrist	10/25/12

Part II.

1) Syllabus of Record

I. Catalog Description

GEOS 102 The Dynamic Earth Lab 0c-2l-1cr

Prerequisites: No Geoscience Majors/Minors

Corequisite: GEOS 101

Introduces the techniques geologists use to study the earth and reconstruct its past. Labs cover minerals, rocks, map interpretation, fossil identification and may include field trips during the scheduled lab period.

II. Course Outcomes and Assessment (Expected Undergraduate Student Learning Outcomes)

Objective 1:

Students will learn what the scientific method is and apply it to questions of plate tectonics and topographic map interpretation.

Expected Student Learning Outcomes 1 and 2

Informed and Empowered Learners

Rationale:

The scientific method forms the basis for all investigations into the Earth's current state and past history. Students will create their own hypotheses and then test them in lab using their own critical observations of tectonic and topographic maps.

Objective 2:

Students will investigate the environments and processes which form the three major rock types (igneous, metamorphic and sedimentary and then learn how to interpret the historical rock record in terms of ancient environments, tectonic events and global climate changes.

Expected Student Learning Outcomes 1 and 2

Informed and Empowered Learners

Rationale:

Rocks hold the record of the Earth's geologic past in their structures, fossil content and composition. Course assignments and content will engage students in the critical interpretation of rocks, strengthening their ability to reconstruct past events based on their own observations.

Objective 3:

Students will examine stratigraphic sections using tools such as cross-bed inclination, unconformity geometry, rock deformation and fossil content in order to determine the relative age and geologic history of the sequence.

Expected Student Learning Outcomes 1 and 2

Informed and Empowered Learners

Rationale:

The order in which geologic events occur is a key component of reconstructing the ancient past. Assignments and course content will require students to master interpretive tools such as cross-bed inclination, unconformity geometry, rock deformation and fossil content in order to answer hypothetical questions that involve the relative age and geologic history of rock sequences.

Objective 4:

Students will examine the impact of rock folding and faulting on the map patterns of rock units throughout the state of Pennsylvania and elsewhere, and interpret them to deduce the underground structures of weakness that might be present.

Expected Student Learning Outcomes 1 2 and 3

Informed, Empowered and Responsible Learners

Rationale:

The ability to decipher map patterns and imagine the underground earth structures that create them will allow students to become empowered consumers when they are faced with the choice of where to purchase a home or whether to support an economic development activity near their home.

III. Course Outline

Lab 1: Scientific method and plate boundaries	2 hours
Lab 2: Topographic maps	2 hours
Lab 3: Mineral identification	2 hours
Labs 4 - 6: Rock identification and interpretation	6 hours
Lab 7: Exam One	2 hours
Lab 8: Principles of stratigraphy and geologic time	2 hours
Lab 9: Fossil identification and ancient environments	2 hours
Labs 10: Field trip to a fossiliferous rock outcrop	2 hours
Lab 11: Geologic maps and structures	2 hours
Lab 12: Earthquakes	2 hours
Lab 13: Reconstruction of dinosaur stride and morphology	2 hours
Lab 14: Exam Two	2 hours

IV. Evaluation Methods

Each component of the course will contribute to final grade according to:

Exam 1	25%
Exam 2	25%
In Class Assignments	30%
Quizzes	20%
Total	100%

V. Example Grading Scale

The final grade for this course will be determined using the following schedule:

A=90-100%; B=80-89%, C=70-79%, D=60-69%, F=<60%

VI. Attendance Policy

The attendance policy will conform to IUP's undergraduate course attendance policy as outlined in the undergraduate catalog.

VII. Required textbooks, supplemental books and readings

Text: Lutkins, Frederick K., Tarbuck, Edward J. and Tasa, Dennis, 2011, Essentials of Geology 11th Edition: Prentice Hall, 576 pages.

Lab Manual: IUP Instructors lab manual available at Pro-Packet (varies by instructor)

VIII. Special resource requirements

There are no special resource requirements for this course.

IX. Bibliography

In addition to the required textbooks and supplemental readings from science journals, the following will be used to develop the course curriculum:

Asher, Pranoti, 2001, Teaching an Introductory Physical Geology Course to a Student with Visual Impairment. *Journal of Geoscience Education*, v49 n2 p166-69.

Fletcher, Chip, 2011, Introducing Critical Thinking to the Physical Geology Classroom. Wiley Faculty Network Peer-Reviewed Guest Lecture(Feb 17, 2011). Web Archive: https://wiley.adobeconnect.com/_a44433639/p224esq32s3/

Liben, Lynn S., Karstens, Kim A. and Christensen, Adam, 2011, Spatial Foundations of Science Education: The Illustrative Case of Instruction on Introductory Geological Concepts. *Cognition and Instruction*, v29 n1 p45-87.

Lutkins, Frederick K., Tarbuck, Edward J. and Tasa, Dennis, 2010, Earth: An Introduction to Physical Geology 10th Edition: Prentice Hall 744 pages.

Marshak, Steve, Wilkerson, M. Beth & Wilkerson, M. Scott, 2009, Essentials of Geology 3rd Edition: Norton, 776 pages.

Wicander, Reed, and Monroe, James, 2008, Essentials of Physical Geology 5th Edition: Brooks Cole, 503 pages.

2. SUMMARY OF PROPOSED REVISIONS

1. Objectives – course objectives were modified from the 1995 syllabus of record and aligned with the Expected Undergraduate Student Learning Outcomes (EUSLO).

2. Common Learning Objectives for a laboratory Natural Science course were incorporated into the content of the course. These objectives include: understand a body of knowledge in a science domain; understand that science knowledge is generated by an empirical approach to nature and analyze problems from the perspective of a natural scientist; demonstrate an understanding of intellectual honesty in the context of scientific methodology, and contrast science with pseudoscience; understand how science knowledge is relevant to non-scientists and use critical thinking skills and scientific methodology.

3. Updated text to a more current book and also updated the bibliography.

3. JUSTIFICATION/RATIONALE FOR REVISIONS

The course is a currently approved for both Liberal Studies Non-Laboratory Natural Science and Laboratory Natural Science (in conjunction with its companion course GEOS 102). Both courses are being revised to meet the new curriculum criteria.

4. OLD SYLLABUS OF RECORD (attached)

Part III. Letters of Support or Acknowledgement

None attached.

Liberal Studies Course Approval General Information

1. This course was developed and has been taught by many different instructors in the department. During a single semester, the course is generally taught in several sections by multiple instructors. Occasionally, one instructor may teach two sections, or two sections may be taught by two different instructors. Instructors frequently consult and collaborate on syllabi, textbooks and assignments for this course.

2. Readings taken from Vassar College Professor Jill S. Schneiderman's collection of essays entitled "The Earth Around Us: Maintaining a Livable Planet" [W.H. Freeman and Company: New York, 2000, 455p.; ISBN 0-7167-3397-8] will showcase contributions that female scientists have made to geology. Authors published in this collection include Marcia Bjornerud (Lawrence University), Allison McFarlane (George Mason University), Cathryn Manduca (Carleton College), Kirsten Menking (Vassar College), Naomi Oreskes (University of California at San Diego), and Jill Singer (Buffalo State University).

3. In addition to the textbook "Essentials of Geology", the class will read a variety of government and university web-sites (updated each term) to engage in interactive learning about plate tectonics, mineral resources, earthquakes, fossils and maps.

4. This course introduces students to the fundamental techniques that geologists use to make interpretations of earth features. This course is intended to give students enough knowledge of earth science and the scientific method to permit them to make informed and responsible decisions. The strong emphasis on how nature impacts human civilization and how human activity in turn affects nature makes this course very different from our majors courses such as GEOS 201, 202 and 203 that go into more detail and depth about the materials and evidence required for actual geologic investigations.

Example Assignment and Grading Rubric

Lab 6: Geologic Time

Wouldn't it be great to have a time machine, so we could go back in time and study extinct animals like trilobites and dinosaurs when they were still alive? Well, since we can't do that, we have to figure out a way to "tell time" for the Earth's past from evidence that we can still find today.

Geologists have figured out many different ways to "tell time" based on the rocks and fossils that have survived from the Earth's past. Some of these methods are good for certain kinds of rocks (IE, sedimentary), but not for others. Other methods work well for very old rocks, but not for younger rocks. Our lab today will cover some of the main methods of **Age Dating** and also introduce you to the **Geologic Time Scale**, a "calendar" of time periods which geologists have constructed by dating millions of fossils and rocks around the world. By the end of lab, you should be able to put rock layers in order by age, a skill you will use next week on our field trip.

I. RELATIVE AGE DATING

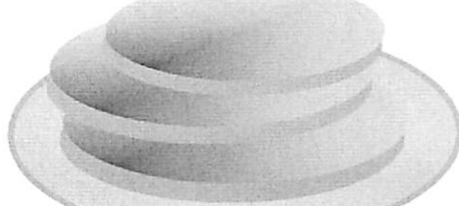
Do you know exactly how old your grandmother is? How about your grandfather? If not, do you at least know whether your grandmother is older or younger than your grandfather? In that case, you have already figured out how to do "Relative Age Dating" -- you can put your relatives in order by their age, even if you don't know their exact age in years. We can do the same thing with rock layers.

A. Superposition

When you see several rock layers stacked up at a single location, you know they probably didn't all form at one time. To figure out what order they formed in, it's helpful to first make yourself some pancakes. Answer the following 'Comprehension Questions':

Which pancake did you put on the plate first?
Is this the oldest or youngest pancake?

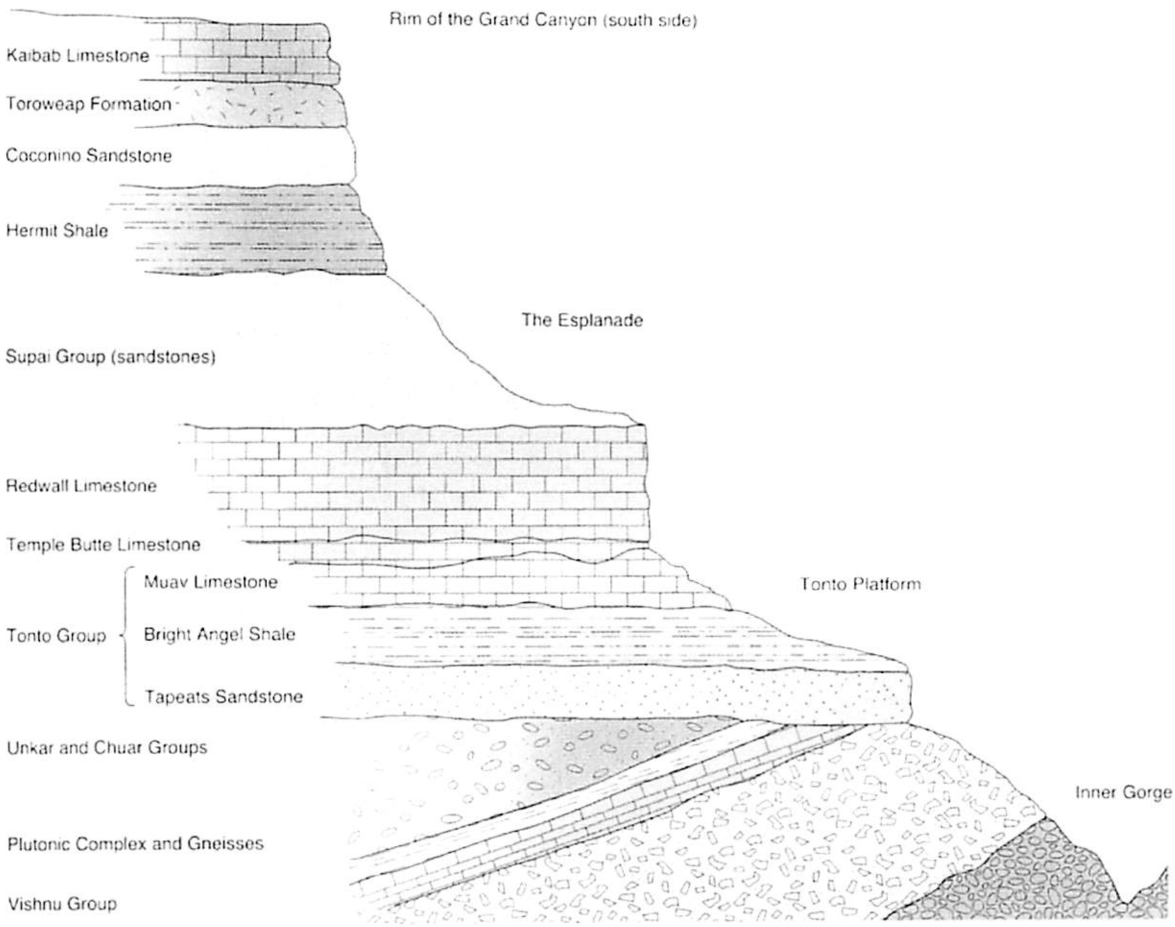
Which pancake did you put on the plate last?
Is this the oldest or youngest pancake?



This method of dating rocks is called THE PRINCIPLE OF SUPERPOSITION and it was discovered back in the 1600's by Nicolai Steno. It states that the rock layer at the bottom of a stack will be the OLDEST and the rock layer at the top of a stack will be the YOUNGEST. Each rock layer in between will have an intermediate age....younger than the rocks below it, older than the rocks above it. We can use this principle to put rock layers into the correct order as long as we are sure that they are right-side up.

Exercise One

Number the rock layers in the Grand Canyon from oldest (1) to youngest (15).



Answer the following Application Questions:

Which rock layer is the oldest of them all? ____________________

Which rock layer is the youngest of them all? ____________________

Answer the following Synthesis Question:

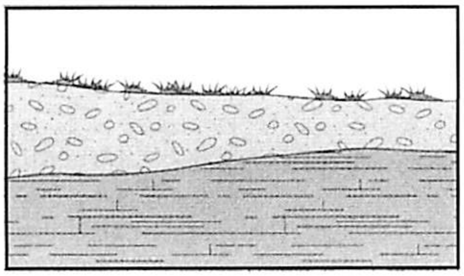
This is a nice, easy way to date rocks....but what limitations can you see to using this principle to date all the rocks in the world?

B. Unconformities

The sedimentary rock layers at the Grand Canyon create a record of ancient time periods, but it's not a complete record. That's because rocks do not form all the time, so not every time period from the past is represented in the rock record. Long periods of time can pass without making any rocks (or fossils). Even if some rocks are formed, later uplift and mountain-building can erode and destroy them. Sometimes, erosion is so severe that it strips off all the sedimentary rocks in an area, right down to the crystalline igneous basement. In this case, we lose all the information that was contained in those rocks.

These "gaps" or periods of "missing time" are known as **UNCONFORMITIES**.

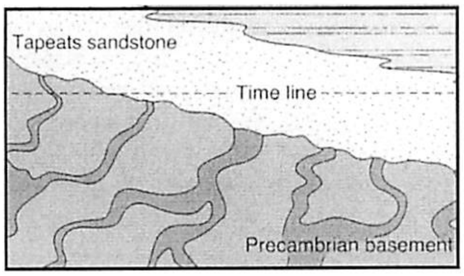
Exercise Two
Each of the following unconformities tells us something different about what happened during the period of time whose record has been lost. Demonstrate your comprehension of these features by matching each picture with the correct interpretation:

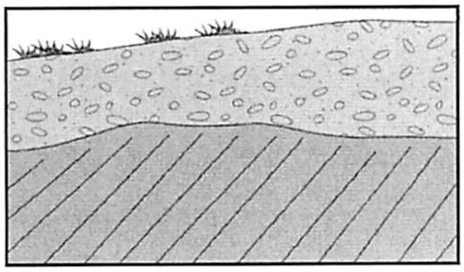


I. During this period of missing time, an episode of mountain building caused older rock layers to become faulted or folded.

II. During this period of missing time, sediment formation was shut off, but no mountain-building occurred.

III. During this period of missing time, uplift and erosion destroyed a large portion of the sedimentary rock record.





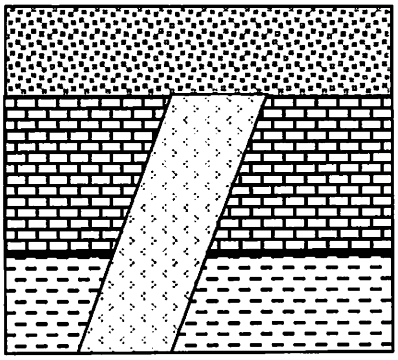
C. Cross-Cutting Relations

Since there are many rocks that do NOT form in layers, we need to have some other tools in our dating tool-chest to assign them all relative ages. One thing that can be very useful for igneous rocks is to see what rocks they cross-cut. In order for an igneous vein or pluton to intrude into some other rocks, those other rocks must already pre-exist. If we see an igneous vein cutting across other rocks, we know those rocks must be OLDER than the igneous rock. This is known as the PRINCIPLE OF CROSS-CUTTING RELATIONS.

Answer the following Application Questions:

Exercise Three

Put the rocks below in order by age from oldest (1) to youngest (4). Be careful!



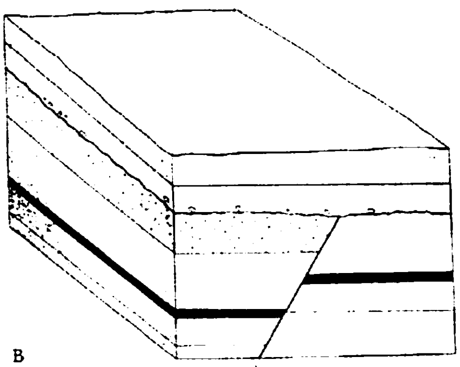
← What do you think might have happened here?

Is there a single right answer to this question?

You can also use cross-cutting relations to determine whether a fault moved before or after a rock was formed. If the fault cuts and moves the rock, it must be YOUNGER than the rock; if the fault is CUT BY the rock and does not appear to move it, it must be OLDER than the rock.

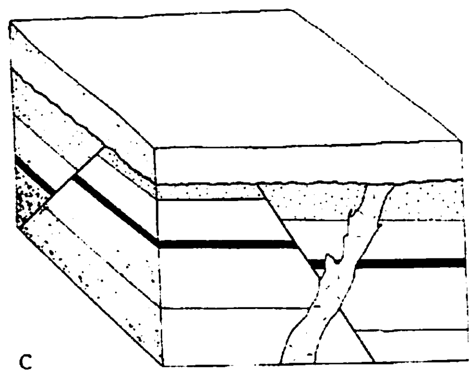
Exercise Four

Which is older in the diagram below, the fault or the dark rock layer?



B

Which is older in the diagram below, the fault or the igneous intrusion?



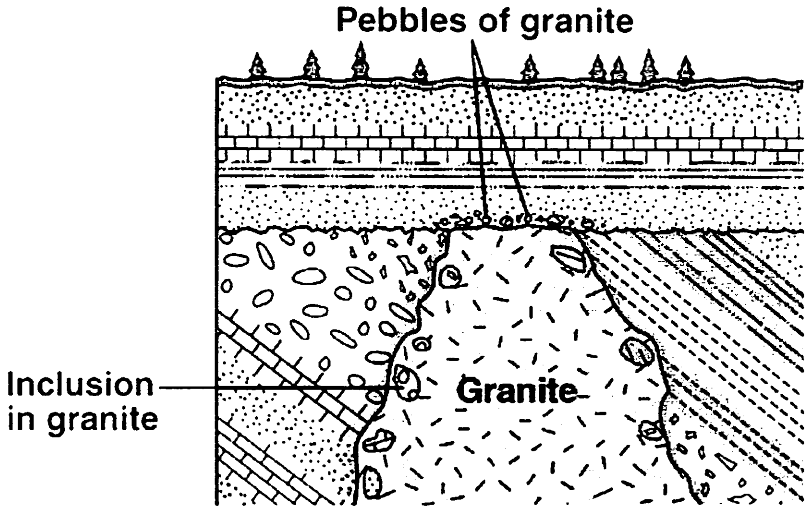
C

D. Included Pieces

Another way you can compare two rocks to each other determine their relative age is to see whether one rock includes pieces of the other. The rock which broke into pieces before the younger rock formed around it has to be the older of the two.

Exercise Five

Answer the following Synthesis Questions about how one rock can become included in another. Describe the geologic events which must have occurred to produce each of these examples.



Example 1: inclusions of conglomerate in granite:

Example 2: pebbles of granite included in sandstone:

Exercise Six

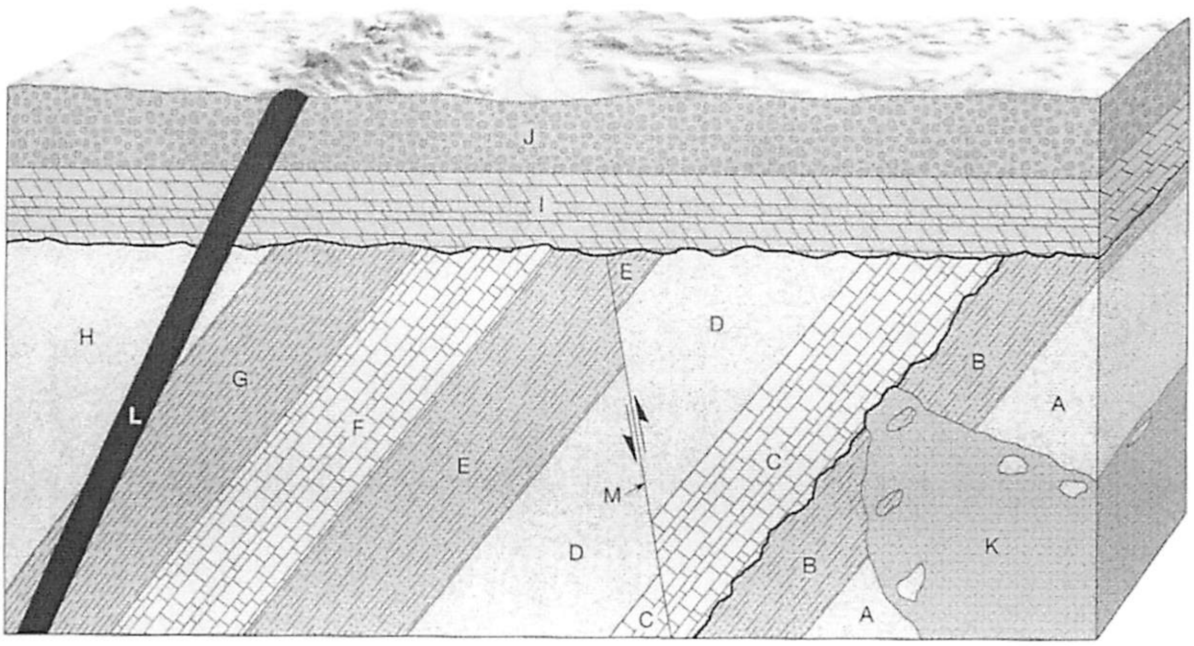
Examine the rock samples placed around the classroom and determine which of the two rocks is older and which is younger, on the basis of included pieces. (This is an Application Question)

Sample 1:

Sample 2:

Exercise Seven

Using all of the principles of relative age dating, can you give a relative date (1=oldest, 13 =youngest) to every lettered feature in this block diagram on the next page? Be sure to look carefully at included pieces and cross-cutting relations. You can assume that K and L are igneous intrusions, and that none of the rocks are upside-down. This is an Application Question.

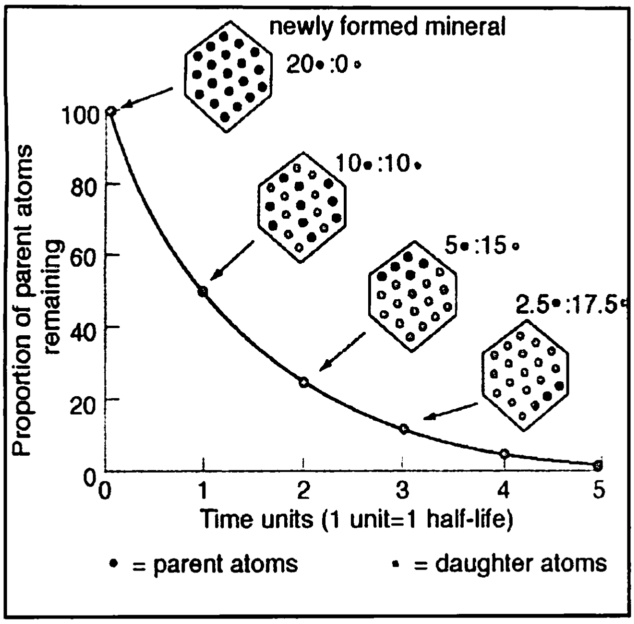


Can you be absolutely sure that you put fault M and rocks F, G & H in the right order relative to each other? Why or why not? This is a Synthesis Question.

III. ABSOLUTE AGE DATING

In addition to putting geologic features in relative order, we can also give many of them an age in years, also known as an absolute age. We do this by measuring tiny amounts of radioactive elements that are stored inside certain minerals. Unlike normal chemical elements, which remain the same no matter how old they are, radioactive elements decay or change into new elements. These new elements may or may not also be radioactive. We call the original elements the **PARENTS** and we call the newly-formed elements the **DAUGHTERS**.

Radioactive decay is unlike many other natural processes because it is non-linear. That means that the change from parent to daughter occurs much faster at first, but then gradually slows down through time. The result is that radioactive elements hang around for a very long time, often millions of years, which is why nuclear waste disposal is such a controversial topic.



Even though it is non-linear, the conversion of parent material to daughter material can be measured and predicted. We often use a concept called "half-life" to describe the way that radioactive elements decay.
A half-life is the amount of time it takes for exactly one-half of the parent material present in a mineral to turn into daughter material. Each time a "half-life" of time passes, the amount of parent is cut in half and the amount of daughter product increases by the same amount.

Answer the following Comprehension Questions:

Exercise Eight

1. If you started out with 1 gram of parent element, how much would be is left after one half-life of time had passed?

2. How much of the original parent element would be left after two half-lives?

3. How much new daughter element would you have made after two half-lives?

4. If the half life for this element was 10 years, and you found a mineral with 0.125 grams of parent element and 0.875 grams of daughter element, how old would that mineral be?

Exercise Nine

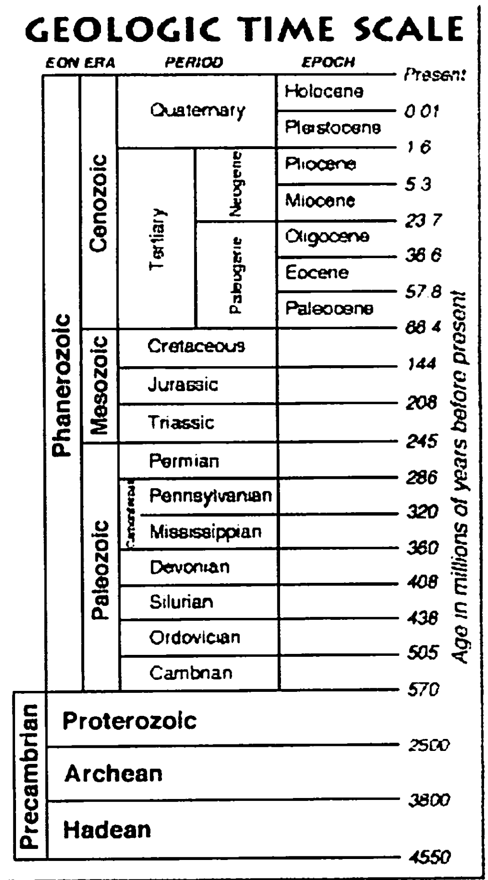
If our class was a mineral and every student was a radioactive element with a half-life of one year, when would it be safe to come back into the lab room? Model this process by standing up if you are radioactive and sitting down once you have decayed to a non-radioactive state. The instructor will call out the half-lives based on your birthdays. How many years does it take to lose all radioactivity? (This is a Comprehension Question.)

Not every rock contains minerals which are rich enough in radioactive elements to be dated this way. An additional complication is that some radioactive elements decay quickly (over thousands of years) while others decay slowly, over millions or even billions of years. This makes certain dating systems much better for young rocks while others are much better for older rocks. Fill in the following chart to demonstrate your Comprehension of radiometric dating systems.

Name of Dating System	Half-life of Parent Element	Source Materials	Dating Range	Better for old or young rocks?
Uranium-lead	4.46 billion years	Zircon, Sphene, Apatite	>100 million years	
Potassium-argon	1.25 billion years	Biotite, Muscovite, K-Feldspar	>100,000 years	
Rubidium-strontium	48.8 billion years	Biotite, Muscovite, K-Feldspar	>100 million years	
Carbon-14	5730 years	Organic Matter	<50,000 years	

III. GEOLOGIC TIME

Once enough rocks and fossils around the world have been dated by relative and absolute age dating, we can construct a "calendar" of geologic ages, shown schematically to the right. Answer the following Comprehension, Application and Synthesis Questions.



Exercise Ten

1. The dinosaurs lived from 245 to 66.4 million years ago. What periods of time make up the Age of Dinosaurs?

2. Pennsylvania's state fossil, the trilobite, dominated the Cambrian Period. How long ago did it live?

3. How old do you think most of the rocks around Indiana PA are? (Hint: look for our name on the chart!)

One problem with these kinds of time charts is that they don't show how much of the earth's past history passed BEFORE any recognizable large life-forms had evolved. It took billions of years for the first primitive life-forms to slowly evolve in the ocean, and it has only been fairly recently that land plants and animals appeared in the fossil record.

Lab Grading Rubric

	Excellent (5 points)	Good (3 to 4 points)	Unsatisfactory (0 to 2 points)
Comprehension Pts _____	Student answers all comprehension questions clearly and with specific details.	Student answers all comprehension questions with only minor errors and/or with fewer details.	Student answers some comprehension questions incorrectly or does not answer at all.
Application Pts _____	Student answers all principle application questions clearly and with specific details.	Student answers all principle application questions with only minor errors and/or with fewer details.	Student answers some principle application questions incorrectly or does not answer at all.
Synthesis Pts _____	Student answers all synthetic questions clearly and with specific details.	Student answers all synthetic questions with only minor errors and/or with fewer details.	Student answers some synthetic questions incorrectly or does not answer them at all.

Old Syllabus of Record

GS 102 The Dynamic Earth Lab

I. Catalog Description:

GS 102 The Dynamic Earth Lab — 1 credit, 2 lab hours (0c-2l-1sh)

Pre-requisite: No Geoscience Majors/Minors
Co-requisite: enrollment in GS 101

Introduces students to the techniques geologists use to study the earth and reconstruct its past. Labs cover minerals, rocks, map interpretation, fossil identification. Includes field trips during the scheduled lab period.

II. Course Objectives

1. Students will learn the techniques used to identify rocks and minerals, and employ them to reconstruct ancient tectonic activity.
2. Students will learn to identify fossils and use them to recreate the earth's ancient environments and life-forms.
3. Students will learn to read geologic and topographic information from maps and apply those techniques to actual localities out in the field.

III. Course Outline

A. Rock & Mineral Identification (4 labs)
- Minerals
- Igneous Rocks
- Sedimentary Rocks
- Metamorphic Rocks

B. Map Skills (2 labs)
- Topographic Maps
- Geologic Maps & Cross-Sections

C. Midterm Exam (1 lab)

D. Fossils & Environments (3 labs)
- Invertebrates
- Vertebrates & Plants
- Dinosaur Trackways

E. Field Excursions (3 labs)
- Sedimentation
- Fossil Collecting
- Environmental Geology

F. Final Exam (1 lab)

IV. Evaluation Methods

30% Quizzes. Eight ten-point quizzes will cover previous week's lab or field trip.

70% Two non-cumulative lab exams, worth one-hundred points each. Exams will consist of sample identification, short essay and map-based questions. Tests will be adjusted to a mean of 75% so that 90-100%=A; 80-89%=B; 70-79%=C; 60-69%=D; below 60%=F. The same scale will be used for the final point score.

V. Required textbooks, supplemental books and readings:

The IUP Dynamic Earth Lab Manual (Course Packet). This lab manual was locally developed to take advantage of the unique local geology of the area around IUP. Nationally published lab manuals were consulted during the development process to ensure quality, parity and relevance to national trends in the geological sciences.

VI. Special resource requirements: None

VII. Bibliography:

Foster, R.J., 1991, GEOLOGY (6th Ed), Columbus: Merrill Publishing, 228 pp.

Laing, D., 1991, THE EARTH SYSTEM: AN INTRODUCTION TO EARTH SCIENCE: Dubuque: Wm. C. Brown, 590 p.

Tarbuck, E.J. and Lutgens, F.K., 1994, EARTH SCIENCE (7th Edition). New York: McMillan College Publishing Company, 755 p.

Thompson, G.R., Turk, J. and Levin, H.L., EARTH PAST AND PRESENT: AN ENVIRONMENTAL APPROACH. New York, Saunders College Publishing, 663 p.