GEOLOGY TRANSFER ASSURANCE GUIDE (TAG)
April 24, 2017

Ohio Transfer Module:

Ohio Transfer Module (OTM) Requirements: 36-40 semester hours. Students should select courses within the OTM that complement the selected major and meet any specific general education requirements. Students are encouraged to complete the OTM to ensure maximum transferability and application of credits.

Required Disciplines	Minimum Required Hours	Recommended Courses
Area I. English Composition	3 Semester Hours	
Area II. Mathematics	3 Semester Hours	Calculus I (TMM005)
Area III. Arts & Humanities	6 Semester Hours	
Area IV. Social Sciences	6 Semester Hours	
Area V. Natural & Physical Science	6 Semester Hours	General Chemistry I (Co/Prerequisite) & II sequence w/labs for major (OSC008 & 009) Calculus-Based Physics I w/lab (OSC016)

Additional courses beyond the minimum required hours, from any of the disciplines listed above, will count toward the completion of the OTM (36-40 semester hours).

Foreign Language - Demonstrate competencies through the 200 level. Credits: Up to 16 semester hours.

Major Courses – Hours/Courses listed below that count toward the major or pre-major requirements

OSC025 – Physical Geology with Lab	Credits: 4 Semester Hours
Advising Notes:	
OSC026 – Historical Geology with Lab	Credits: 4 Semester Hours
Advising Notes:	
OSC027 – Mineralogy with Lab	Credits: 4 Semester Hours
Advising Notes: Prerequisite of Physical Geology with Lab (OSC025) or an equivalent course AND Corequisite or Prerequisite of General Chemistry I (OSC008)	

Transfer Assurance Guides Total Guaranteed Credits (Range)	
Ohio Transfer Module (OTM)	36 – 40 Semester Hours
Foreign Language	0 – 16 Semester Hours
Pre-major/Major	0 – 12 Semester Hours

Institutional Requirements: For entrance and graduation, a transfer student must meet all institutional requirements which would include, but may not be limited to: minimum grade point average, residency requirements, upper division credits attained, minimum grades in specific courses, performance requirements (ex. dance, music) and other requirements of native students from the same institution.

OSC025 – Physical Geology with Lab
4 Semester Hours

Suggested Textbook Topics:
Minerals; Rocks and fossils; Igneous rocks and activity; Weathering, erosion and mass wasting; Igneous, sedimentary and metamorphic rocks; Earthquakes and the Earth's interior; Plate tectonics; Radiometric dating; Solar Nebula Theory; and Water systems - running water and ground water.

Related TAG: Geology

General Course Description:
Earth's interior, theory of plate tectonics and the rock cycle. Internal processes: plate tectonics and the formation of geologic structures; volcanoes, earthquakes, and mountain building. Surface processes: weathering, erosion, and mass wasting. Hydrologic cycle and changing landscapes. Energy and mineral resources. Laboratory component stresses introduction to and use of basic scientific methods and problem solving.

Statewide Learning Outcomes:

A minimum of 70% of the Student Learning Outcomes, including essential outcomes marked with an asterisk (*), must be met.

Students will be able to:

1. **Utilize the methods of scientific inquiry.***
2. Explain characteristics of Earth systems, such as climate change.
3. Recognize properties and classification of Earth materials and natural resources and understand their formation.
4. Describe surficial processes and their rates including weathering, erosion, and landform evolution.
5. Recognize glacial and hydrologic systems and features.
6. **Demonstrate an understanding of the development and application of the theory of plate tectonics.***
7. Describe and recognize applications and impacts of Earth sciences to society.
8. Explain the origin of the Earth in the context of the Solar Nebula Theory and deep time as confirmed by radiometric dating.

Lab Course Learning Outcomes:

9. **Describe and recognize physical samples of minerals and rocks and interpret topographic and geologic maps.***
10. Demonstrate proper and safe use of experimental techniques and tools/instruments.

OSC026 – Historical Geology with Lab
4 Semester Hours

Suggested Textbook Topics:
General understanding of the basic geologic concepts; portrayal of evolution in the fossil record; Solar Nebula Theory, geologic time, and radiometric age dating; and physical, chemical, and organic evolution in the pre-Cambrian, Paleozoic, Mesozoic, and Cenozoic.

Related TAG: Geology

General Course Description:
The scientific origin of the Earth in space and the scientific origin of life and its evolution. Physical and biological evolution of the oceans, atmosphere, and continents through geologic time. Lab component stresses further application of scientific methods and problem solving.

Statewide Learning Outcomes:

A minimum of 70% of the Student Learning Outcomes, including essential outcomes marked with an asterisk (*), must be met.

Students will be able to:
1. Explore methods of scientific inquiry.
2. Understand the physical and chemical origin and evolution of the earth.
3. **Understand the Earth's origin and evolution of life in the context of the Solar Nebula Theory, the biological theory of evolution, and deep time.***
4. Explain scientific methods of relative and absolute age dating.
5. Interpret geologic history using rocks, fossils, and geologic maps.
6. Understand the evolution of significant geological concepts.

Lab Course Learning Outcomes:
7. **Identify fossils and their temporal and environmental significance.***
8. Demonstrate proper and safe use of experimental techniques and tools/instruments.
9. **Reconstruct geologic history using age-dating methods, geologic maps, rocks, and fossils.***

OSC027 – Mineralogy with Lab
4 Semester Hours

Co-requisite or Pre-requisite: General Chemistry I (OSC008)
Pre-requisite: Physical Geology with Lab (OSC025) or an equivalent course

Suggested Textbook Topics:
Atomic structure and bonding, Crystallography, Crystal chemistry, and Systematic mineralogy.

Related TAG: Geology

General Course Description:
Occurrence, associations, characteristics, crystallography and crystal chemistry of common minerals. Laboratory identification emphasizing physical properties.

Statewide Learning Outcomes:

A minimum of 70% of the Student Learning Outcomes, including essential outcomes marked with an asterisk (*), must be met.

Students will be able to:

1. **Demonstrate an understanding of physical properties and classification of minerals and mineral systems and their relevance to society.***
2. Demonstrate an understanding of atomic structure and bonding.
3. Demonstrate an understanding of basic crystal chemistry and crystallography.
4. Interpret phase diagrams and mineral stability.
5. Identify mineral associations relative to their geological environment.

Lab Course Learning Outcomes:

6. Develop skills in optical microscopy and/or other instrumentation through observation of physical geological materials.
7. **Identify and classify minerals and mineral groups.***
8. Demonstrate proper and safe use of experimental techniques and tools/instruments.

OSC023 – General Chemistry I and II Course Sequence (Revised 9/30/2016)
(A Combination of OSC008 and 009)
8-10 Semester Hours

OSC008 – General Chemistry I (with Lab)
4-5 Semester Hours
***Prerequisite*:** Proficiency with algebra

***Suggested Textbook Topics*:** Lecture to include a standard modern general chemistry text designed for a full-year sequence of general chemistry for science majors

Related TAGs: Biology, Bioengineering, Chemical Engineering, Chemistry, Geology, Physics

***General Course Description*:**
An introduction to the fundamental principles of chemistry, including measurement and calculation; chemical stoichiometry; the properties of gases; atomic and molecular structure; bonding; thermochemistry; and periodic properties.

Note: These core competencies were aligned with the American Chemical Society (ACS) recommendations in mind. All experimental chemistry lab work must be performed in a traditional hands-on lab setting, and will build on topics covered in the corresponding lecture course.

Students must be proficient in all of the following core competencies:

1. Significant figures
2. Fundamental structures of atoms and molecules
3. Nomenclature
4. Principles of ionic, covalent and metallic bonding, including Lewis structure, hybridization, and valence bond and molecular orbital theories
5. Stoichiometry
6. Chemical reactions (acids and bases, oxidation-reduction, precipitation, etc.)
7. Solutions and concentrations
8. Thermochemistry
9. Electronic configuration and atomic orbitals
10. Elemental classification and periodicity
11. Behavior of gases
12. Societal applications of chemistry
13. Chemical problem solving using algebraic methods

Lab Course:

Students must be proficient in all of the following core competencies:

14. Analytical and preparative skills
15. The ability to effectively collect, analyze and report data
16. Safe laboratory practice

OSC009 – General Chemistry II (with Lab)
4-5 Semester Hours
***Prerequisite*:** General Chemistry I (OSC008)

***Suggested Textbook Topics*:**
Lecture to include a standard modern general chemistry text designed for a full-year sequence of general chemistry for science majors

Related TAGs: Biology, Bioengineering, Chemical Engineering, Chemistry, Geology

***General Course Description*:**
A continuation of the study of the principles of chemistry, including solution properties; acids and bases; chemical equilibrium; thermodynamics; reaction kinetics; and electrochemistry

Note: These core competencies were aligned with the American Chemical Society (ACS) recommendations in mind. All experimental chemistry lab work must be performed in a traditional hands-on lab setting, and will build on topics covered in the corresponding lecture course.

Students must be proficient in all of the following core competencies:

1. Intermolecular forces and phase changes
2. Solutions and colligative properties
3. Chemical kinetics
4. Chemical equilibrium
5. Acid-base and solubility equilibria
6. Thermodynamics (including entropy and free energy)
7. Electrochemistry

8. Descriptive chemistry, including chemical properties and periodic patterns of reactivity
9. Societal applications of chemistry
10. Chemical problem solving using algebraic methods

Lab Course:

Students must be proficient in all of the following core competencies:

11. Analytical and preparative skills
12. The ability to effectively collect, analyze and report data
13. Safe laboratory practice

TMM005 - Calculus I (Updated June 3, 2015)

Typical Range: 4-5 Semester Hours

In a Calculus I course, students should:

- develop mathematical thinking and communication skills and learn to apply precise, logical reasoning to problem solving.
- be able to communicate the breadth and interconnections of the mathematical sciences through being presented key ideas and concepts from a variety of perspectives, a broad range of examples and applications, connections to other subjects, and contemporary topics and their applications.
- experience geometric as well as algebraic viewpoints and approximate as well as exact solutions.
- use computer technology to support problem solving and to promote understanding, as most calculus students, especially those who may take only one semester, profit from the use of a graphing utility and a tool for numerical integration.
- for students in the mathematical sciences, progress from a procedural/computational understanding of mathematics to a broad understanding encompassing logical reasoning, generalization, abstraction, and formal proof; gain experience in careful analysis of data; and become skilled at conveying their mathematical knowledge in a variety of settings, both orally and in writing.

– Adapted from the MAA/CUPM 2004 Curriculum Guide

To qualify for OTM equivalency of TMM005 (Calculus I), a course must cover as a minimum the essential learning outcomes, denoted by an asterisk (*). A Calculus I course may also commonly include some of the listed nonessential learning outcomes. These optional topics should be included only if there is adequate course time to do so beyond giving primary course attention to the essential learning outcomes. At least 70% of the classroom instructional time has to be spent on the essential learning outcomes. The optional learning outcomes are learning experiences that enhance, reinforce, enrich or are further applications of the essential learning outcomes. If review of prerequisite course content is necessary, only a minimal amount of time should be devoted to such review.

The successful Calculus I student should be able to apply the following competencies to a wide range of functions, including piecewise, polynomial, rational, algebraic, trigonometric, inverse trigonometric, exponential and logarithmic:

1. **Determine the existence of, estimate numerically and graphically and find algebraically the limits of functions. Recognize and determine infinite limits and limits at infinity and interpret them with respect to asymptotic behavior.***

2. **Determine the continuity of functions at a point or on intervals and distinguish between the types of discontinuities at a point.***

3. **Determine the derivative of a function using the limit definition and derivative theorems. Interpret the derivative as the slope of a tangent line to a graph, the slope of a graph at a point, and the rate of change of a dependent variable with respect to an independent variable.***

4. **Determine the derivative and higher order derivatives of a function explicitly and implicitly and solve related rates problems.***

5. **Determine absolute extrema on a closed interval for continuous functions and use the first and second derivatives to analyze and sketch the graph of a function, including determining intervals on which the graph is increasing, decreasing, constant, concave up or concave down and finding any relative extrema or inflection points. Appropriately use these techniques to solve optimization problems.***

6. Determine when the Mean Value Theorem can be applied and use it in proofs of other theorems such as L'Hopital's rule.

7. Use differentials and linear approximations to analyze applied problems.

8. **Determine antiderivatives, indefinite and definite integrals, use definite integrals to find areas of planar regions, use the Fundamental Theorems of Calculus, and integrate by substitution.***

OSC016 –Calculus-Based Physics I with Lab for Majors
4-5 Semester Hours
***Co-Requisite*:** Calculus I (TMM005)

***Related TAGs*:** Bioengineering, Biology, Chemistry, Computer/Electrical Engineering, Geology, Industrial Engineering, Math, Physics

Understanding and/application of the following topics using calculus concepts and methods where appropriate:

1. Kinematics – one and two dimensional
2. Vectors – vector Arithmetic
3. Force and Newton's Laws of Motion
4. Work, Energy, Conservation of Energy
5. Linear momentum
6. Collisions
7. Rotational kinematics and dynamics
8. Angular momentum and rotational energy
9. Simple harmonic motion
10. Waves and sound
11. Solid and fluid properties
12. Heat and thermodynamics
13. Kinetic theory of gases

GEOLOGY TAG
FACULTY PARTICIPANTS
September 2016 - April 2017

Name	Institution
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