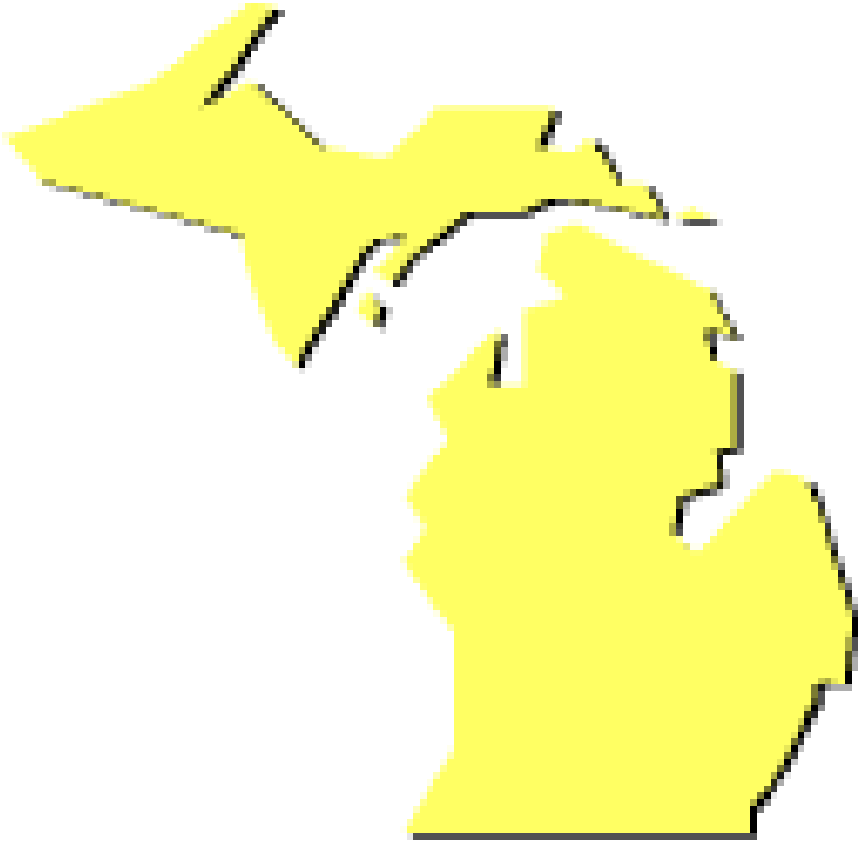
Standards for the Preparation of Teachers
DI
Integrated Science
(Secondary)



Adopted by the Michigan State Board of Education

Standards for the Preparation of Teachers of Integrated Science (Secondary)
DI Endorsement

Preface

Development of the Proposal

Over the last several years, a referent group of professional educators developed a proposal to adopt standards for the preparation of integrated science teachers. These standards align with standards developed by the National Science Teachers Association and the Michigan Curriculum Framework for science education.

A secondary integrated science endorsement prepares candidates to teach integrated science, biology, chemistry, physics, and earth/space science at the secondary level in courses designed to meet the Michigan Curriculum Framework science standards. The preparation of integrated science teachers includes courses of study in each of the three major categories of science identified in the Michigan Curriculum Framework: Life Sciences, Physical Science, and Earth/Space Science. The Secondary Integrated Science Endorsement requires either a group major with a minimum of 36 semester hours distributed among the three major categories for a balance of credits across the areas, or a comprehensive group major with a minimum of 50 semester hours distributed among the three major categories with no additional minor area of study. Candidates who apply for the DI endorsement (secondary) must pass the Michigan Test for Teacher Certification integrated science test at the secondary level for their secondary certificate.

To provide information and gather feedback on the proposal, a copy was also forwarded to selected groups/organizations, all Michigan teacher preparation institutions, and a random sample of intermediate and local school districts for review and comment. As presented in this document, the standards reflect the feedback received.

State Board adoption of these standards typically leads to the creation of a new certification test for teachers prepared to teach secondary integrated science. Test development for a new Michigan Test for Teacher Certification in secondary integrated science will be scheduled according to the recommendation of the Standing Technical Advisory Council.

Approval of Programs

Teacher preparation institutions that wish to continue to offer programs to prepare secondary integrated science teachers are required to submit an application for program approval that demonstrates how the new standards are met throughout the proposed curriculum. The programs must be re-approved to show compliance with the new standards. Following initial approval, the teacher preparation programs will be reviewed every five years through the Periodic Review/Program Evaluation process.

Content Guidelines/Standards Matrix

College/University University of Detroit Mercy **Code** DI

Source of Guidelines/Standards Michigan State Board of Education, August 2002 **Program/Subject Area** Integrated Science (Secondary)

A – Awareness
The integrated science teacher recognizes/recalls the existence of different aspects of integrated science and related teaching strategies.

B – Basic Understanding
The integrated science teacher articulates knowledge about integrated science and related instructional and assessment strategies. The integrated science teacher demonstrates proficiency in using the knowledge at a fundamental level of competence acceptable for teaching.

C – Comprehensive Understanding
The integrated science teacher is able to apply broad, in-depth knowledge of the different aspects of integrated science in a variety of settings. (This level is not intended to reflect mastery; all teachers are expected to be lifelong learners.)

An integrated science endorsement prepares a teacher to teach integrated science at the secondary level in courses designed to meet the Michigan Curriculum Framework science standards. The preparation of integrated science teachers includes courses of study in each of the three major categories of science identified in the Michigan Curriculum Framework: Life Sciences, Physical Science, and Earth/Space Science. The Secondary Integrated Science Endorsement requires a group major with a minimum of 36 semester hours distributed among the three major categories for a balance of credits across the areas. Candidates choosing a secondary integrated science course of study may elect a comprehensive group major earning 50 semester hours distributed among the three major categories with no additional minor area of study. Candidates who apply for the DI Endorsement (secondary) must pass the Michigan Test for Teacher Certification integrated science test at the secondary level for their secondary certificate.

DIRECTIONS: List required courses on matrix and provide additional narrative to explain how standards are met. If electives are included, they should be clearly indicated. Adjust size of cells as needed.

	Standard/Guideline	Narrative Explaining how Required Courses and/or Experiences Fulfill the Standards for Secondary Programs	
No.	**Submit a narrative that explains how this program:**	**36 Semester hour Major**	**50 Semester Hour Comprehensive Group Major**
A.	uses the Michigan Curriculum Framework K-12 Science Content Standards and Benchmarks as the critical foundation for teacher preparation, ensuring that secondary integrated science teachers have the content knowledge and the ability to teach this curriculum; and	BIO103 Environmental Science, BIO 120/121 General Biology I lecture/lab, and BIO122/123 General Biology II lecture/lab. CHM 103 Chemistry in Society, CHM107 General Chemistry I, CHM110 Chemistry Lab I. CHM 227 Organic Chemistry I, CHM 228 Organic Chemistry Laboratory I, CHM 470 Basic Biochemistry I. GEO 211 World Regional Geography PHY108 History of the Universe, PHY130/131 General Physics I lecture/lab, and PHY132 General Physics II. The courses listed above are all designed to give students the depth and breadth of knowledge needed to become professionals in the teaching of 7-12 students. As part of this review process, the instructors became familiar with the Michigan Curriculum Framework (MCF) for their disciplines.	BIO103 Environmental Science, BIO 120/121 General Biology I lecture/lab, and BIO122/123 General Biology II lecture/lab. CHM 103 Chemistry in Society, CHM107 General Chemistry I, CHM110 Chemistry Lab I. CHM 227 Organic Chemistry I, CHM 228 Organic Chemistry Laboratory I, CHM 470 Basic Biochemistry I. GEO 211 World Regional Geography PHY108 History of the Universe, PHY130/131 General Physics I lecture/lab, PHY132/133 General Physics II lecture/lab. The courses listed above are all designed to give students the depth and breadth of knowledge needed to become professionals in the teaching of 7-12 students. The Comprehensive Group Major candidates also select six hours from: BIO 270 Genetics, BIO 420 Evolution, BIO 448 Ecology, CHM 229 Organic Chemistry II, CHM 230 CHM Laboratory, or CHM 387 Quantitative Analysis. These courses give the candidates additional depth and breadth of knowledge needed to teach more advanced high school biology or chemistry classes. As part of this review process, the instructors became familiar with the Michigan Curriculum Framework (MCF) for their disciplines.

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B.	develops an understanding of the interconnectedness of all science, along with major unifying themes, and relates this understanding to the teaching of science; and	The courses listed in Standard A, especially those above the 100-level, are interwoven with connections between the sciences and to the relevance of the subject matter to everyday life. Higher level courses routinely involve at least one presentation by students to their peers and the teaching faculty member. As discussed in Section A, the candidates continue to demonstrate their understanding of the *MCF* standards and benchmarks in their sequence of Education courses, especially in EDU 401/402. 469, 475, and during EDU 490 Student Teaching. Please see Standard C for a detailed explanation.	The courses listed in Standard A, especially those above the 100-level, are interwoven with connections between the sciences and to the relevance of the subject matter to everyday life. Higher level courses routinely involve at least one presentation by students to their peers and the teaching faculty member. As discussed in Section A, the candidates continue to demonstrate their understanding of the *MCF* standards and benchmarks in their sequence of Education courses, especially in EDU 401/402, 469, 475, and during EDU 490 Student Teaching. Please see Standard C for a detailed explanation.
C.	prepares candidates to understand and teach biology, chemistry, physics, and earth/space science as integrated content.	Education candidates are introduced to the *Michigan Curriculum Framework K-12 Science Content Standards and Benchmarks* in EDU 401/402 Introduction to Elementary and Secondary Education. Throughout the semester, the potential secondary Teacher Education candidates observe in a 7-12 grade classroom of the major and/or minor for which they are considering certification. They conduct a field study and write up their findings as a case study. Education methods courses require that candidates use the appropriate *MCF* standards to complete projects, papers, unit and lesson plans. Secondary candidates enhance their knowledge of *MCF* standards for each of the Integrated Science disciplines in EDU 469 Curriculum and Methods of Teaching in Secondary Schools I. The course teaches the basic of curriculum and lesson/unit design and basic secondary instructional strategies. The candidates must link the appropriate *MCF* standards to lesson/unit plans and course presentation. EDU 475 Curriculum and	Education candidates are introduced to the *Michigan Curriculum Framework K-12 Science Content Standards and Benchmarks* in EDU 401/402 Introduction to Elementary and Secondary Education. Throughout the semester, the potential secondary Teacher Education candidates observe in a 7-12 grade classroom of the major and/or minor for which they are considering certification. They conduct a field study and write up their findings as a case study. Education methods courses require that candidates use the appropriate *MCF* standards to complete projects, papers, unit and lesson plans. Secondary candidates enhance their knowledge of *MCF* standards for each of the Integrated Science disciplines in EDU 469 Curriculum and Methods of Teaching in Secondary Schools I. The course teaches the basic of curriculum and lesson/unit design and basic secondary instructional strategies. The candidates must link the appropriate *MCF* standards to lesson/unit plans and course presentation. EDU 475 Curriculum and

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C. (cont.)	prepares candidates to understand and teach biology, chemistry, physics, and earth/space science as integrated content.	Methods of Teaching in Secondary Schools II: Science is designed to increase candidates' repertoires of instructional strategies through research, classroom presentations, and building a series of portfolios with lesson plans and articles appropriate to 7-12 student abilities. Candidates are required to create lessons using the appropriate *MCF* standards and benchmarks. The directions and assessment rubrics require exact *MCF* references. In EDU 459/600 Instructional Technology the final project is an interdisciplinary team design of an authentic, technology-enriched learning activity that connects content area standards with student technology standards and meets the diverse needs of students. A science candidate works to include integrated science concepts in the interdisciplinary project. The secondary reading methods course (EDU 478/578 Reading in the Content Areas) also involves the candidates in creating lessons based on the *MCF*. When the candidates design, teach, and actively involve the class in using a strategy that will increase students' understanding of what they read, science candidates will focus on scientific content comprehension. The focus is maintained in the other literacy assignments. The candidates link their lessons to the *MCF*. During Student Teaching, EDU 490 Student Teaching in the Secondary Schools, candidates work with the secondary school's curriculum and present lessons designed to help secondary students learn the concepts and skills required for them in the *MCF*.	Methods of Teaching in Secondary Schools II: Science is designed to increase candidates' repertoires of instructional strategies through research, classroom presentations, and building a series of portfolios with lesson plans and articles appropriate to 7-12 student abilities. Candidates are required to create lessons using the appropriate *MCF* standards and benchmarks. The directions and assessment rubrics require exact *MCF* references. In EDU 459/600 Instructional Technology the final project is an interdisciplinary team design of an authentic, technology-enriched learning activity that connects content area standards with student technology standards and meets the diverse needs of students. A science candidate works to include integrated science concepts in the interdisciplinary project. The secondary reading methods course (EDU 478/578 Reading in the Content Areas) also involves the candidates in creating lessons based on the *MCF*. When the candidates design, teach, and actively involve the class in using a strategy that will increase students' understanding of what they read, science candidates will focus on scientific content comprehension. The focus is maintained in the other literacy assignments. The candidates link their lessons to the *MCF*. During Student Teaching, EDU 490 Student Teaching in the Secondary Schools, candidates work with the secondary school's curriculum and present lessons designed to help secondary students learn the concepts and skills required for them in the *MCF*.

			NARRATIVE EXPLAINING HOW REQUIRED COURSES AND/OR EXPERIENCES FULFILL THE STANDARDS FOR SECONDARY PROGRAMS	
NO.	**STANDARD/GUIDELINE**	**LEVEL OF PROFICIENCY**	**36 SEMESTER HOUR MAJOR**	**50 SEMESTER HOUR COMPREHENSIVE GROUP MAJOR**
	The preparation of secondary integrated science teachers will enable them to:			
1.0	understand and develop the major concepts and principles of biology, chemistry, earth/space science, and physics, which may include such topics as the following:			
1.1	Cellular Function, including			
1.1.1	cell theory	B	BIO 120/121 General Biology I lecture/lab, foundational course with research-based lab experiences. These courses survey cell theory through readings, lecture, lab observations and experiments, discussion, and examinations to ensure that students learn about cell theory.	BIO 120/121 General Biology I lecture/lab, foundational course with research-based lab experiences. These courses survey cell theory through readings, lecture, lab observations and experiments, discussion, and examinations. If Comprehensive candidates elect any of the Biology electives (BIO 270-Genetics, 420-Evolution, 448-Ecology) for their six required elective hours, they will deepen their understanding of cell theory.
1.1.2	cell types	B	BIO 122/123 General Biology II with lab. These courses survey cell types through a traditional lecture series supplemented with audio visual aids and an accompanied laboratory where students observe the biological and chemical phenomena described in the lecture to ensure that they learn about cell types.	BIO 122/123 General Biology II with lab. The These courses survey cell types through a traditional lecture series supplemented with audio visual aids and an accompanied laboratory where students observe the biological and chemical phenomena described in the lecture. If Comprehensive candidates elect any of the Biology electives (BIO 270-Genetics, 420-Evolution, 448-Ecology) for their six required elective hours, they will deepen their understanding of cell types.
1.1.3	cell structure and function	C	BIO 120/121 General Biology I with lecture/lab. These courses survey cell structure and function through readings, lecture, lab observations and experiments, discussions, and examinations to ensure that	BIO 120/121 General Biology I with lecture/lab. These courses survey cell structure and function through readings, lecture, lab observations and experiments, discussions, and examinations. CHM 470 Basic Biochemistry I also studies cell

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1.1.3 (cont.)	cell structure and function		students learn about cell structure and function. CHM 470 Basic Biochemistry I also studies cell structure and function through readings, lectures, discussions, and class activities.	structure and function through readings, lectures, discussions, and class activities. If Comprehensive candidates elect any of the Biology electives (BIO 270-Genetics, 420-Evolution, 448-Ecology) for their six required elective hours, they will deepen their understanding of cell structure and function.
1.1.4	protein synthesis	A	BIO 120/121 General Biology I with lecture/lab. These courses survey protein synthesis through readings, lecture, lab observations and experiments, discussions, and examinations to ensure that students learn about protein synthesis. CHM 470 Basic Biochemistry I also studies protein synthesis through readings, lectures, discussions, and class activities.	BIO 120/121 General Biology I with lecture/lab. These courses survey protein synthesis through readings, lecture, lab observations and experiments, discussions, and examinations. . CHM 470 Basic Biochemistry I also studies protein synthesis through readings, lectures, discussions, and class activities. If Comprehensive candidates elect any of the Biology electives (BIO 270-Genetics, 420-Evolution, 448-Ecology) for their six required elective hours, they will deepen their understanding of protein synthesis.
1.1.5	cell division (mitosis & meiosis)	A	BIO 120/121 General Biology I with lecture/lab. These courses survey cell division (mitosis & meiosis) through readings, lecture, lab observations and experiments, discussions, and examinations to ensure that students learn about cell division.	BIO 120/121 General Biology I with lecture/lab. These courses survey cell division (mitosis & meiosis) through readings, lecture, lab observations and experiments, discussions, and examinations. If Comprehensive candidates elect any of the Biology electives (BIO 270-Genetics, 420-Evolution, 448-Ecology) for their six required elective hours, they will deepen their understanding of cell division (mitosis & meiosis).
1.2	Organization of Living Things, including			

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1.2.1	life cycles (including sexual and asexual reproduction)	C	BIO 120/121 &122/123 General Biology I and II lecture with labs. These courses survey reproductive cycles among all representative living groups and engage students in lectures, lab observations and activities, and examinations to ensure that students learn about life cycles.	BIO 120/121 &122/123 General Biology I & II lecture with labs. These courses survey reproductive cycles among all representative living groups and engage students in lectures, lab observations and activities, and examinations to ensure that students learn about life cycles. If Comprehensive candidates elect any of the Biology electives (BIO 270-Genetics, 420-Evolution, 448-Ecology) for their six required elective hours, they will deepen their understanding of life cycles (including sexual and asexual reproduction).
1.2.2	living and non-living	C	BIO 120/121 &122/123 General Biology I and II lecture with labs. These courses engage students in lectures, lab observations/activities, and examinations to ensure that they learn about living and non–living life cycles.	BIO 120/121 &122/123 General Biology I and II lecture with labs. These courses engage students in lectures, lab observations/activities, and examinations to ensure that they learn about living and non –living life cycles. If Comprehensive candidates elect any of the Biology electives (BIO 270-Genetics, 420-Evolution, 448-Ecology) for their six required elective hours, they will deepen their understanding of living and non-living cycles.
1.2.3	systems	C	BIO 122/123 General Biology II lecture with lab. The students learn about systems through a traditional lecture series supplemented with audio visual aids and an accompanied laboratory where students observe the biological and chemical phenomena described in the lecture.	BIO 122/123 General Biology II lecture with lab. The students learn about systems through a traditional lecture series supplemented with audio visual aids and an accompanied laboratory where students observe the biological and chemical phenomena described in the lecture. If Comprehensive candidates elect any of the Biology electives (BIO 270-Genetics, 420-Evolution, 448-Ecology) for their six required elective hours, they will deepen their understanding of systems.

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1.2.4	Classification	B	BIO 120/121 General Biology I lecture with labs. BIO 122/123 General Biology II lecture with labs. Classification is learned through readings, lectures, discussions, and laboratory activities.	BIO 120/121 General Biology I lecture with labs. BIO 122/123 General Biology II lecture with labs. Classification is learned through readings, lectures, discussions, and laboratory activities. If Comprehensive candidates elect any of the Biology electives (BIO 270-Genetics, 420-Evolution, 448-Ecology) for their six required elective hours, they will deepen their understanding of classification.
1.2.5	growth and development (embryology, etc.)	A	BIO 120/121 General Biology I lectures and labs and BIO 122/123 General Biology II lecture with labs provided students with a biology foundational survey of topics such as growth and development.	BIO 120/121 General Biology I lectures and labs and BIO 122/123 General Biology II lecture with labs provided students with a biology foundational survey of topics such as growth and development. If Comprehensive candidates elect any of the Biology electives (BIO 270-Genetics, 420-Evolution, 448-Ecology) for their six required elective hours, they will deepen their understanding of growth and development (embryology, etc.)
1.2.6	photosynthesis	B	BIO 120/121 General Biology I lecture with labs teaches photosynthesis.	BIO 120/121 General Biology I lecture with labs teaches photosynthesis. If Comprehensive candidates elect any of the Biology electives (BIO 270-Genetics, 420-Evolution, 448-Ecology) for their six required elective hours, they will deepen their understanding of photosynthesis.
1.2.7	cellular respiration	B	BIO 120/121 General Biology I lecture with labs teaches cellular respiration.	BIO 120/121 General Biology I lecture with labs teaches cellular respiration. If Comprehensive candidates elect any of the Biology electives (BIO 270-Genetics, 420-Evolution, 448-Ecology) for their six required elective hours, they will deepen their understanding of cellular respiration.

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1.3	Concepts of Heredity, including			
1.3.1 1.3.1 (cont.)	Mendelian genetics Mendelian genetics	B	BIO 120/121 General Biology I lecture with labs covers Mendelian genetics.	BIO 120/121 General Biology I lecture with labs covers Mendelian genetics. If Comprehensive majors choose BIO 270 Genetics as an elective, they will acquire deeper understanding of Mendelian genetics through research, lecture, discussion, and problem solving activities. Mendelian genetics is also studied in BIO 420 Evolution and BIO 448 Ecology.
1.3.2	traits passed from one generation to the next	C	BIO 120/121 General Biology I lecture with labs studies traits passed from one generation to the next through lectures, labs, discussions, and analysis of the basic principles of inheritance as seen in various living forms.	BIO 120/121 General Biology I lecture with labs studies traits passed from one generation to the next through lectures, labs, discussions, and analysis of the basic principles of inheritance as seen in various living forms. If Comprehensive candidates elect any of the Biology electives (BIO 270-Genetics, 420-Evolution, 448-Ecology) for their six required elective hours, they will deepen their understanding of traits passed from one generation to the next.
1.3.3	molecular genetics (structure of DNA)	A	BIO 120/121 General Biology I lecture with labs studies molecular genetics (structure of DNA) by readings, lectures, discussions, and laboratory activities. CHM 470 Basic Biochemistry I also provides additional study.	BIO 120/121 General Biology I lecture with labs studies molecular genetics (structure of DNA) by readings, lectures, discussions, and laboratory activities. CHM 103 Chemistry in Society also studies the structure of DNA through its focus on applying chemistry in forensics. CHM 470 Basic Biochemistry I also provides additional study. If Comprehensive majors choose BIO 270 Genetics as an elective, they will acquire a deeper understanding of molecular genetics (structure of DNA) through research, lecture, discussion, and problem solving activities.

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1.3.4	modern genetics (electrophoresis, genetic engineering, DNA fingerprinting, etc.)	A	BIO 120/121 General Biology I lecture with labs studies modern genetics by readings, lectures, discussions, and laboratory activities. CHM 470 Basic Biochemistry I also provides additional study.	BIO 120/121 General Biology I lecture with labs studies modern genetics by readings, lectures, discussions, and laboratory activities. CHM 103 Chemistry in Society also studies modern genetics through its focus on applying chemistry in forensics. CHM 470 Basic Biochemistry I provides additional study. If Comprehensive majors choose BIO 270 Genetics as an elective, they will acquire deeper understanding of modern genetics through research, lecture, discussion, and problem solving activities.
1.3.5	population genetics	B	BIO 120/121 General Biology I lecture with labs. BIO 122/123 General Biology II lectures with labs.	BIO 120/121 General Biology I lecture with labs. BIO 122/123 General Biology II lectures with labs. If candidates elect BIO 420 Evolution as one of the required electives their understanding of population genetics will be enhanced.
1.3.6	Environmental effects on heredity	B	BIO 120/121 General Biology I lecture with labs teaches environmental effects on heredity through readings, lectures, discussions, class activities, and laboratory experiments. Environmental effects on heredity are discussed in the effects of disease and illness due to human interaction with the environment in GEO 211 as the different world regions are studied.	BIO 120/121 General Biology I lecture with labs teaches environmental effects on heredity through readings, lectures, discussions, class activities, and laboratory experiments. Environmental effects on heredity are discussed in the effects of disease and illness due to human interaction with the environment in GEO 211 as the different world regions are studied. If Comprehensive candidates elect BIO 420 Evolution and/or BIO 448 Ecology, their understanding of environmental effects on heredity will be enhanced.
1.4	Evolutionary Change, including			

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1.4.1	diversity/speciation	A	BIO 120/121 General Biology I lectures with labs. BIO 122/123 General Biology II lectures with labs. Both courses study diversity/speciation by readings, lectures, discussions, and laboratory activities.	BIO 120/121 General Biology I lectures with labs. BIO 122/123 General Biology II lectures with labs. Both courses study diversity/speciation by readings, lectures, discussions, and laboratory activities. If Comprehensive candidates elect BIO 420 Evolution or BIO 448 Ecology as electives, they will deepen their understanding of diversity/speciation.
1.4.2	theory of evolution (adaptation, variation, and natural selection and relationships between species, including human)	B	BIO 122/123 General Biology II (lectures and labs) studies the theory of evolution during the third through eighth sessions through readings, lectures, discussions, and classroom activities, along with the first laboratory exercise.	BIO 122/123 General Biology II (lectures and labs) studies the theory of evolution during the third through eighth sessions through readings, lectures, discussions, and classroom activities, along with the first laboratory exercise. If Comprehensive candidates elect BIO 420 Evolution or BIO 448 Ecology as electives, they will deepen their understanding of the theory of evolution.
1.4.3	fossils/ancient life	B	BIO 120/121 General Biology I lecture and lab and BIO 122/123 General Biology II lecture and lab cover fossils/ancient life as part of the instruction about the theory of evolution. They are also covered in GEO 211 as students study the historical geography of each world region.	BIO 120/121 General Biology I lecture and lab and BIO 122/123 General Biology II lecture and lab cover fossils/ancient life as part of the instruction about the theory of evolution. They are also covered in GEO 211 as students study the historical geography of each world region. If Comprehensive candidates elect BIO 420 Evolution or BIO 448 Ecology as electives, they will deepen their understanding of fossils/ancient life.
1.4.4	Extinction	B	BIO 122/123 General Biology II lecture and lab covers extinction as part of the instruction about the theory of evolution. Extinction is discussed in GEO 211 World Regional Geography through journal	BIO 122/123 General Biology II lecture and lab covers extinction as part of the instruction about the theory of evolution. Extinction is discussed in GEO 211 World Regional Geography through journal articles, presentations, and discussions

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1.4.4 (cont.)	Extinction		articles, presentations, and discussions including causes and current efforts to prevent extinction.	including causes and current efforts to prevent extinction. If Comprehensive candidates elect BIO 420 Evolution or BIO 448 Ecology as electives, they will deepen their understanding of extinction.
1.5	Ecological Systems, including			
1.5.1	community relationships, including predator/prey and symbiosis	C	BIO 120 covers community relationships when studying evolution. BIO 122/123 General Biology II also covers the topic in sessions on ecosystem, animal behavior, populations, and communities. GEO 211 World Regional Geography includes journal articles, discussions, and presentations on the effects of community relationships, predator/prey and symbiosis in relationship to the world's water and food supply.	BIO 120 covers community relationships when studying evolution. BIO 122/123 General Biology II also covers the topic in sessions on ecosystem, animal behavior, populations, and communities. GEO 211 World Regional Geography includes journal articles, discussions, and presentations on the effects of community relationships, predator/prey and symbiosis in relationship to the world's water and food supply. Additional study occurs in BIO 448 Ecology for those Comprehensive majors who elect it as one of the required electives.
1.5.2	population	B	Population and the influences of various population of species, including humans, is studied as part of environmental concerns in courses such as BIO 103 Environmental Science, GEO 211 World Regional Geography, and PHY 108 History of the Universe.	Population and the influences of various population of species, including humans, is studied as part of environmental concerns in courses such as BIO 103 Environmental Science, CHM 103 Chemistry in Society, GEO 211 World Regional Geography, and PHY 108 History of the Universe.
1.5.3	transfer of energy (food chains/webs)	C	BIO 120/121 General Biology I (lectures with labs) studies transfer of energy through lectures, labs, and discussions. Transfer of energy is also studied in CHM 107/110 General Chemistry 1 lecture and lab, CHM 108/111 General Chemistry II lecture and	BIO 120/121 General Biology I (lectures with labs) studies transfer of energy through lectures, labs, and discussions. Transfer of energy is also studied in CHM 103 Chemistry in Society, CHM 107/110 General Chemistry 1 lecture and lab, CHM 108/111 General Chemistry II lecture and

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1.5.3 (cont.)	transfer of energy (food chains/webs)		lab, CHM 227/228 Organic Chemistry I lecture and lab, CHM 470 Basic Biochemistry I, PHY 108 History of the Universe, and PHY 130/131 General Physics I lecture and lab.	lab, CHM 227/228 Organic Chemistry I lecture and lab, CHM 470 Basic Biochemistry I, PHY 108 History of the Universe, and PHY 130/131 General Physics I lecture and lab. If Comprehensive candidates elected CHM 229/230 Organic Chemistry II or CHM 387 Quantitative Analysis as their 6 hours of required electives, they would broaden their understanding of transfer of energy.
1.5.4	biogeochemical cycles	B	BIO 120/121 General Biology I lecture and lab covers biogeochemical cycles through readings, lectures, discussion, and experiments. BIO 103 Environmental Science reviews basic chemistry and relationships with biology.	BIO 120/121 General Biology I lecture and lab covers biogeochemical cycles through readings, lectures, discussion, and experiments. BIO 103 Environmental Science reviews basic chemistry and relationships with biology. CHM 470 Basic Biochemistry I includes study of biogeochemical cycles. If Comprehensive majors choose BIO 448 Ecology as one of their required electives, they will deepen their understanding.
1.5.5	human impact	B	The human impact on ecological systems is studied through readings, lectures, discussion, classroom activities, and laboratory investigations in the final sessions of BIO 122/123 General Biology II. BIO 103 Environmental Science considers the human impact on all aspects of the environment studied. GEO 211 World Regional Geography studies the human impact on the physical as well as economic, social, and political systems of each region studied.	The human impact on ecological systems is studied through readings, lectures, discussion, classroom activities, and laboratory investigations in the final sessions of BIO 122/123 General Biology II. BIO 103 Environmental Science considers the human impact on all aspects of the environment studied. GEO 211 World Regional Geography studies the human impact on the physical as well as economic, social, and political systems of each region studied. Comprehensive majors who elect to take BIO 448 Ecology as one of their required electives deepen their understanding of the human impact on eco systems and the environment.

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NO.	**STANDARD/GUIDELINE**	**LEVEL OF PROFICIENCY**	**36 SEMESTER HOUR MAJOR**	**50 SEMESTER HOUR COMPREHENSIVE GROUP MAJOR**
1.6	Human Biology, including			
1.6.1 1.6.1 (cont.)	anatomy and physiology anatomy and physiology	B	BIO 122/123 General Biology II lectures with labs. The students learn about anatomy and physiology through a traditional lecture series supplemented with audio visual aids and an accompanying laboratory.	BIO 122/123 General Biology II lectures with labs. The students learn about anatomy and physiology through a traditional lecture series supplemented with audio visual aids and an accompanying laboratory. If Comprehensive candidates elect BIO 270 Genetics and/or BIO 420 Evolution as required electives, they will gain deeper understanding of anatomy and physiology.
1.6.2	disease and immunology	A	BIO 122/123 General Biology II lectures with labs discusses disease and immunology as part of readings (Chapter 19) and lecture (February 25 in the syllabus). In GEO 211 World Regional Geography the diseases and immunology unique to each region are discussed with specific emphasis on third world countries and the effects of endemic, epidemic, and pandemic diseases in relationship to immunology and treatment.	BIO 122/123 General Biology II lectures with labs discusses disease and immunology as part of readings (Chapter 19) and lecture (February 25 in the syllabus). In GEO 211 World Regional Geography the diseases and immunology unique to each region are discussed with specific emphasis on third world countries and the effects of endemic, epidemic, and pandemic diseases in relationship to immunology and treatment.
1.6.3	health habits	B	BIO 122/123 General Biology II lectures with labs discusses disease and immunology as part of readings (Chapter 19) and lecture (February 25 in the syllabus). In GEO 211 World Regional Geography the health habits and their consequences unique to each region are discussed as part of understanding the human impact on environment and health issues.	BIO 122/123 General Biology II lectures with labs discusses disease and immunology as part of readings (Chapter 19) and lecture (February 25 in the syllabus). In GEO 211 World Regional Geography the health habits and their consequences unique to each region are discussed as part of understanding the human impact on environment and health issues.
1.6.4	resource management	C	BIO 103 Environmental Science studies resource management through textbook and handout readings, lectures, discussion, and	BIO 103 Environmental Science studies resource management through textbook and handout readings, lectures, discussion, and the writing of a

			NARRATIVE EXPLAINING HOW REQUIRED COURSES AND/OR EXPERIENCES FULFILL THE STANDARDS FOR SECONDARY PROGRAMS	
NO.	**STANDARD/GUIDELINE**	**LEVEL OF PROFICIENCY**	**36 SEMESTER HOUR MAJOR**	**50 SEMESTER HOUR COMPREHENSIVE GROUP MAJOR**
1.64 (cont.)	resource management		the writing of a paper analyzing a problem presented through readings and classroom activities. Management of regional resources in relation to other regions is discussed in GEO 211 World Regional Geography as part of studying each regions environment and economic political status.	paper analyzing a problem presented through readings and classroom activities. Management of regional resources in relation to other regions is discussed in GEO 211 World Regional Geography as part of studying each regions environment and economic political status.
1.6.5	human population growth and diversity	B	BIO 103 Environmental Science, and BIO 122 General Biology II lecture. Each course engages the students in studying human population growth and diversity through readings, lectures, and discussions. In BIO 103, it could also be a topic for the written paper. GEO 211 World Regional Geography also analyzes human population growth and diversity as part of its regional studies.	BIO 103 Environmental Science, and BIO 122 General Biology II lecture. Each course engages the students in studying human population growth and diversity through readings, lectures, and discussions. In BIO 103, it could also be a topic for the written paper. GEO 211 World Regional Geography also analyzes human population growth and diversity as part of its regional studies. Comprehensive majors who elect BIO 448 Ecology as one of their required electives deepen their understanding of population growth through readings, lectures, web based simulations, and discussions over a four week unit of study.
1.7	Earth/Space Science, including			
1.7.1	lithosphere and historical geology	C	PHY 108 History of the Universe covers lithosphere and historical geology by readings in the James Trefil and Robert M. Hazen textbook, *The Sciences: An Integrated Approach 4th Edition* (Chapters 16 & 17) as well as essays, articles, and other handouts provided by the instructor and selected weekly by the students from print media for study and comment in their journal. Lectures, class discussions and	PHY 108 History of the Universe covers lithosphere and historical geology by readings in the James Trefil and Robert M. Hazen textbook, *The Sciences: An Integrated Approach 4th Edition* (Chapters 16 & 17) as well as essays, articles, and other handouts provided by the instructor and selected weekly by the students from print media for study and comment in their journal. Lectures, class discussions and activities, weekly homework of problems sets, and a term project ensure that

			NARRATIVE EXPLAINING HOW REQUIRED COURSES AND/OR EXPERIENCES FULFILL THE STANDARDS FOR SECONDARY PROGRAMS	
NO.	**STANDARD/GUIDELINE**	**LEVEL OF PROFICIENCY**	**36 SEMESTER HOUR MAJOR**	**50 SEMESTER HOUR COMPREHENSIVE GROUP MAJOR**
1.7.1 (cont.)	lithosphere and historical geology		activities, weekly homework of problems sets, and a term project ensure that students understand such concepts. CHM 103 Chemistry in Society and CHM 227/228 Organic Chemistry I lecture and lab teach a few instrumental methods (mass spectrometry, infrared spectroscopy) that could be applied to earth/space study. In GEO 211 World Geography the lithosphere and historical geology of each region is touched on through readings, lectures, and map study as part of understanding the history of the region economically, politically, and socially. It is emphasized that the physical setting is basic to understanding the regions.	students understand such concepts. CHM 103 Chemistry in Society and CHM 227/228 Organic Chemistry I lecture and lab teach a few instrumental methods (mass spectrometry, infrared spectroscopy) that could be applied to earth/space study. In GEO 211 World Geography the lithosphere and historical geology of each region is touched on through readings, lectures, and map study as part of understanding the history of the region economically, politically, and socially. It is emphasized that the physical setting is basic to understanding the regions.
1.7.2	hydrosphere	C	PHY 108 History of the Universe touches on the hydrosphere during the readings, lectures, discussions, and activities of week 11, “Cycles of the Earth” (hydrologic cycle). GEO 211 World Regional Geography extensively reviews and discusses the hydrosphere and the hydrologic cycle and its importance to the survival of people in world regions.	PHY 108 History of the Universe touches on the hydrosphere during the readings, lectures, discussions, and activities of week 11, “Cycles of the Earth” (hydrologic cycle). GEO 211 World Regional Geography extensively reviews and discusses the hydrosphere and the hydrologic cycle and its importance to the survival of people in world regions. If Comprehensive candidates choose BIO 448 Ecology as one of their required electives, they will gain deeper understanding of the hydrosphere through readings, lectures, discussions, spreadsheet calculations, and web-based simulations. Studies and activities during the final sessions focus on the physical environment.

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1.7.3	atmosphere, weather, climate	C	PHY 108 History of the Universe studies atmosphere, weather, and climate during the readings, lectures, discussions, and activities of week 11 (Trefil and Hazen textbook, Chapter 18, "Cycles of the Earth"). Atmosphere, weather, and climate are basic areas studied in GEO 211 World Regional Geography as each world region is analyzed.	PHY 108 History of the Universe studies atmosphere, weather, and climate during the readings, lectures, discussions, and activities of week 11 (Trefil and Hazen textbook, Chapter 18, "Cycles of the Earth"). Atmosphere, weather, and climate are basic areas studied in GEO 211 World Regional Geography as each world region is analyzed. If Comprehensive candidates choose BIO 448 Ecology as one of their required electives, they will gain deeper understanding of the hydrosphere through readings, lectures, discussions, spreadsheet calculations, and web-based simulations. Studies and activities during the final sessions focus on the physical environment, including the climate.
1.7.4	astronomy	B	PHY 108 History of the Universe introduces astronomy concepts during the first three weeks of the course ("Science: A Way of Knowing," "The Ordered Universe," "Forces and Motion") and continues the study during weeks 9 ("The Stars"), 10 ("Earth and Other Planets"), and 14 ("Cosmology"). Readings, lectures, discussions, and class room activities are used to facilitate student learning.	PHY 108 History of the Universe introduces astronomy concepts during the first three weeks of the course ("Science: A Way of Knowing," "The Ordered Universe," "Forces and Motion") and continues the study during weeks 9 ("The Stars"), 10 ("Earth and Other Planets"), and 14 ("Cosmology"). Readings, lectures, discussions, and class room activities are used to facilitate student learning.
1.8	Chemistry and Physics: Major Concepts and Principles of Physics and Chemistry			
1.8.1	Inorganic Chemistry, including			

			NARRATIVE EXPLAINING HOW REQUIRED COURSES AND/OR EXPERIENCES FULFILL THE STANDARDS FOR SECONDARY PROGRAMS	
NO.	**STANDARD/GUIDELINE**	**LEVEL OF PROFICIENCY**	**36 SEMESTER HOUR MAJOR**	**50 SEMESTER HOUR COMPREHENSIVE GROUP MAJOR**
1.8.1.1	atomic/molecular structure and bonding	B	Covered in general chemistry, CHM107/110 lecture and lab through pre-class readings in Brady, Russell, Holum's text, *Chemistry, Matter and its Changes* and lectures. In addition to participation in class discussions and other activities, students demonstrate their understanding of the concepts and principles by their performances on randomly chosen quiz days, a mid-term examination, and a final examination. ***This explanation applies to anytime CHM 107/110 is listed in this matrix.***	Foundational concepts are introduced in CHM 103 Chemistry in Society through readings, lectures, and guest presentations. Through written reviews of guest speakers' presentations, participation in class discussions/activities, quizzes, and examinations, candidates demonstrate their knowledge. Covered in general chemistry, CHM107/110 lecture and lab through pre-class readings in Brady, Russell, Holum's text, *Chemistry, Matter and its Changes* and lectures. In addition to participation in class discussions and other activities, students demonstrate their understanding of the concepts and principles by their performances on randomly chosen quiz days, a mid-term examination, and a final examination. ***This explanation applies to anytime CHM 107/110 is listed in this matrix.***
1.8.1.2	stoichiometry	B	Covered in CHM107/110 General Chemistry I lecture and lab when discussing organic functionality.	Covered in CHM107/110 General Chemistry I lecture and lab when discussing organic functionality.
1.8.1.3	gas laws	B	Covered in CHM107/110 General Chemistry I lecture and lab, chapter 10, of Brady, Russell, Holum.	Covered in CHM107 General Chemistry I lecture and lab, chapter 10, of Brady, Russell, Holum.
1.8.1.4	states of matter	C	Covered in CHM107/110 General Chemistry I lecture and lab, early chapters of Brady, Russell, Holum.	Covered in CHM107/110 General Chemistry I lecture and lab, early chapters of Brady, Russell, Holum.
1.8.1.5	equilibria	A	Covered in CHM108/111 General Chemistry II lecture and lab, several chapters of Brady, Russell, Holum, especially Chapter 14.	Covered in CHM108/111 General Chemistry II lecture and lab, several chapters of Brady, Russell, Holum, especially Chapter 14.

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1.8.1.6	acid-bases	B	Covered in CHM107/110 General Chemistry I lecture and lab and CHM108/11 General Chemistry II lecture and lab. CHM 470 Basic Biochemistry I also studies acid-bases through readings, lectures, discussions, and class activities.	Covered in CHM107/110 General Chemistry I lecture and lab and CHM108/11 General Chemistry II lecture and lab. CHM 470 Basic Biochemistry I also studies acid-bases through readings, lectures, discussions, and class activities.
1.8.1.7	electrochemistry	A	Covered in CHM108/111 General Chemistry II lecture and laboratory, chapter 19 of Brady, Russell, Holum.	Covered in CHM108/111 General Chemistry II lecture and laboratory, chapter 19 of Brady, Russell, Holum.
1.8.1.8	nomenclature	C	CHM 107/110 General Chemistry I lecture and lab introduces scientific nomenclature and provides practice in accurate use during lectures, discussions, and classroom activities. CHM 227/228 Organic Chemistry I lecture and lab – nomenclature is examined throughout the courses as a tool for understanding the uniformity of scientific language. New nomenclature is taught as appropriate in any Chemistry class. Students are expected to use the correct nomenclature in written and oral presentations.	CHM 107/110 General Chemistry I lecture and lab introduces scientific nomenclature and provides practice in accurate use during lectures, discussions, and classroom activities. CHM 227/228 Organic Chemistry I lecture and lab – nomenclature is examined throughout the courses as a tool for understanding the uniformity of scientific language. New nomenclature is taught as appropriate in any Chemistry class. Students are expected to use the correct nomenclature in written and oral presentations.
1.8.1.9	qualitative analysis	A	Covered in CHM 107/110 General Chemistry 1 lecture and lab. In CHM 227/228 students apply the qualitative methods of mass spectrometry, infrared spectroscopy, and nuclear magnetic resonance in the determination of organic chemical structure.	Covered in CHM 107/110 General Chemistry 1 lecture and lab. CHM 103 Chemistry in Society and CHM 227/228 Organic Chemistry I lecture and lab also teach qualitative analysis and methods of application. Both classes engage students in readings, lectures, discussions, and classroom activities about qualitative analysis. In CHM 103 students apply qualitative and quantitative methods of chemistry in the study of forensics. In CHM 227/228 students apply the

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1.8.1.9 (cont.)	Qualitative analysis			qualitative methods of mass spectrometry, infrared spectroscopy, and nuclear magnetic resonance in the determination of organic chemical structure.
1.8.2	Organic Chemistry, including:			
1.8.2.1	Aliphatic and alicyclic reactions	A	Covered in CHM 227/228 Organic Chemistry I lecture and lab– all major classes of aliphatic and alicyclic reactions (substitution, elimination, addition, radical, pericyclic) are discussed in the courses.	Covered CHM 227/228 Organic Chemistry I lecture and lab--all major classes of aliphatic and alicyclic reactions (substitution, elimination, addition, radical, pericyclic) are discussed in the courses. If Comprehensive candidates elect CHM 229/230 Organic Chemistry II lecture and lab, they deepen their understanding of aliphatic and alicyclic reactions through class and laboratory studies and investigations.
1.8.2.2	stereochemistry	A	In CHM 227/228 Organic Chemistry I lecture and lab, stereochemistry is discussed with emphasis on its importance to the pharmaceutical industry and biochemistry.	In CHM 227/228 Organic Chemistry I lecture and lab, stereochemistry is discussed with emphasis on its importance to the pharmaceutical industry and biochemistry. If Comprehensive candidates elect CHM 229/230 Organic Chemistry II lecture and lab, they deepen their understanding of stereochemistry through class and laboratory studies and investigations.
1.8.2.3	Structure and nomenclature of major functional groups	C	Covered in CHM107 General Chemistry I, chapter 8 of Brady, Russell, Holum. CHM 227/228 Organic Chemistry I lecture and lab provide understanding in this area. It is a major objective of the course structure and as such, is covered on every assignment, quiz, and exam. CHM 470 Basic Biochemistry I also teaches structure and nomenclature of major functional	Covered in CHM107 General Chemistry I, chapter 8 of Brady, Russell, Holum. CHM 227/228 Organic Chemistry I lecture and lab provide understanding in this area. It is a major objective of the course structure and as such, is covered on every assignment, quiz, and exam. CHM 470 Basic Biochemistry I also teaches structure and nomenclature of major functional groups as appropriate during lectures,

			NARRATIVE EXPLAINING HOW REQUIRED COURSES AND/OR EXPERIENCES FULFILL THE STANDARDS FOR SECONDARY PROGRAMS	
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1.8.2.3 (cont.)			groups as appropriate during lectures, discussions, and class activities.	discussions, and class activities.
1.8.2.4	aromatic compounds	B	Covered in CHM107/110 Organic Chemistry I lecture and lab chapter 8 of Brady, Russell, Holum. In CHM 227/228 Organic Chemistry I lecture and lab, the difference between aliphatic and aromatic compounds is learned mechanistically by examining the different reactions possible with these classes of molecules.	Covered in CHM107 Organic Chemistry I chapter 8 of Brady, Russell, Holum. In CHM 227/228 Organic Chemistry I lecture and lab, the difference between aliphatic and aromatic compounds is learned mechanistically by examining the different reactions possible with these classes of molecules. If Comprehensive candidates elect CHM 229/230 Organic Chemistry II lecture and lab, they deepen their understanding of aromatic compounds through class and laboratory studies and investigations.
1.8.2.5	spectroscopy	B	CHM 227/228 Organic Chemistry I lecture and laboratory covers all major spectroscopic techniques in the course structure (mass spectrometry, infrared spectrophotometry and nuclear magnetic resonance spectroscopy).	CHM 227/228 Organic Chemistry I lecture and laboratory covers all major spectroscopic techniques in the course structure (mass spectrometry, infrared spectrophotometry and nuclear magnetic resonance spectroscopy). CHM 229/230 Organic Chemistry II lecture and lab, if elected by Comprehensive majors, will deepen their understanding of spectroscopy.
1.8.2.6	heterocyclic compounds	A	CHM 227/228 Organic Chemistry I lecture and laboratory – heterocyclic compounds, with special emphasis on their importance to nature are discussed.	CHM 227/228 Organic Chemistry I lecture and laboratory – heterocyclic compounds, with special emphasis on their importance to nature are discussed. CHM 229/230 Organic Chemistry II lecture and lab, if elected by Comprehensive majors, will deepen their understanding of heterocyclic compounds.

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NO.	**STANDARD/GUIDELINE**	**LEVEL OF PROFICIENCY**	**36 SEMESTER HOUR MAJOR**	**50 SEMESTER HOUR COMPREHENSIVE GROUP MAJOR**
1.8.2.7	polymers	B	CHM 227/228 Organic Chemistry I lecture and laboratory – polymers and the monomers that they consist of are studied in regard to the reactions that generate these synthetic molecules.	CHM 227/228 Organic Chemistry I lecture and laboratory - polymers and the monomers that they consist of are studied in regard to the reactions that generate these synthetic molecules. CHM 229/230 Organic Chemistry II lecture and lab, if elected by Comprehensive majors, will deepen their understanding of polymers.
1.8.2.8	Biomolecules	B	CHM 227/228 Organic Chemistry I lecture and laboratory – biomolecules (proteins, lipids, carbohydrates, nucleic acids, and cofactors) are used as standards for functional group reactivity and the ordered character of nature. The study of biomolecules is the focus of CHM 470 Basic Biochemistry I through readings, lectures, discussions, and class activities.	CHM 227/228 Organic Chemistry I lecture and laboratory - biomolecules (proteins, lipids, carbohydrates, nucleic acids, and cofactors) are used as standards for functional group reactivity and the ordered character of nature. CHM 229/230 Organic Chemistry II lecture and lab, if elected by Comprehensive majors, will deepen their understanding of biomolecules. The study of biomolecules is the focus of CHM 470 Basic Biochemistry I through readings, lectures, discussions, and class activities.
1.8.3	Physics, including:			
1.8.3.1	mechanics	C	PHY 108 History of the Universe introduces mechanics when history is covered during first 2 sessions in Chapters 2 and 5. Students complete a sequence of introductory classes and laboratories including PHY 130/131 General Physics I, where Galilean laws, Kepler's laws, and Newton's laws are introduced and learned through readings (J. D. Cutnell and K. W. Johnson's text *Physics 6th Edition*), home work assignments, lectures, demonstrations and laboratory experiments.	PHY 108 History of the Universe introduces mechanics when history is covered during first 2 sessions in Chapters 2 and 5. Students complete a sequence of introductory classes and laboratories including PHY 130/131 General Physics I, where Galilean laws, Kepler's laws, and Newton's laws are introduced and learned through readings (J. D. Cutnell and K. W. Johnson's text *Physics 6th Edition*), home work assignments, lectures, demonstrations and laboratory experiments.

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1.8.3.2	electricity and magnetism	C	PHY 108 History of the Universe introduces electricity and magnetism during Week 2-The Ordered Universe; and studies in more depth during week 3-Forces and Motion, and week 6-Waves and Electromagnetic Radiation. Electricity and magnetism are covered in PHY 132 General Physics II through lectures, demonstrations and problem solving (See Lecture Topics), and with experiments in PHY 133 General Physics II Lab (See Experiments).	PHY 108 History of the Universe introduces electricity and magnetism during Week 2-The Ordered Universe; and studies in more depth during week 3-Forces and Motion, and week 6-Waves and Electromagnetic Radiation. Electricity and magnetism are covered in PHY 132 General Physics II through lectures, demonstrations and problem solving (See Lecture Topics), and with experiments in PHY 133 General Physics II Lab (See Experiments).
1.8.3.3	Thermodynamics	C	Laws are introduced in PHY 108 History of the Universe through readings in chapters 3 and 4 of Trefil & Hazen, lectures, discussions, and classroom activities. Additional coverage is provided in CHM107/110 General Chemistry I lecture and lab as part of the study of thermochemistry, chapter 6 of Brady, Russell, Holum. CHM 108/111 General Chemistry II lecture and lab also presents thermodynamics during week 12, chapter 18 of Brady, Russell, Holum.	Laws are introduced in PHY 108 History of the Universe through readings in chapters 3 and 4 of Trefil & Hazen, lectures, discussions, and classroom activities. Additional coverage is provided in CHM107/110 General Chemistry I lecture and lab as part of the study of thermochemistry, chapter 6 of Brady, Russell, Holum. CHM 108/111 General Chemistry II lecture and lab also presents thermodynamics during week 12, chapter 18 of Brady, Russell, Holum.
1.8.3.4	Waves, vibrations, and optics	C	PHY 108 History of the Universe introduces wave, vibrations, and optics during week six of the course (Chapter 6 of Trefil & Hazen) and again during the study of earthquakes as part of the study of plate tectonics during Week 11 (Chapter 17). Waves, vibrations, and optics are also studied at the end of mechanics study just before fluids in Trefil and Hazen (Chapter 10) during the final two	PHY 108 History of the Universe introduces wave, vibrations, and optics during week six of the course (Chapter 6 of Trefil & Hazen) and again during the study of earthquakes as part of the study of plate tectonics during Week 11 (Chapter 17). Waves, vibrations, and optics are also studied at the end of mechanics study just before fluids in Trefil and Hazen (Chapter 10) during the final two weeks of PHY 130/131

			NARRATIVE EXPLAINING HOW REQUIRED COURSES AND/OR EXPERIENCES FULFILL THE STANDARDS FOR SECONDARY PROGRAMS	
NO.	**STANDARD/GUIDELINE**	**LEVEL OF PROFICIENCY**	**36 SEMESTER HOUR MAJOR**	**50 SEMESTER HOUR COMPREHENSIVE GROUP MAJOR**
1.8.3.4 (cont.(			weeks of PHY 130/131 General Physics I lecture and lab.	General Physics I lecture and lab.
1.8.3.5	Atomic and nuclear physics	B	Fusion, atomic and nuclear physics are covered in PHY 108 through lecture and problem solving. Week 7 (Chapter 8 in Trefil and Hazen text) and week 8 (Chapter 12) focus on the atom through readings, lectures, classroom activities and discussion, and problem solving activities.	Fusion, atomic and nuclear physics are covered in PHY 108 through lecture and problem solving. Week 7 (Chapter 8 in Trefil and Hazen text) and week 8 (Chapter 12) focus on the atom through readings, lectures, classroom activities and discussion, and problem solving activities.

No.	Standard/Guideline	Narrative Explaining how Required Courses and/or Experiences Fulfill the Standards for Secondary Programs
	The preparation of secondary integrated science teachers will enable them to:	
2.0	apply mathematics, including statistics, to investigations in the sciences, including the analysis of data;	**36 and 50 Semester Hour Major:** Students perform these activities throughout their academic careers at UDM. BIO 103 Environmental Science is a topic oriented course providing environmental information for making intelligent choices for scientific, social, political and economic issues. Mathematics, including statistics, is applied as appropriate to analyses and discussion within topics. Readings from the textbook (P. H. Raven and L. R. Berg, *Environment 3rd Edition*) and the course web site also include application of mathematics. Lectures, weekly quizzes, a written paper, and final examination also ensure that students learn and can apply mathematics. BIO 120/121 General Biology I (lecture with lab) uses quantitative mathematical analysis (homework assignments, in-class experiments and exercises, projects, papers, exams) with a variety of biology/life topics. CHM 103 Chemistry in Society; CHM 107/110 General Chemistry I lecture and lab; CHM 108/111 General Chemistry II lecture and lab. These Chemistry courses include the application of qualitative and quantitative analysis to problems, where students demonstrate their understanding through home work problems, class discussions, quizzes, laboratory experiments, logs, written papers, and examinations. CHM 470 Biochemistry I incorporates mathematics into the class activities and candidates understanding of readings and lectures. The physics courses require the application of mathematics to investigations in physics. While learning the role of the scientific process in explaining the history of the universe in PHY 108 History of the Universe, students use simple algebra, proportions, and other data such as statistics to complete assignments: homework problems, readings, classroom activities, projects, quizzes, and examination. PHY 130/131 General Physics I lecture and lab; PHY 132/133 General Physics II lecture and lab. Both courses require extensive use of calculation, measurement, equations, and other mathematics in written and on line homework and class assignments as well as in classroom discussions and laboratory experiments about dynamics, energy, fluids, motion, principles and laws of physics etc**.** **Comprehensive major candidates (50 Credit Hour Major) who select one of the Biology courses (BIO 270-Genetics, 420-Evolution, 448-Ecology) and/or of the Chemistry courses (CHM 229 Organic Chemistry II, CHM 230Organic Chemistry II Lab, CHM 387-Quantitative Analysis) as a required elective, deepen their ability to apply mathematics to investigations in the sciences.** Education courses continue candidates' development of their ability to analyze data to inform their teaching practices. In EDU 475 Curriculum and Methods of Teaching in Secondary Schools II: Science secondary candidates learn how to teach middle and secondary students the many connections between mathematics, including statistics and the analysis of data in investigations in the sciences. As the candidates explore the content, methodology, and the processes of science that are used in classroom teaching, each of the biological, earth, and physical sciences are viewed as integrated disciplines. Candidates have additional experiences with

No.	Standard/Guideline	Narrative Explaining how Required Courses and/or Experiences Fulfill the Standards for Secondary Programs
	The preparation of secondary integrated science teachers will enable them to:	
2.0 (cont.)	apply mathematics, including statistics, to investigations in the sciences, including the analysis of data;	learning how to teach the mathematics connection with science. During the third session candidates engage in a heart rate investigation from Chapter 6 of Ebenezer's text and in a soil sample demonstration from Chapter 11 during the 8th session about environment. Candidates maintain a professional folder of such lessons and supporting articles. EDU 459 Instructional Technology provides an additional opportunity to demonstrate the ability to apply mathematics to scientific investigations through a cross disciplinary authentic, technology-enriched learning activity that connects content area standards with student technology standards and meets the diverse needs of students. During their Student Teaching (EDU 490), candidates demonstrate their ability to integrate content across disciplines and are evaluated by themselves, Cooperating Teacher, and University Supervisor on their effectiveness.
3.0	relate the study of science to contemporary, historical, technological, and societal issues; in particular, relate the concepts of science to current controversies such as cloning, genetically-modified food, the use of energy, exploitation of resources, global changes, and medical research, as well as other issues;	**36 and 50 Semester Hour Major:** Students relate biology, chemistry, earth/space, and physics to contemporary, historical, technological, and societal issues though readings, discussions, and projects and experiments in their science content classes and by participating in panel discussions and lectures from outside speakers during college and university sponsored events. Some examples: In BIO 103 Environmental Science students read articles out of popular literature that relate to class issues and write a paper that analyzes the articles. They also discuss how the environmental issues impact human beings and communities. In BIO 120, students participate in a service learning project at the Detroit Science Center under the direction of UDM's Leadership Development Institute. In BIO 122/123 General Biology II students reach an understanding of humans' place in the ecosystem. In CHM 103 Chemistry and Society students learn how to apply general chemical concepts in forensic analysis. CHM 110 General Chemistry I Lab involves students in analysis of food products. CHM 227/228 Organic Chemistry I lecture and lab involve the students in readings, lectures, discussions, and laboratory investigations in which they determine the general modes of organic reaction and employ their knowledge in solving of mechanistic problems. In CHM 470 Basic Biochemistry I the students discuss the impact of chemistry on daily life as part of each topic, especially as concerns genetically modified food. In GEO 211 World Regional Geography, students read and review articles about topics such as diseases of Africa and free trade with China in which they discuss the impact of the news on the global world. In PHY 108 History of the Universe students keep a weekly journal in which they discuss articles about science and technology relevant to every day life. **Comprehensive majors (50 Semester Hour Major) have additional opportunities to demonstrate their ability to relate the study of science to real life in the 6 hours of electives they may choose from Biology and Chemistry courses. Some examples: In BIO 270 Genetics lectures and problem sets are designed to give students the genetics knowledge necessary to make informed decisions about issues of public interest such as prenatal testing and transgenic crops. In BIO 420 Evolution, discussions occur about the**

No.	Standard/Guideline	Narrative Explaining how Required Courses and/or Experiences Fulfill the Standards for Secondary Programs
	The preparation of secondary integrated science teachers will enable them to:	
3.0 (cont.)	relate the study of science to contemporary, historical, technological, and societal issues; in particular, relate the concepts of science to current controversies such as cloning, genetically-modified food, the use of energy, exploitation of resources, global changes, and medical research, as well as other issues;	**relationship between science and religion. In BIO 448 Ecology, such real world connections permeate the lecture topics and activities. In CHM 229/230 Organic Chemistry II lecture and lab the students reinforce the practices of exercising logic, attention to detail, memorization and critical thinking in the solving of organic chemical problems. CHM 387 Quantitative Analysis focuses on the application of chemistry, mathematical, and instrumentation principles to environmental studies, genetically modified foods and other biological concepts, medicine, manufacturing, and quality control.** As the discovery of new scientific concepts reaches the public (e.g. pharmaceutical) and implementation (e.g. animal cloning, bio-chemical attacks) occurs, they impact society, the schools, and what is taught to elementary and secondary students. Candidates study the impact of such issues on school finance and curriculum through the interactive lecture and discussion format of EDU 440 School and Society. Such study facilitates the candidates' understanding of the connection between scientific concepts and current human/world issues. In EDU 475 Curriculum and Methods of Teaching in Secondary Schools II: Science, candidates learn how to create lessons and experiments that help middle and high school students see how science and its procedures relate to their world. Candidates discuss, design lessons, and present them when learning how to teach constellations, earth, space, and time; electricity; kinetic molecular theory; matter and energy changes; etc. Session 8 (Chapter 11 of Ebenezer) introduces the STSE Pawel Model (Science-Technology-Society-Environment Connection), which includes the study of sustainable development. Candidates maintain a professional folder of such lessons and supporting articles. During their Student Teaching (EDU 490), candidates demonstrate their ability to correlate life experiences into areas of learning and are evaluated on their ability by themselves, their 7-12 Cooperating Teacher, and University Supervisor.
4.0	locate appropriate resources, design and conduct inquiry-based open-ended scientific investigations, interpret findings, communicate results, and make judgments based on evidence;	**36 and 50 Semester Hour Major:** The laboratory experiences encountered during the biology, chemistry, and physics introductory and general lecture/laboratory courses provide students with ample opportunities to conduct inquiry-based investigations. In BIO 121, students are required to write their experiments on the exercise sheets in their manuals. The experiment on cold acclimation must be written as a formal lab report according to a rubric. In addition to the series of labs, students complete four practical exams in which they are tested relating to the experiments performed and laboratory tasks learned. Introduced in CHM110, General Chemistry Lab I. Students are required to keep notes for every experiment conducted in a permanent notebook, which is checked regularly for completion. Every lab is written up as a one-page separate report following the standard lab report format. Two are checked for corroboration in the notebook. Quizzes are also completed to demonstrate further the students understanding of inquiry-based open-ended investigations. CHM 111 General Chemistry II Laboratory carefully spells out for students the skills needed to complete successful experiments (think critically, common quantitative chemical techniques,

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4.0 (cont.)	locate appropriate resources, design and conduct inquiry-based open-ended scientific investigations, interpret findings, communicate results, and make judgments based on evidence;	common chemical reactions, how to work in a chemistry laboratory etc). By learning these skills and designs for conducting inquiry-based open-ended scientific investigations, students are prepared to function effectively at a laboratory bench and to design original investigations. In PHY 131 General Physics I Lab and PHY 133 General Physics II Lab students conduct a series of experiments following a standard lab report format. In PHY 133 they specifically learn how to design and set up small experiments. Biology, Chemistry, and Physics classes engage students in traditional lab exercises and include open ended experiment/inquires at various points of insight. Such activities give students the foundation in inquiry based science skills necessary to teach secondary students scientific concepts and laboratory skills. The Education Department's "Conceptual Framework" clearly states that all graduates will be life long learners and professional educators who are scholars, inquirers, and ethical professionals. The "Framework" guides the Teacher Education program and courses. Throughout the Education program, candidates conduct research, interpret findings, use the data to make judgments, and communicate their results in written and oral presentations. Candidates learn how to create lessons and experiments to engage middle and high school students in inquiry-based open-ended scientific investigations in EDU 475 Curriculum and Methods of Teaching in Secondary Schools II: Science. Inquiry is introduced at the beginning of the course. The STSE model sets the basis for an in-depth exploration of curriculum sections that, in most cases, are labeled as optional extensions. Reflection inquiry is written in the text as well as application of methods of inquiry and problem solving. This includes social applications of explanations and solutions and personal reactions based upon explanations and solutions. Candidates are also taught the "Pre-service Teachers Practice During Practicum" strategy (Chapter 5 Ebenezer). As part of the activities during sessions two and three about strategies for scientific inquiry, the instructor demonstrates a lesson. The candidates observe, discuss, and become involved in groups with hands on activities. They record their observations, explanations, and diagrams and practice questions for a learning discussion: "Tell me what it means" or "Why did you say that?" As a culminating experience candidates select a lesson that includes an experiment and present it to the class for review and feedback. The Standard and Benchmark being addressed must be included. Candidates maintain a professional folder of such lessons and supporting articles. During their Student Teaching (EDU 490), candidates demonstrate their ability to design and conduct investigations for middle and high school students that are open-ended experiments, requiring interpretation of findings, the ability to communicate results effectively, and to make judgments based on evidence.

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	The preparation of secondary integrated science teachers will enable them to:	
5.0	construct new knowledge for themselves through research, reading and discussion, and reflect in an informed way on the role of science in human affairs;	**36 and 50 Semester Hour Major:** The laboratory experiences at UDM have been designed with the results of published scientific research in mind and thinking in an informed way about the role of science in human affairs. BIO 103 Environment Science lecture is a topic oriented course providing environmental information for making intelligent choices for scientific, social, political and economic issues. CHM 107/110 General Chemistry I lecture and laboratory engages students in discussions about the role of science in human affairs as the various topics are presented through readings, lectures, class activities, and laboratory investigations. PHY 108 History of the Universe focuses the first week on the scientific method (Chapter 1 "Science: A Way of Knowing in Trefil and Hazen) and applies the procedures throughout the course's weekly journal writings about science articles and the topic's application to life, readings, lectures, discussions, term project, quizzes, and examinations. GEO 211involves students in field research on the internet, print readings, discussions, and class individual and group activities. Students analyze economic activities in world regions in terms of geographic influences, human interactions with the environment, and aspects of interdependence among world regions. The skills learned in the 100 level Biology, Chemistry, Geography, Physics classes and laboratories are effectively adaptable to the work of teachers. Education faculty members require their students to construct new knowledge for themselves through research, reading and discussion and to reflect upon their practice. These qualities are required in Education class room discussions, presentations, projects, and curriculum, unit, lesson planning, papers, and presentations. Candidates learn how to create lessons and experiments to engage middle and high school students in inquiry-based open-ended scientific investigations in EDU 475 Curriculum and Methods of Teaching in Secondary Schools II: Science. As explained in Standard 4, candidates also learn the Pre-service Teachers Practice During Practicum" method (Chapter 5 Ebenezer) to create open-ended projects which include problem solving activities in the methods course. The scientific process is applicable to other aspects of professional practice. Candidates are required to reflect upon their lesson/unit designs and to set direction for themselves in terms of inquiry-based open ended scientific investigations. Their final project is to design a science unit or program and explain the program to a group of teachers, parents, and/or students. It is presented to their classmates who simulate the selected group and critique the program through questions and recommendations. During their Student Teaching (EDU 490) candidates demonstrate these skills and are evaluated on their effectiveness by themselves, the 7-12 Cooperating Teacher, and University Supervisor.

No.	Standard/Guideline	Narrative Explaining how Required Courses and/or Experiences Fulfill the Standards for Secondary Programs
	The preparation of secondary integrated science teachers will enable them to:	
6.0	understand and promote the maintenance of a safe science classroom as identified by the Council of State Science Supervisors, including the ethical and appropriate use and care for living organisms and scientific equipment, and the safe storage, use, and disposal of chemicals;	**36 and 50 Semester Hour Major:** Safe laboratory procedures are explained during the first session of any Biology, Chemistry, and Physics laboratory course and verbally reinforced at the beginning of each laboratory session. Signs throughout the labs reinforce these safe practices with scientific equipment and the safe storage, use and disposal of chemicals. Teacher Education candidates see the qualities of a safe classroom during the field study/case study project in EDU 401/402 Introduction to Elementary and Secondary Education when they spend time in a 7-12 grade classroom of their major and/or minor. EDU 469 Curriculum and Methods of Teaching in Secondary Schools, which includes study of classroom leadership/management, will enhance the candidates' ability to provide safe classrooms. While the Council of State Science Supervisors' document is not referenced specifically in the syllabus, candidates will use it as they design lessons/units that must reference the *Michigan Curriculum Framework*'s bench marks for science. The unique requirements for safety in a science classroom and laboratory are studied and demonstrated in the science methods course, **EDU 475**. A two part detailed handout based on safety guidelines from the Michigan Council for Teachers of Science and the MDE *Michigan Curriculum Framework* is distributed to the candidates during the second session. It includes guidelines for teachers and what every secondary student must know about safety and follow in a 7-12 classroom. Safety and ethical issues are reinforced in all class handouts, especially for the unit project which is based on the ELSMT. During their Student Teaching experience, candidates are expected to follow and enforce the policies of the school to which they are assigned.

No.	Standard/Guideline	Narrative Explaining how Required Courses and/or Experiences Fulfill the Standards for Secondary Programs
	The preparation of secondary integrated science teachers will enable them to:	
7.0	demonstrate competence in the practice of teaching as defined within the Entry Level Standards for Michigan Teachers;	**36 and 50 Semester Hour Major:** The *Entry-Level Standards for Michigan Teachers* (*ELSMT*) is one of the resources that were used when the Education Program and courses were designed. It continues to be referenced as the methods courses are taught and revised. In EDU 401/402 Introduction to Elementary and Secondary Education, candidates are introduced to the Department's *Conceptual Framework* and Education Department goals for their candidates. Candidates use them as guides as they reflect on a life in teaching and complete their action research based on observations, activities, and interviews in a 7-12 district and classroom. In Education core courses such as EDU 420 Education Philosophy and EDU 440-School and Society candidates reference MDE guidelines in their discussions and written and oral assignments. EDU 432 Psychology of Education requires candidates to demonstrate teaching skills that reflect both *MCF* and ELSMT guidelines in 7-12 tutorial settings and in the university classroom. SED 460 Education and Mainstreaming of Exceptional Persons also requires candidates to reference them in their adaptive lesson plan and presentation and other assignments. The general secondary methods courses, such as EDU 459-Instructional Technology and EDU 478 Reading in the Content areas, require candidates to design and present instructional strategies specific to their disciplines and to reference state standards and benchmarks, including ELSMT. In EDU 469 Curriculum and Methods of Teaching in Secondary Schools, the candidates learn the basics of secondary curriculum, unit, and lesson design and they are required to reference appropriate MDE sites to explain their decisions. The *MCF* is correlated with the ELSMT, so Education candidates also reference it as they develop lessons and units built around the specific 7-12 standards and bench marks in EDU 475 Curriculum and Methods of Teaching in Secondary Schools II: Science. To ensure that student presented lesson and unit plans address the ELSMT, the candidates receive a copy of the ELSMT during the fourth session; and it is referred to throughout the course. By the time candidates have their student teaching assignments, they are familiar with the ELSMT and *MCF* for secondary sciences. They demonstrate their competence in the practice of teaching in 7-12 science classrooms and are evaluated on indicators based on the ELSMT. As part of this state review process, an Education committee compared the final evaluation forms used to evaluate candidates' performances during Student Teaching (EDU 490) with the MDE "Criteria for an Assessment of Pedagogy." The members agreed that the forms continue to be complementary with the ELSMT and identified criteria such as use of technology and classroom management skills that may need enhancement in future editions.

No.	Standard/Guideline	Narrative Explaining how Required Courses and/or Experiences Fulfill the Standards for Secondary Programs
	The preparation of secondary integrated science teachers will enable them to:	
8.0	create and maintain an educational environment in which conceptual understanding will occur for all science students;	**36 and 50 Semester Hour Major:** The Biology, Chemistry, Geography, and Physics courses all maintain an environment in their classrooms and laboratories where students can develop conceptual understanding of the individual sciences as well as the integrated nature of science. Once again, Education candidates enter the Education program with these conceptual understandings. By design, diversity issues are included in the Education courses. Candidates are required to design lesson/unit plans that speak to the experiences and abilities of all students regardless of gender, socio-economic status, ethnicity, and special needs. In EDU 432 Psychology of Education, candidates learn various theories of child growth and development and use them to analyze their 7-12 classroom observations, in class cooperative learning experiences, and supervised clinic tutoring experiences, as well as discuss their application in the 7-12 class room as part of their final paper. In SED 460 Education and Mainstreaming of Exceptional Persons, the principles of mainstreaming and the instructional methodologies and approaches to meet the needs of the various exceptionalities within the "least restrictive environment" and/or general classroom setting are examined and explored. The candidates develop and present to the class a lesson plan adapted for at risk/special education students. Integrated Science students would present a lesson dealing with teaching science concepts. At least three sessions of EDU 469 Curriculum and Methods of Teaching in Secondary Schools I are devoted to "concept attainment." Candidates are involved in pre class readings; class lectures, discussions, plus designing and presenting lessons for teaching concepts of the various disciplines. Science candidates focus on the concepts as identified in the *MCF* for science. In EDU 475 Curriculum and Methods of Teaching in Secondary Schools II: Science, Education candidates learn how to create and maintain a positive grades 7-12 classroom environment for conceptual understanding of science principles and skills. Conceptual learning strategies are part of what candidates look for during their weekly observations and collecting of articles and lesson plans to include in their professional folders. They also address concepts in their inductive and deductive lesson plans, various inquiry based lesson plans, technology enhanced lesson plans, and in their final written unit plan for presentation to a simulated adult audience during class. The Student Teaching experience (EDU 490) provides the candidates with the final opportunity to demonstrate their abilities to teach conceptual understanding to all students. It is imbedded in a number of indicators on the evaluation sheets used by the candidates themselves, the 7-12 Cooperating Teachers, and the University Supervisor. (*Student Teaching Handbook* on the web site) For example: Understands and applies developmental and psychological knowledge of children; provides for individual differences; provides for diverse and special needs; exhibits subject area content mastery; monitors students' progress and adjusts the teaching; integrates content across disciplines; and, provides high engaged time on task participation.

No.	Standard/Guideline	Narrative Explaining how Required Courses and/or Experiences Fulfill the Standards for Secondary Programs
	The preparation of secondary integrated science teachers will enable them to:	
9.0	develop an understanding and appreciation for the nature of scientific inquiry; and	**36 and 50 Semester Hour Major:** The classroom activities and laboratory experiences in the Biology, Chemistry, and Physics courses are designed to promote inquiry-based investigations and appreciation for the scientific method. Integrated Science candidates begin their Education program with this understanding and mind set about the nature of scientific inquiry. The assignments, projects, presentations, discussions, and other instructional practices in the Education courses continue the candidates' involvement in scientific inquiry and how to help middle and high school age students learn and appreciate the nature of scientific inquiry. During their student teaching (EDU 490), Integrated Science candidates are evaluated on this standard as part of the "Applies appropriate classroom management skills" and "Utilizes creative judgment in the teaching process" indicators. (Appendices of the *Student Teaching Handbook* on the web site.) Please see the responses in the science content standards (1.0 – 1.8.2.4, plus 4 and 5.)

No.	Standard/Guideline	Narrative Explaining how Required Courses and/or Experiences Fulfill the Standards for Secondary Programs
	The preparation of secondary integrated science teachers will enable them to:	
10.0	demonstrate competence in the practice of teaching through investigative experiences and by demonstrating the application of the scientific process and in assessing student learning through multiple processes.	**36 and 50 Semester Hour Major:** The mixture of lecture, lab, small group learning, problem solving, library research, technology based research, and student presentations in the Biology, Chemistry, Geography, and Physics courses demonstrates that candidates reach the Education program having experienced these principles and assessment practices in their science courses. The Education faculty continues a variety of investigative experience, research procedures, and assessment processes in their courses beginning with the field observations and case study presented in print and speeches in EDU 401/402 Introduction to Elementary and Secondary Education. Students are regularly engaged in creating objective driven assessments for class assignments. Assessment practices are also addressed in EDU 432 Psychology of Education and in SED 460 Education and Mainstreaming of Exceptional Persons. At least three sessions in EDU 469 Curriculum and Methods of Teaching in Secondary Schools I are devoted to teaching the basics of assessing secondary student learning and the candidates demonstrating their ability to design and use such assessments. As explained previously in Standards 4, 5, and 9, candidates demonstrate their competence in the practice of teaching through investigative experiences in EDU 475 Curriculum and Methods of Teaching in Secondary Schools II: Science and during EDU 490 Student Teaching. In EDU 475 candidates are given reflecting and assessing rubrics for application to their own work as well as with the textbook models reviewed and discussed in class. Assessment is addressed through readings and classroom demonstrations, activities, and discussion for these topics: assessment (Ebenezer, pp. 348-388); authentic and continuous assessment (351-379 and 353-365); culminating experiences (365-379); designing process (299-300); developing self-directed learners (400); graphic organizers (360-361); interviews (355-359); performance based--MEAP proficiencies, portfolios, especially use of multiple intelligences allowing for different styles of learning (361-365); projects (361 plus); reporting student progress and researching teacher practices (400 plus); science investigations (373); scoring keys and guides (379-381); standardized tests; student journals (159-160); teacher-made observations (359 plus); and written tests (365-371). During their Student Teaching experience (EDU 490), candidates are involved in the assessment practices of the assigned classroom and grade 7-12 cooperating teacher and are evaluated on their effective use of a variety of assessment practices and their ability to communicate the information to students and parents.