

Program Summary

Integrated Science (DI): Secondary Comprehensive Major and Group Major

The University Detroit Mercy (UDM), a Catholic institution whose mission flows from the educational traditions of the Sisters of Mercy of the Americas and the Society of Jesus, exists to provide excellent student-centered undergraduate and graduate education in an urban context. A UDM education seeks to integrate the intellectual, spiritual, ethical, and social development of students. It emphasizes the worth of the individual. Further, the University expects its diverse graduates to be distinguished world citizens, community members, and leaders who:

- Reflect on the meaning of their lives.
 - Think and communicate clearly, imaginatively, and effectively.
 - Process the skills and competencies of a college education.
 - Understand diverse cultural heritages.
 - Have a sense of social responsibility and a desire to serve society.
- (2003-2005 Undergraduate Catalog, 89-91)*

UDM's Core Curriculum consists of a set of requirements (48 hours) based on six objectives that express, in further detail, this academic purpose. The list of approved core courses is published in the *Schedule of Classes* issued for each term. Education students taking their majors in the College of Engineering and Science (CES) must complete the same Core Curriculum as all UDM students with specific recommendations from Core options in Objectives 1, 2, 3, 5 and 6; Objective 4 remains the same as the general Core Curriculum outline requirements. The specific CES recommendations are:

Objective 1 Communication Skills—Take CST 101 Fundamentals of Speech and ENL 131 Academic Writing.

Objective 2 Mathematical and Computer Skills—Take MTH 140 (or MTH 141/142 depending on the program) and Computer Science (Required course depends on program).

Objective 3 Scientific Literacy—At least two courses must be in Natural Science. In some programs, all courses may be selected from Natural Science. BIO 103, BIO 108, CHM 103, and PHY 108 are included in the list of courses that fulfill this UDM core objective.

Objective 5 Diverse Human Experience—Two courses from 5A (History and Religious Studies), 5B (Literary Experiences), and 5C (Aesthetic Experiences). Take one course from 5D (Comparative Experiences).

Objective 6 Social Responsibility— (Education students choose one course from any of the Ethics courses.)

Contemporary Socio-Political Problems—(Education students choose one course from the general core outline--depending on the program.) BIO 499, CHM 429, CHM 474 and EDU 440 are included in the list of courses that fulfill this UDM core objective. *(Class Schedule on WEB site)*

The Integrated Science Education courses for majors for Secondary certification are offered by the Biology, Chemistry and Biochemistry, and Physics Department in the

College of Engineering and Science plus Geography in the College of Liberal Arts and Education.

The Department of Education, housed in the College of Liberal Arts and Education (CLAE), offers baccalaureate, post-degree, and master's degree teacher education programs with State of Michigan certification in three areas: Elementary Education, Secondary Education, and Special Education. Each program requires the completion of coursework in three areas:

- University core curriculum.
- A teaching major and minor in approved academic areas.
- Professional education, including student teaching.

In addition to these programs, UDM Education Department delivers the same graduate and postgraduate certification programs to cohorts of K-12 Detroit Archdiocese teacher candidates through Experience Plus. All programs may be completed on a full or part-time basis either during the day, late afternoon, evening, or weekend. UDM majors and minors in Elementary, Special Education, and/or secondary education are completed in the following colleges and appropriate departments:

- ∞ College of Business Administration
- ∞ College of Engineering & Science (Includes Mathematics) and
- ∞ College of Health Professions
- ∞ College of Liberal Arts

The Department of Education, therefore, works closely with the faculty members throughout the University to ensure that each student is effectively advised and assisted to complete her/his Education program with a quality major and/or minor.

UDM offers teacher certification in Integrated Science (DI) for students who wish to teach in secondary schools. The Integrated Science group major for Secondary Certification is a program of 43 hours. It includes is a program of 30 required hours from Biology, Chemistry, and Physics, completed in the College of Engineering and Science, and Geography, completed in the College of Liberal Arts and Education plus 13 additional hours in General Chemistry, Organic Chemistry, and Biochemistry. The Secondary comprehensive major is a program of 56 hours, which includes the same 43 hours as the Secondary group major plus 3 additional hours in Chemistry, 3 additional hours in Environmental Science, 1 additional hour of Physics laboratory, and 6 hours of electives selected from these courses: BIO 270 Genetics, 420 Evolution, 448 Ecology, CHM 229 Organic Chemistry II, 230 Organic Chemistry Laboratory II, or CHM 387 Quantitative Analysis. The *Michigan Curriculum Framework* for Integrated Science specifies the guidelines for integrating basic concepts and scientific inquiry skills into real-world contexts throughout the Secondary grades. Those concepts include the areas of Life Science (cells, organization of living things, heredity, evolution, ecosystems); Physical Science (matter and energy, changes in matter, motion of objects, waves and vibrations); and Earth Science (geosphere, hydrosphere, atmosphere and weather, solar system, galaxy and universe). UDM students take classes that give them an in depth knowledge of these concepts and the appropriate science inquiry skills to become an secondary education teacher.

A. Philosophy, Rationale, and Objectives

Philosophy: The science faculty members, housed in the Biology, Chemistry and Biochemistry, and Physics Departments in College of Engineering and Science and the Geography faculty member in the Education Department work together with the Education faculty to prepare teacher education candidates for the Integrated Science teacher certification. The philosophies of these departments are complementary. They all believe that theory and scholarly research need to be placed in the proper historical, social and political context. They seek to integrate laboratory and field experience into the learning process so that students not only learn about their discipline but also construct knowledge in a real and tangible manner. Students, thus, have the advantage of developing a knowledge and skill base which empowers them to be active, positive contributors to the local, national and global societies. In order to teach students from diverse backgrounds, socio-economic status, and abilities in urban, suburban, and rural settings, UDM Education, Geography, and Science faculty believe that a strong pedagogy program must be a full partner with academic knowledge.

Rationale: The role of science in today's complex and highly technological society is considered as a critical determinant to our future as a global community. With this in mind, the faculties of the Science and of the Education Departments strive to provide an education which integrates the intellectual, spiritual, moral and social development of their students. This integration requires a solid base of discipline knowledge which demonstrates the interrelationships within the discipline as well as those relationships with other disciplines. It is through this kind of study that students learn and practice the knowledge and skills required to be inquiring, reflective, ethical and value-driven educators. Preparation for the Integrated Science secondary teacher certification enables teacher candidates to use this knowledge and skill base to make knowledgeable, practical and creative applications of theory as well as to identify issues and solve problems which challenge our ability to create a better world.

In today's complex world, science teachers need to use the skills of the art and science of teaching to teach their students to learn how science can help them to be productive members of society. Current developments such as environmental impact of chemicals, increased production of pollutants, uses of radioactivity in modern society, nuclear power, the application of biochemical principles in recombinant DNA technology, ecological and environmental problems, and space exploration require ethical, caring, responsive citizens capable and willing to make knowledgeable decisions. The Integrated Science program of studies is designed to provide the knowledge, skills, and practice that Teacher Education students need in order to be competent educators in this regard.

Objectives: The general objectives for the preparation of all Elementary and Secondary teacher education candidates, including those with Integrated Science Majors and Minors, are delineated in the "Education Department's Conceptual Framework," which is published annually along with the "Education Department's Code of Ethics" in its *Teacher Education Handbook*. This "Framework," which complements the Michigan Department of Education's Standards for the Elementary and Secondary Integrated Science programs and the Entry-Level Standards for

Michigan Teachers (ELSMT), identifies three dimensions of the role of teacher:

- ∞ A *scholar* who uses the research-knowledge base for teaching integrated with the liberal arts and sciences disciplines.
- ∞ An *inquirer* who is skilled in decision-making based on ethical, critical, and reflective thinking.
- ∞ A *moral agent* who values and acts according to the UDM values and the “Department of Education Professional Code of Ethics.”

These general objectives, in addition to complementing the University mission and the Biology, Chemistry, Geography, and Physics faculties’ philosophies, reflect the key ideas expressed by the Michigan State Board of Education-August 2002 Content Guidelines/Standards (SBE Standards) and the “*Michigan Curriculum Framework Content Standards for Integrated Science*”. Additionally, they are aligned with the Michigan Test for Teacher Certification (MTTC).

These content categories have been reviewed by the Science, Geography, and Education faculty, who believe that the Integrated Science program of studies effectively prepares candidates for certification as teachers of science in the Secondary classroom as follows:

Sub area: Secondary

**Approximate Percentage
Of Questions on Test**

Constructing and Reflecting on Scientific Knowledge	25%
Life Sciences	25%
Earth/Space Sciences	25%
Physical Sciences	25%

Constructing and Reflecting on Scientific Knowledge

Understand and apply the principles and procedures for conducting scientific research.

Apply knowledge of methods and equipment used in scientific investigations.

Understand the nature and history of scientific thought and inquiry.

Understand the relationship of science and technology to contemporary, historical, and societal issues.

Understand interrelationships among the life, physical, and earth/space sciences and their connections to mathematics and technology.

Life Sciences

Understand cell structure and function.

Understand the organization, characteristics, and functions of living things.

Understand characteristics of human biology.

Understand concepts of heredity and modern genetics.

Understand evolutionary change of life on Earth.

Understand characteristics of ecological systems.

Earth/Space Sciences

Understand characteristics of the lithosphere and the history and processes of the changing earth.
Understand characteristics of the hydrosphere.
Understand the earth's atmosphere, weather, and climate.
Understand features of the universe and the methods of astronomy.

Physical Sciences

Understand the chemical properties of matter.
Understand the nature of chemical changes in matter.
Understand the physical properties of matter, the ideal gas laws, and the nature of physical change in terms of molecular behavior.
Understand and apply the concepts of mechanics.
Understand and apply the concepts of electricity and magnetism.
Understand and apply the basic concepts of energy and thermodynamics.
Understand the characteristics of waves and vibrations and the properties of light and sound.

B. Sequence of Courses and/or Experiences

UDM's College of Liberal Arts and Education offers baccalaureate, post-degree, and master's degree teacher education programs with State of Michigan certification in three areas: Elementary Education, Secondary Education, and Special Education.

Each program requires the completion of coursework in these areas:

- ∞ University core curriculum.
- ∞ A teaching major and a teaching minor in approved academic subject areas.
- ∞ Professional education, including field experiences and student teaching.

The UDM 48 Hour Core Curriculum is explained in the *2003-2005 Undergraduate Catalog* (89-91) and is published, with a list of approved courses for each of the six objectives, in the *Class Schedule* for each of the three terms (16-18 Term I 2003-2005). Education students are encouraged to select courses that will complement their certification as well as their major and minor areas of study. For example: Integrated Science students would be encouraged to select courses in the Mathematics, Science, Social Studies, Literature, and the Fine Arts that would complement their Integrated Science major as well as another area of study as required for secondary certification with the Integrated Science group major. Those objective areas are:

1. Communication Skills (6 hours; 2 courses—Speech and Academic Writing).
2. Mathematical and Computer Skills (6 hours—choices in Mathematics and Computer).
3. Scientific Literacy (9 hours—choices from the Social Sciences and Natural Sciences).
4. Meaning and Value (9 hours—choices from Philosophy, Religious Studies).
5. Diverse Human Experience (12 hours—choices from Historical, Literary, Aesthetic, Comparative Experiences and Languages).
6. Social Responsibility (6 hours—choices from Ethics and Contemporary Social Problems, ranging from Philosophy, Health Services, Religious

Studies across Social and Natural Sciences, Criminal Justice, Communication, Women's Studies.)

The sequence of courses listed in Form XX for the Integrated Science (DI) Secondary majors provides a systematic study of the fundamental knowledge of the science disciplines, their methods of inquiry, and their interdisciplinary relationships among the sciences as well as with mathematics and other disciplines such as English and the Social Sciences. Courses are offered from four departments in two University of Detroit Mercy colleges (College of Engineering and Science and College of Liberal Arts and Education). The courses selected for each program from Biology, Chemistry, Geography, and Physics effectively provide Education candidates with an Integrated Science foundation for teaching elementary science and for teaching basic secondary biology, chemistry, earth/space science, and physics courses. The courses in the Biology, Chemistry, Geography, and Physics develop the students' understanding of the fundamental concepts that comprise the respective disciplines' content and the methods used to create knowledge in each discipline. Teacher education students engage in both constructing and reflecting on scientific knowledge as they engage in both theory and laboratory courses involving the basic/general concepts of each discipline. The programs are compatible with major and minor programs in each of the sciences, thereby providing the students with the viable option of pursuing a career in a science field (dental and medical tracks) and in teaching concomitantly. The candidates learn how to teach the sciences in the Education program, which is initiated by the end of the Sophomore year. Candidates, however, may only take six Education hours without passing all three sections of the Michigan Basic Standards Test (MBST).

The Mathematics prerequisite for CHM 107/110 General Chemistry I lab and lecture is MTH 140 Elementary Functions; its prerequisite is MTH 101 Algebra, which has MTH 095 Elementary Algebra or equivalent as a prerequisite. The Mathematics prerequisite for PHY 130/131 General Physics I lecture and lab is Algebra. Students are assigned to an initial Mathematics course to meet the three hour UDM Core Curriculum (MTH 101 or MTH 111 Mathematical Analysis 1 or higher) depending on their UDM COMPASS math placement test, review of academic records and ACT and/or SAT math score with an academic advisor, and the student's college program. Integrated Science candidates Secondary certification, therefore, take MTH 101 Algebra or higher during their first Freshman semester on campus to prepare themselves for CHM 107/110 General Chemistry I lecture and lab either during their second Freshman semester or later and for PHY 130/131 General Physics I lecture and lab, which is usually taken during their Junior year. Candidates take BIO 120/121 General Biology I lecture and lab first and then BIO 122/123 General Biology II lecture and lab, usually during their Freshman year. Once their Mathematics requirement is met they may begin the Chemistry sequence with CHM 107/110. Secondary majors then may take CHM 108/111 General Chemistry II lecture and lab. Secondary majors continue with CHM 227/228 Organic Chemistry I during their Sophomore and/or Junior years. PHY 108 History of the Universe and GEO 211 World Regional Geography may be taken at any point of Secondary program, but both should be completed by the candidates' Junior year. They then enroll in PHY 130/131 General Physics I lecture and lab and PHY 132/133 lecture and lab during their Junior year in order to be prepared for the MTTC, which must be passed prior to being

assigned to student teaching during their final university year. Secondary group majors are not required to take PHY 133 laboratory. BIO 103 Environmental Science and CHM 103 Chemistry in Society, required for the Secondary comprehensive major may be taken at any point of the students' university career, and is most often delayed until after the General Biology and Chemistry courses when the candidate has definitely chosen Education as their career. Both courses along with PHY 108 and GEO 211 provide candidates with a clear understanding of the integration of science needed to teach 7-12 students. Secondary comprehensive majors are then positioned to take the required CHM 470 Basic Biochemistry I and six hours of required electives from these choices: BIO 270 Genetics, BIO 420 Evolution, BIO 448 Ecology, CHM 229 Organic Chemistry II, CHM 230 Organic Chemistry Laboratory II, CHM 387 Quantitative Analysis.

C. Varied Instructional Approaches

The Biology, Chemistry, Geography, and Physics faculties and the Education faculty prepare students to utilize a variety of instructional approaches by modeling creative, logical, and effective teaching practices in their classes and laboratories. A review of the Integrated Science course syllabi reveals the range of teaching methods used by the various faculty members to instill the skills and knowledge of each discipline: lectures, discussion, study guides, textbooks, laboratory experiments and reports, films, quizzes, use and review of web sites, critical analysis of articles from scholarly journals, essays, and examinations. A review of the Education Syllabi on the UDM WEB reveals a similar range of teaching methods practiced by the Education faculty. Educators also include group/team/collaborative activities, building a community of learners, both non-fiction and fiction analysis, field observations and research, written and oral presentations enhanced with electronic equipment/programs, and other education projects and assessment tools. A review of the Education Courses listed in Form XXX, the "Course Descriptions," and the course syllabi on the WEB link explicates the wide range of instructional methods taught to Elementary, Secondary, and Special Education teacher candidates. EDU 400 Introduction to Education provides a semester long initial field experience with the "Field Research/Case Study" where students observe and work with a teacher in their major and/or minor areas. This project allows them to observe a variety of instructional strategies and to reflect upon their effectiveness and appropriateness for their developing teaching style. In addition to a variety of technology methods used and demonstrated in all the Education courses, EDU 459 Instructional Technology and EDU 600 Computer Use in Education teach a variety of instructional approaches for using many kinds of technology to assess various learning styles of students and to accommodate those learning styles. These courses also develop the candidates' knowledge, skills, and attitudes for applying technology in education settings. As the candidates develop their assignments, the science candidates focus on their majors and minors. These courses were developed to address the Seventh Standard of the Entry Level Standards for Michigan teachers. Secondary candidates take the same core Education courses, but a series of different secondary methods courses. In EDU 469 Curriculum and Methods of Teaching in Secondary Schools I, students are introduced to secondary level curriculum and instructional methods. Topics include methods of instruction, classroom leadership/management, lesson designs, assessment, evaluation, and reporting of student progress. In EDU 475 Curriculum and Methods of Teaching in

Middle and Secondary Schools II: Science, they are asked to consider the sciences and geography as they concentrate on learning the theory behind instructional methods uniquely effective for teaching and learning every science discipline. They also have opportunities to observe and reflect about learning in grade 7-12 classrooms as well as to practice methods within the college classroom and in grade 7-12 classrooms. EDU 478/578 Reading in the Content Areas provides instruction in a variety of methods for teaching reading to secondary students across the curriculum. Student teaching, EDU 490, for secondary candidates (7-12 grades), provides students with a full semester of appropriate grade level real teaching experiences with grade 7-12 cooperating teachers and college supervisors. Observations early in those courses and seven seminars complement their experiences and encourage self reflection and feedback about their instructional methods in collaboration with grade 7-12 cooperating Teachers and UDM college/university supervisors. A Secondary candidate is assigned to a secondary teacher of science, preferably one who teaches more than one discipline. If at all possible, the cooperating teacher to whom the group majors are assigned also teaches a class in the candidate's minor area.

D. Elementary and Secondary Level Preparation Differences

The main differences are in the number of content area courses. Elementary candidates are required to complete 29 hours for an Integrated Science minor; 41 hours for a major. They complete 37 hours in the Education program where the only difference from the secondary are in the methods courses and an additional 3 hours in Reading and Language Arts. Eight hours of student teaching are included in the 37 hours. The Secondary candidates complete 43 hours for an Integrated Science group major plus a minor in another discipline, which may be a specific science; 56 hours for a comprehensive major. Their Education program consists of 34 hours, including 8 hours of student teaching.

E. Gender Equity, Multi-cultural, and Global Perspectives

Integrated Science majors and minors learn to incorporate issues of gender equity, multicultural and global perspectives which are addressed within their University Core Curriculum courses. Objective IV- Meaning and Value (9 hours), Objective V- Diverse Human Experience (9 hours) and Objective VI-Social Responsibility (5-6 hours) require all students to select classes from Philosophy, Religious Studies, History, English, Human Services, and/or the Fine Arts. Instructors in the science courses take care to provide a comfortable learning environment for those whose voices have traditionally been stifled in the sciences and mathematics. The College's success is documented by the National Science Foundation's recognition that the College of Engineering and Science has a highly favorable rate for admission and graduation of women. The College was sought out for recipients of Clare Boothe Luce Scholarships in Physical Sciences and Engineering; it will have two Luce Scholars in programs beginning in fall 2005. The Education Courses continue the infusion of equity issues throughout the program.

F. Multiple Methods of Student Assessment

Integrated Science minors and majors learn a variety of assessment tools from personal experience in every content course, which are then adaptable to their own teaching. All courses rely on regular quizzes and examinations to assess the students' knowledge. For example, quizzes and exams in BIO 120 and BIO 122 include

objective type questions and problems that are evaluated using rubrics that connect the students' theoretical knowledge to practical, real life situations involving principles of Biology. In the complementary laboratories (BIO 121 and 123), students write lab reports that are assessed regularly. They are taught how to assess their work in laboratories and how to write standard laboratory reports according to specific guidelines. These guidelines acquaint students with professional publishing formats, and serve as a check list to ensure proficiency in scientific methodology, statistical usage and data interpretation, practical use of technology, and application of biological concepts. Classroom exams, exercises, problem sets, and/or short papers are also included as a percentage of the students' grade in courses such as: BIO 103, 270, 420, and 448. Quizzes and exams in CHM 107 General Chemistry I and CHM 108 include objective type questions and problems that are evaluated using rubrics that connect the students' theoretical knowledge to practical, real life situations involving principles of Chemistry. In the complementary laboratories, students keep permanent notebook lab notes about experiments and write lab reports that are assessed regularly. They are taught how to assess their work in laboratories and how to write standard laboratory reports according to specific guidelines. Homework assignments and problem sets are also included as a percentage of the students' grade in courses such as: CHM 111, 227, 228, 229, 230, and 470. Quizzes and exams in History of the Universe (PHY 108) include objective type questions and short answer questions that are evaluated using rubrics that connect the students' theoretical knowledge to practical, real life situations involving principles of Physics. In both General Physics I (130) and Laboratory (131) and in General Physics II (132) and Laboratory (133), students are taught how to assess their work in laboratories and how to write standard laboratory reports according to specific guidelines. Homework assignments are also included as a percentage of the students' grade in courses. The Geography course (GEO 211) also assesses with homework article reviews, in class activities, quizzes, field research, and examinations.

The Education courses continue to model and to teach a variety of assessment processes, including authentic models and/or other alternative assessments procedures. In methods EDU 469, portfolio assignments must include assessments appropriate to the lesson's or unit's objectives and the specific content being taught. Students become familiar with a variety of assessment tools and practices. They are also taught how to construct student-led conferences and demonstrate their ability to the peers in the class. EDU 475 (Science Methods) teaches students a variety of evaluative strategies for use in dealing with specific problems in science instruction; students demonstrate their acquisition of assessment skills through written and oral presentations. They also develop a "science and management kit" that is composed of a series of folders, one of which must include articles about a variety of assessment processes and their plans for assessing their future students. The evaluation forms used by the grade 7-12 cooperating teachers and the University supervisors in Student Teaching (EDU 490) include evaluation of the assessment practices use by the student teachers to evaluate the performances of their 7-12 students.