

COVER SHEET
Initial Science Education

National Science Teachers Association

Please submit two copies of this cover sheet.

SUBMITTED BY: Loyola College in Maryland
(Name of Institution)

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DATE: 15 SEP 2000 PHONE: 410.617.5377

DATE OF ON-SITE VISIT: Spring 2002

NAME OF PROGRAM OFFERED FOR REVIEW IN THIS DOCUMENT: _____

Secondary Science Content and Certification Programs

Please list the programs offered by your institution in outline form, distinguishing them by: (a) level of the program (undergraduate [UG], postbaccalaureate [PB], graduate [G]); (b) grade range for which preparation is intended; (c) science subjects in which candidates would be licensed to teach; and (d) nature of preparation (single field [SF], dual field [DF], broad field [BF], minor or endorsement [M/E], or other [O]). **See the example under the instructions for clarification.** (For large or complex programs, attach a sheet with this information.)

<u>LEV</u>	<u>GRD</u>	<u>SUBJECT(S)</u>	<u>NAT</u>	<u>MAT</u>
UG	7-12	Chemistry	SF	1
UG	7-12	Secondary Chemistry Certification	SF	1
UG	7-12	Biology	SF	2
UG	7-12	Secondary Biology Certification	SF	2
UG	7-12	Physics	SF	3
UG	7-12	Secondary Physics Certification	SF	3

Checklist of materials to be enclosed with this program review document:

For the overview and scope of the program, please provide:

Table of contents.

Explanation of the knowledge base, philosophy for preparation, and goals and objectives of the program.

Overview of the program and how science education relates to other fields of study in education and in the sciences.

C. List of faculty with primary assignments in the specialty area, including rank, responsibilities and tenure status. (Do not send vitae.)

- C. The number of graduates from the program over the last three years, or an explanation if there have been none over that period.
- C. Criteria used at admission to post-baccalaureate programs to determine if the candidate has adequate content background in the subject to be taught.

Matrices
 Appendices

This section should include *any documentation* needed to validate assertions made in the matrix. This could include, but is not limited to:

- Program descriptions and course(s) of study including courses and sequences taken by semester/quarter/trimester. **Clearly distinguish required from elective courses.** Advising sheets are suggested for all programs.
- Syllabi as needed to validate indicators, learning experiences and assessments.
- Copies of significant assessment instruments or descriptions of criteria for assessment not found in syllabi.
- Data summaries and analyses based on candidate performance.
- Documentation of goals for improvement of science education over the next five years and the basis for selecting these goals.

NOTE: The appendices should be limited to a maximum of 100 pages. The complete program review document should be no more than 140 pages.

I verify that the information provided in this program review document is accurate and true:

	Dr. Victor R. Delclos
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Undergraduate Science Major/Education Minor & Secondary Science Certification Program

Knowledge Base

Following the initial suggestions for science literacy standards put forth in *Science For All Americans* (AAAS, 1989), Project 2061 organized specific grade-appropriate science content goals for achieving literacy in *Benchmarks For Science Literacy* (AAAS, 1993). In each of these works, considerable attention was paid to the unifying themes in the sciences to be studied in the country's schools. The importance of these themes is reflected by the inclusion of content standards for each science discipline in the *National Science Education Standards* (NSES) (National Research Council, 1995). Also included in the NSES are specific standards for science teaching, professional development of science teachers and assessment of science education, as well as standards for science education programs and systems.

Many of the changes in science education, as called for in the NSES, concern the manner in which students are taught science. Hands-on, minds-on, inquiry-based learning, where students are able to personally construct meaning in scientific endeavors and relate them to societal issues are some of the major tenets of the NSES reforms in science teaching. But the NSES go beyond current trends in constructivist, inquiry-based classroom teaching to propose that teacher preparation and professional development programs should be conducted in the same manner, using the same teaching methods as outlined for the elementary and secondary schools. Not only should good science teaching be grounded in current teaching methods and science-related pedagogy, but teachers should enter the classroom with significant experiences in science content, and scientific and technological strategies for the investigation, analysis and presentation of socially relevant problems in science. Intended for pre-service and in-service science teachers alike, the NSES Professional Development Standard A states, in part:

“Professional development for teachers of science requires learning essential science content through the perspectives and methods of inquiry. Science learning experiences for teachers must:

- Involve teachers in actively investigating phenomena that can be studied scientifically, interpreting results, and making sense of findings consistent with currently accepted scientific understanding.**
- Address issues, events, problems, or topics significant in science and of interest to participants.**
- Introduce teachers to scientific literature, media, and technological resources that expand their science knowledge and their ability to access further knowledge.”**

Involving teachers in authentic, relevant investigations requires them to perform like researchers, employing scientific thinking and using available technology to accomplish their task. The ultimate goal is for these teachers to translate their understanding of the workings of scientific research into appropriate classroom curriculum and learning experiences for their students. Students majoring in Biology, Chemistry, and Physics at Loyola who wish to minor in Education or obtain secondary teaching certification are taught science content and teaching methodology through solid programs which uphold the ideals of the *Benchmarks* and the NSES. Candidates are well-grounded in their scientific knowledge through investigations in cellular/molecular, organismal, and population biology in the Biology major, analytical, biochemical, inorganic, organic, and physical chemistry in the Chemistry major, and mechanics, electromagnetism, thermodynamics, optics, and quantum theory in the Physics major.

The Education Department at Loyola supports the firm content foundations of the departments of Biology, Chemistry, and Physics by preparing candidates majoring in the sciences to teach at the secondary level in Maryland. Candidates explore the major theories and principles of learning, motivation, and assessment, in light of current research and the application to learning and teaching. Students learn to appreciate the theoretical complexity of teaching and learning and to develop conceptual tools for working with students by thinking critically about, and discussing various issues related to learning in and out of schools. They learn to articulate a clear theory of learning and motivation, based on current research and theory, and to apply it to their own teaching in the sciences by learning and understanding various behavioral, cognitive, and humanistic views and strategies of learning and motivation. Candidates examine the biological and psychological perspectives that contribute to the normal development of an individual from prenatal growth through young adulthood focusing on cognitive, language, motor, socialization, personality, and moral development. They discuss and recognize the impact of socioeconomic

status and poverty on child development and family relations. The candidates are expected to apply theoretical principles of child development to construct meaningful teaching experiences for all students. They critically examine trends in child development patterns from a multicultural perspective and recognize the role culture plays in child development and teaching.

To best meet the needs of future students, candidates are provided with an understanding of special education, the diverse learner, and assessment and instructional strategies for adolescents with special needs. Candidates are expected to identify and describe major philosophies, theories, and trends in the field of special education. For each area of disability, candidates become familiar with general information on physical and psychological characteristics, incidents and etiology, diagnostic and therapeutic services, interventions and educational programs, technology, and findings of recent research. Candidates demonstrate an understanding of issues related to the assessment, identification, and placement of students with various exceptionalities. Candidates are also expected to identify federal laws and regulations relative to rights and responsibilities, student identification, and delivery of services.

Candidates are expected to create unit plans in the sciences that are consistent with the NSES and the Maryland Core Learning Goals. Within the context of the unit plan, they develop daily lessons that utilize a variety of teaching strategies and methods of assessment, in order to create positive classroom environments conducive to safety and student learning. Candidates focus on establishing objectives that are measurable and aligned with national and state guidelines for science knowledge. They consider Dimensions of Learning, teaching and learning styles, questioning and investigative techniques, and gender and ethnic issues relative to classroom instruction. The candidates come to an understanding that organization and comprehensive planning are the basis for effective classroom management.

References

American Association for the Advancement of Science, 1989, *Project 2061: Science for All Americans*: Washington, DC, American Association for the Advancement of Science.

American Association for the Advancement of Science, 1993, *Project 2061: Benchmarks for Science Literacy*: Washington, DC, American Association for the Advancement of Science.

National Research Council, 1995, *National Science Education Standards*: National Academy Press, Washington, DC, 262 p.

Program Overview

The content requirements for certification in Science are a minimum of thirty credits. Fifteen credits must be in the area of concentration: Biology, Chemistry, or Physics. Three credits in mathematics at the calculus level or higher are required. In addition, the candidate must have three credits in each of the following areas except the area of concentration: Chemistry, Biology, Physics, and Earth Science. These content requirements are based on the Maryland State Department of Education requirements for certification in Science and are more than satisfied by the requirements for an undergraduate degree in Biology, Chemistry, or Physics at Loyola.

The requirements for a minor in secondary science certification are in addition to those of the individual science major, and are as follows:

Professional Coursework

- ED301 Educational Psychology (3cr)
- ED429 Secondary School Methods of Teaching (3cr)
- ED474 Introduction to Reading in the Content Area (3cr)
- ED475 Teaching Reading in the Content Area II (3cr)
- DEDU437 Methods of Teaching Science (3cr)
- RS496 Introduction to Special Education (4cr)

Internships

- ED432 Internship Phase One in middle and high school (1cr)
- ED452 Internship Phase Two – Science (10cr)

Total Credits - 30

Graduate Statistics

Undergraduate Secondary Science Graduates

- 1997 – 1
- 1999 – 1

Graduate Secondary Science Graduates

- 1997/98 – 3
- 1998/99 – 1
- 1999/00 – 6

Post-Baccalaureate Admissions

Candidates admitted to a post-baccalaureate program are required to have an undergraduate GPA of 3.00. If a candidate's GPA is below 3.0 but not lower than 2.75 he or she may be considered for provisional acceptance. Provisional acceptance requires candidates to take three specific courses and receives a B or better in each course before full acceptance is granted.

Those candidates with a degree in the content area in which certification is sought are required to get six credits in updating if the undergraduate degree is more than five years old. If the degree is current, no additional work is required. When a candidate seeks certification in a content area other than that of the undergraduate degree, the candidate's transcript is analyzed to determine if the candidate has an adequate academic background. If previous coursework is deemed lacking in the content area, additional work is required before the candidate begins the second phase of the internship.

Faculty

Faculty Teaching Biology Courses

Dr. Andrew Schoeffield	Associate	tenured
Dr. David Rivers	Associate	tenured
Dr. Donald Keefer	Full	tenured
Dr. Bernadette Roche	Assistant	not tenured
Dr. Elissa Derrickson	Associate	tenured
Dr. Kim Derrickson	Associate	tenured
Dr. Kirsten Crossgrove	Assistant	not tenured
Dr. Neena Din	Assistant	not tenured
Mr. Eugene Meyer	Core	N/A
Dr. Lindsey Pantone	Adjunct Assistant	N/A
Ms. Jennifer Scraftford	Instructor	N/A
Dr. Charles Graham	Full	tenured
Dr. Elaine Shea	Assistant	not tenured *
Dr. Brian Barr	Assistant	not tenured*

Faculty Teaching Chemistry Department

Dr. Timothy J. McNeese	Full	tenured
Dr. Melvin P. Miller	Emeritus	
Dr. David F. Roswell	Full	tenured
Dr. Norbert M. Zaczek	Emeritus	
Dr. Francis J. McGuire	Emeritus	
Dr. Daniel M. Perrine	Associate	tenured
Dr. Brian K. Barr	Assistant	not tenured **

Dr. Elaine M. Shea	Assistant	not tenured **
Dr. James Salmon, S. J.	Adjunct Assistant **	

Faculty Teaching Physics Department

Dr. Gregory N. Derry	Associate	tenured
Dr. Randall S. Jones	Associate	tenured
Dr. Mary L. Lowe	Associate	tenured
Dr. Joseph Ganem	Associate	tenured
Ms. Helene Perry	Emerita	
Dr. Robert Davis	Adjunct Assistant	

*(Chemistry Department appointment)

** (Biology Department appointment)

*** (Theology Department appointment)

**National Science Teachers Association
Program Review Matrix**

Name of Program(s) _____ Chemistry and Secondary Chemistry Certification _____ Level(s) UG

1.0 Rationale. State the rationale for the content organization and structure of the program and explain how and why the conceptual content in each licensure area (if appropriate) has been selected.

The purpose of the Chemistry Department's curriculum is to provide undergraduate students with a sound education in the fundamental areas of modern chemistry. Students who complete all of the required courses listed in the program of study receive a Bachelor of Science degree which is certified by the American Chemical Society. To prepare the student for a successful career in chemistry, our undergraduate curriculum emphasizes both breadth and opportunity for specialization. Upon graduation, students will have completed 400 hours of classroom work and 500 hours of laboratory work in chemistry. Major courses comprise about one-third of the total undergraduate curriculum; within the chemistry major, course requirements are distributed evenly over the sub-disciplines of analytical, biochemistry, inorganic, organic and physical chemistry. The requirements for a minor in secondary teaching certification in chemistry follow the same rationale as those for chemistry majors and are included in the program standard descriptions. The Chemistry Department has developed a program of undergraduate research, available to students for credit during the academic year and as part of the College's Hauber Science Undergraduate Fellows Program during the summer months. Faculty advisors supervise students' independent research as a problem-oriented activity which attempts to unify the components of the chemistry curriculum. As with all laboratory procedures, preparation of well-written reports is an essential part of the research endeavor. The Chemistry program is comprehensive and successful completion of its requirements meets the NCATE standards.

The Chemistry Department is certified by the American Chemical Society and is required to submit an annual report to its Committee on Professional Training. This report documents any changes in faculty and curriculum, provides information about the numbers of degrees granted in chemistry, and certifies graduates who have completed the course study by the Society's guidelines. An extensive re-evaluation is scheduled at five-year intervals. Its purpose is to examine faculty performance, curriculum revisions and library and instrumentation acquisitions. Also, the department is a charter member of the Council on Undergraduate Research, a national society for the advancement of scientific research at undergraduate colleges and universities. Its purpose is to recognize departments of chemistry which actively participate in and encourage undergraduate research. Periodic updates of faculty members' research activities and awards, and departmental instrumentation acquisitions and support are published in a semi-annual Directory of Research.

2.0 Program Structure. Provide indicators, practices and assessments in the table below, making sure that related items begin on the same line.

Program Standard	Indicator(s)	Learning Experiences	Assessments and Performance Data
<p>2.1 Content The program prepares candidates to structure and interpret the concepts, ideas and relationships in science that are needed to advance student learning in the area of licensure as defined by state and national standards developed by the science education community. Content refers to: Concepts and principles understood through science. Concepts and relationships unifying science domains. Processes of investigation in a science discipline. Applications of mathematics in science research.</p>	<p>1. The chemistry major provides students with a firm foundation in the general principles of chemistry.</p> <p>2. The chemistry major provides students with an understanding of detailed knowledge in specific areas of chemistry.</p> <p>3. The chemistry curriculum requires students to develop and learn</p>	<p>Learning Experiences</p> <p>1a. Two, three-credit courses (CH101,CH102) designed to introduce students to the principles of chemistry. See syllabi in appendix, pages 1-3.</p> <p>1b. Two, three-credit courses (CH301,CH302) designed to introduce students to the principles of organic chemistry. See syllabi in appendix, pages 12-14.</p> <p>2a. Four, three-credit courses concentrating on quantitative measurement (CH201), mathematical and theoretical models, (CH311,CH312) and instrumental methods of analysis (CH410) of chemical reactions. See syllabi in appendix, pages 9-11, 17-18, 26.</p> <p>2b. Two, three-credit courses on advanced topics of molecular structure and synthesis of inorganic (CH412) and organic (CH406) compounds. See syllabi in appendix, pages 29-33, 25, and representative problems and quiz assignments, pages 61-62 of appendix.</p> <p>2c. Two, three-credit courses (CH431,CH434) concentrating on the principles and experimental techniques in biochemistry. See syllabi in appendix, pages 34-39, and laboratory and computer application assignment, page 64 of appendix.</p> <p>3a. Four, one-credit laboratories designed to introduce students to</p>	<p>Assessments and Performance Data</p> <p>1a. Periodic tests, quizzes, and comprehensive final exam. Sample quizzes and tests on pages 52 and 54 of appendix.</p> <p>1b. Periodic tests and comprehensive final exam. Sample test on page 55 of appendix.</p> <p>2a. Periodic tests, homework projects, and comprehensive final exam. Sample tests and homework project on pages 56-58 and 60 of appendix.</p> <p>2b. Periodic tests, quizzes, homework projects, and comprehensive final exam. Sample assignments, quizzes and projects, and tests on pages 61-63 of appendix.</p> <p>2c. Periodic tests, computer project, laboratory experiments, and comprehensive final exam. Representative examples of tests, computer project, lab experiments on pages 64-65 of appendix.</p> <p>3a. Periodic quizzes, laboratory experiments and report forms.</p>

experimental techniques in the disciplines of chemistry.

observations of chemical phenomena in the principles, preparation, and reactivity of inorganic (CH105,CH106) and organic (CH307,CH308) compounds. See syllabi in appendix, pages 4-8 and 15-16, and representative examples of experiments and report forms, pages 40-41 and 43-44 of appendix.

Representative examples on pages 40-44 of appendix.

3b. Two, one-credit laboratories requiring students to perform accurate and precise quantitative measurements through chemical analysis and instrumental methods of analysis (CH201 (laboratory component), CH411). See syllabi in appendix, pages 9-11, 27-28, and representative experiments and report forms, pages 45-46 of appendix.

3b. Laboratory experiments and reports. Representative examples on pages 45-46 of appendix.

3c. Two, one-credit laboratories in which students interpret experimental results of chemical and physical properties through data analysis (CH315,CH316). See syllabi in appendix, pages 19-21, and representative laboratory and computer assignments, pages 47-48 of appendix.

3c. Computer projects, laboratory experiments and reports. Representative examples on pages 47-48 of appendix.

3d. Two, one-credit laboratories designed to introduce students to the synthesis and characterization of inorganic (CH412 (laboratory component) and organic (CH406) compounds. See syllabi in appendix, pages 25, 31-33, and representative experiments and laboratory assignments, pages 49-50 of appendix.

3d. Laboratory experiments and reports. Representative examples on pages 49-50 of appendix.

<p>4. The chemistry curriculum requires students to apply statistics, calculus, and computer software in the analysis of chemistry and chemical problems.</p>	<p>3e. One, three-credit course requiring students to use modern techniques to characterize biochemical reactions (CH434). See syllabi in appendix, pages 37-39.</p>	<p>3e. Computer application experiments and reports, laboratory experiments and reports. Representative example on page 64 of appendix.</p>
	<p>4a. Introductory courses (CH101, CH102) and laboratories (CH105,CH106) require students to use significant figures in all calculations and statistical comparisons for precision and accuracy of obtained results: see syllabi in appendix, pages 1-8 and representative example of laboratory exercise, pages 40 of appendix.</p>	<p>4a. Periodic quizzes, laboratory experiments and report forms. Representative example on page 40 of appendix.</p>
	<p>4b. Quantitative courses on measurement of physical and chemical processes using chemical and instrumental methods of analysis require students to employ computer software for statistical evaluation of data (CH201,CH412,CH411,CH311, CH312,CH315,CH316,CH410, CH431). See syllabi in appendix, pages 9-11, 17-21, 26-36 and representative examples, pages 45-48, 57, 61, and 64 of appendix.</p>	<p>4b. Laboratory experiments, computer projects, and report forms. Representative examples for CH411,CH412,CH315,CH431 on pages 46-47, 61, 64 of appendix.</p>
	<p>4c. Students are required to use calculus to solve problems in lecture (CH311,CH312) and laboratory (CH315,CH316) covering topics of chemical kinetics, thermodynamics, and quantum mechanics. See syllabi in appendix, pages 17-18, and representative lecture and laboratory assignments, pages 47-48, and 57 of appendix.</p>	<p>4c. Periodic tests, comprehensive final, homework problems assigned with chapter text. Representative example on page 58 of appendix.</p>

Program Standard**2.2 Nature of Science**

The program prepares teachers to engage students in activities to define the values, beliefs and assumptions inherent to the creation of scientific knowledge within the scientific community, and contrast science to other ways of knowing. Nature of science refers to:

Characteristics distinguishing science from other ways of knowing.

Characteristics distinguishing basic science, applied science and technology.

Processes and conventions of science as a professional activity.

Standards defining acceptable evidence and scientific explanation.

Indicator(s)

1. The chemistry curriculum requires students to demonstrate an understanding of chemistry as a scientific endeavor, through written and oral reports that stress the process and interpretation of scientific ways of knowing and explaining our world.

Learning Experiences

1a. All laboratories (CH105, CH106, CH307, CH308, CH201, CH411, CH412 (laboratory component), CH406, CH434) require students to keep legible and complete experimental records for the successful preparation of required written laboratory reports. See syllabi in appendix, pages 4-11, 15-16, 25, 27-33, 37-39; also see "Writing in the Department of Chemistry," pages 51-52 of appendix.

1b. Senior chemistry majors are required to present an oral seminar topic to chemistry faculty and junior and senior chemistry majors following a thorough chemical literature investigation and presentation preparation (CH399,CH401). See syllabi in appendix, pages 22-24; and evaluation form, page 59 of appendix.

Assessments and Performance Data

1a. Lab notebook for recording of all data during laboratory experiments (CH105,CH106,CH307,CH308, CH201,CH411,CH412, (laboratory component), CH406, CH434). See syllabi in appendix, pages 4-11, 15-16, 25, 27-33, 37-39; also see "Writing in the Department of Chemistry," pages 51-52 of appendix.

1b. Evaluation form completed by fellow students and faculty members, page 59 of appendix.

Program Standard**2.3 Inquiry**

The program prepares candidates to engage students regularly and effectively in science inquiry and facilitate understanding of the role inquiry plays in the development of scientific knowledge. Inquiry refers to:

- Questioning and formulating solvable problems.
- Reflecting on, and constructing, knowledge from data.
- Collaborating and exchanging information while seeking solutions.
- Developing concepts and relationships from empirical experience.

Indicator(s)

1. The chemistry major requires students to solve problems to reinforce accepted chemical principles.

2. The chemistry major requires students to analyze and interpret laboratory observations obtained from experiments.

Learning Experiences

1a. Four introductory courses (3 credits each) in General Chemistry (CH101,CH102) and Organic Chemistry (CH301,CH302) emphasize understanding of basic principles of chemistry with assigned homework problems for each text chapter for preparation of quizzes and tests. See CH302 syllabus, pages 13-14 of appendix for example.

1b. Discipline specific courses (3 credits each) in analytical chemistry (CH201,CH410), physical chemistry (CH311,CH312), inorganic (CH412) and organic spectroscopy (CH406), and biochemistry (CH431) emphasize understanding of advanced topics with assigned homework problems for each text chapter and instructor prepared problems. See homework problems for CH412, page 62 of appendix for representative example.

2a. Four, one-credit laboratories designed to introduce students to observations of chemical phenomena in the principles, preparation, and reactivity of inorganic (CH105,CH106) and organic (CH307,CH308) compounds. See syllabi in appendix, pages 4-8, 15-16, and pages 40-41 of appendix for representative examples.

2b. Two, one-credit laboratories requiring students to perform accurate and precise quantitative measurements through chemical analysis and instrumental methods of

Assessments and Performance Data

1a. Periodic tests, quizzes, and comprehensive final exam. Sample quizzes and tests on pages 53-55 of appendix.

1b. Periodic tests, homework projects, and comprehensive final exam. Sample tests and homework projects on pages 56, 58, 60-61, 63, 65 of appendix.

2a. Periodic quizzes, laboratory experiments and report forms. Representative examples on pages 40-44 of appendix.

2b. Laboratory experiments and reports. Representative examples and grading policy on pages 9-11, 27-28, 45-46 of appendix.

analysis (CH201 (laboratory component), CH411). See syllabus in appendix, pages 9-11, 27-28, and representative experiments with report forms, pages 45-46 of appendix.

2c. Two, one-credit laboratories in which students interpret experimental results of chemical and physical properties through data analysis (CH315,CH316). See syllabi in appendix, pages 19-21 and representative experiments with report forms, pages 47-48 of appendix.

2d. Two, one-credit laboratories designed to introduce students to the synthesis and characterization of inorganic (CH412 (laboratory component) and organic (CH406) compounds. See syllabi in appendix, pages 25, 31-33, and representative examples of experiments and laboratory report questions, pages 49-50 of appendix.

2e. One, three-credit course requiring students to use modern techniques to characterize biochemical reactions (CH434). See syllabi in appendix, pages 37-39, and representative examples of computer applications and experimental component, page 64 of appendix.

2c. Computer projects, laboratory experiments and reports. Representative examples on pages 47-48 of appendix.

2d. Laboratory experiments and reports. Representative examples on pages 49-50 of appendix.

2e. Computer projects, laboratory experiments, and reports. Representative example on page 64 of appendix.

Program Standard**2.4 Context of Science**

The program prepares candidates to relate science to the daily lives and interests of students and to a larger framework of human endeavor and understanding. The context of science refers to:

Relationships among systems of human endeavor including science and technology.

Relationships among scientific, technological, personal, social and cultural values.

Relevance and importance of science to the personal lives of students.

Indicator(s)

1. Understand ethical and cultural issues in socially-relevant chemical and technological advances.

Learning Experiences

1. Seminars and class discussions of current events in CH 311 and CH 401. See pages 17, 22-23 of appendix.

Assessments and Performance Data

1. Candidate-led presentations and discussions. See pages 17, 22-23 of appendix.

Program Standard**2.5 Skills of Teaching**

The program prepares candidates to create a community of diverse student learners who can construct meaning from science experiences and possess a disposition for further inquiry and learning. Pedagogy refers to:

Science teaching actions, strategies and methodologies.

Interactions with students that promote learning and achievement.

Effective organization of classroom experiences.

Use of advanced technology to extend and enhance learning.

Use of prior conceptions and student interests to promote new learning.

Indicator(s)

1. Develop and write lesson plan and a sequence of lessons. Develop an awareness of the specific needs of adolescents that are influenced by varying achievement levels, learning styles, developmental progress, and cultural heritage.

2. Develop and write or adapt a unit plan suitable for student teaching, incorporating state science outcomes and national standards.

3. Analyze several theories of learning and teaching such as the

Learning Experiences

1. Review curriculum from local school systems to become familiar with system expectations for units. Internship in Professional Development School. See pages 123, 129, 133-140 of appendix.

2. Prepare and teach a mini-lesson to the science methods class. Internship in a Professional Development School. See page 129, 133-140 of appendix.

3. Review state/national standards. See page 128 of appendix.

Assessments and Performance Data

1. Write or adapt the unit plan. Teach lessons from unit plan. Adapt lessons based on student learning. See pages 123, 129 of appendix.

2. Assess student learning of unit/lessons taught, using performance based assessment process. Provide feedback to candidate on observation and written unit plan, with regard to clarity and interconnectedness between the unit objectives, the daily objectives, and the summative assessment. See page 129, 133-140 of appendix.

3. Self evaluation and peer evaluation using performance based assessment

learning cycle, the generative learning model, and the 5E model.

4. Demonstrate knowledge of theory and principles in the teaching of science.

5. Identify and use a variety of academic and community resources including persons, places, materials (print and no-print), and professional organization to enrich science instruction.

4. Internship in a Professional Development School. See pages 133-140 in appendix.

5. Demonstrate skill and use of instructional resources such as bulletin boards, computer software, laboratory activities, AV equipment, and materials. Internship in a Professional Development School. See pages 128-129, 133-140 of appendix.

process. See page 128, 133-140 of appendix.

4. Written examination. Praxis II assessment. Performance-based assessment process. See pages 128-129 of appendix.
5. Evaluation of bulletin board design. Performance-based assessment process. See pages 128-129, 133-140 of appendix.

**Program Standard
2.6 Curriculum**

The program prepares candidates to develop and apply a coherent, focused science curriculum that is consistent with state and national standards for science education and appropriate for addressing the needs, abilities and interests of students. Science curriculum refers to:

An extended framework of goals, plans, materials, and resources for instruction.

The instructional context, both in and out of school, within which pedagogy is embedded.

Indicator(s)

1. Develop and write or adapt a unit plan suitable for use in student teaching, incorporating state science outcomes.

2. Identify and use a variety of academic and community resources including persons, places, materials (print and non-print), and professional organizations to enrich science instruction.

Learning Experiences

1. Review curriculum from local school systems to become familiar with system expectations for units. Internship in a profession Development School. See page 129, 133-140 of appendix.

2. Demonstrate skill and use of instructional resources such as bulletin boards, computer software, laboratory activities, AV equipment, and materials. Internship in a profession Development School. See page 129, 133-140 of appendix.

Assessments and Performance Data

1. Write or adapt the unit plan. Teach lessons from the unit plan. Adapt lessons based on student learning. Assessment of the written unit plan. See page 129 of appendix.

2. Evaluation of bulletin board design. Performance based assessment process. See pages 128-129, 133-140 of appendix.

**Program Standard
2.7 Social Context**

The program prepares candidates to relate science to the community and

Indicator(s)

1. Identify and use a variety of academic and community resources including persons, places, materials

Learning Experiences

1. Demonstrate skill and use of instructional resources such as bulletin boards, computer software,

Assessments and Performance Data

1. Evaluation of bulletin board design. Performance based assessment process. See pages 128-129, 133-140

to use human and institutional resources in the community to advance the education of their students in science. The social context of science teaching refers to: Social and community support network within which occur science teaching and learning. Relationship of science teaching and learning to the needs and values of the community. Involvement of people and institutions from the community in the teaching of science.

(print and non-print), and professional organizations to enrich science instruction.

2. Develop an understanding of the student population by studying demographic information, cultural and ethnic composition, and other aspects of the community that effect education support for adolescents. Choose from a variety of instructional strategies and resources in order to obtain desired objectives.

laboratory activities, AV equipment, and materials. Internship in a professional Development School. See page 129, 133-140 of appendix.

2. Internship in a professional Development School. See pages 133-140 of appendix.

of appendix.

2. Performance based assessment process. See pages 121, 123, 128, 133-140 of appendix.

Program Standard

2.8 Assessment

The program prepares candidates to use a variety of contemporary assessment strategies to evaluate the intellectual, social, and personal development of the learner in all aspects of science. Assessment refers to:

Alignment of goals, instruction and outcomes.

Measurement and evaluation of student learning in a variety of dimensions.

Use of outcome data to guide and change instruction.

Indicator(s)

1. Select from a variety of assessment procedures those that fit particular objectives and situations. Examine and analyze standardized and teacher made tests as instruments for the evaluation of student performance and progress; develop alternative methods of assessing student achievement.

Engage in thoughtful reflection and analysis of a school in the context of a school system to include an awareness of the structure, goals, and policies, human and instructional resources, school-wide and system-wide instructional assessment programs, and guidelines.

Learning Experiences

1. Develop a long range unit plan incorporating Maryland School Performance Goals.

Write daily lesson plans.

Develop and write quizzes, unit tests, and other evaluation tools.

Provide written reflection on the validity and outcome of teaching strategies and assessments.

Internship in a Professional Development School. See pages 121, 123, 129, 133-140 of appendix.

Assessments and Performance Data

1. Performance based assessment process.

Develop an appropriate performance assessment with equipment and materials fitting into a shoe box. See pages 128-129, 131 of appendix.

Program Standard

2.9 Environment for Learning

The program prepares candidates to

Indicator(s)

1. Understand basic safety rules for laboratory operations.

Learning Experiences

1. Safety is stressed as an essential part of laboratory activities through

Assessments and Performance Data

1. Candidates read and sign a copy of laboratory safety regulations prior to

design and manage safe and supportive learning environments reflecting high expectations for the success of all students. Learning environments refers to:
 Physical spaces within which learning of science occurs.
 Psychological and social environment of the student engaged in learning science.
 Treatment and ethical use of living organisms.
 Safety in all areas related to science instruction.

direct course instruction. See page 10 of appendix.

admittance to laboratory. See page 10 of appendix.

Program Standard

2.10 Professional Practice

The program prepares candidates to participate in the professional community, improving practice through their personal actions, education and development.

Professional practice refers to:

Knowledge of, and participation in, the activities of the professional community.

Ethical behavior consistent with the best interests of students and the community.

Reflection on professional practices and continuous efforts to ensure the highest quality of science instruction.

Willingness to work with students and new colleagues as they enter the profession.

Indicator(s)

1. Describe a code of ethics for secondary teachers.
2. Develop an understanding of being a reflective practitioner, construct a teaching philosophy, explore professional resources, professional development opportunities, professional responsibilities and colloquial relationships.
3. Demonstrate professional attitudes and behavior.
4. Develop individual objectives, reflecting personal needs and interests as the course proceeds; read supplementary texts according to need or interest.

Learning Experiences

1. Internship in Professional Development School. See pages 133-140 of appendix.
2. Provide written reflection and logs. Internship in Professional Development School. See page 123, 133-140 of appendix.
3. Internship in Professional Development School. See pages 133-140 of appendix.
4. Complete readings from texts and handouts as assigned. Internship in Professional Development School. See pages 129-130, 133-140 of appendix.

Assessments and Performance Data

1. Performance-Based Assessment Process. See pages 121, 128, 133-140 of appendix.
2. Performance-Based Assessment Process. See page 128, 133-140 of appendix.
3. Performance-Based Assessment Process. See pages 133-140 of appendix.
4. Curriculum review , final exam, and article critique. Performance-Based Assessment Process. See pages 128, 130, 133-140 of appendix.

3.0 Goals and Self Analysis

The ultimate goal of the secondary

be on performance based assessment.

benchmark includes a holistic

Discuss the data collected from candidate analysis and other sources. Briefly identify and discuss changes you have made or will be seeking to make related to this program standard as a result of your analysis.

science certification program is for the candidates to translate their understanding of the workings of scientific research into appropriate classroom curriculum and learning experiences for their students. Everything flows from this goal. Over the next five years, the Science and Education departments will refine the curriculum required of future teachers so that it is aligned with the INTASC standards and NSES standards. One particular focus will

Additional benchmarks need to be considered for both secondary minor candidates as well as for post-baccalaureate secondary candidates. The Praxis series, particularly Praxis I, is currently under discussion for use in the spring of the second year as one means of identifying the basic skills deficiencies of the candidates. The Praxis I test would become a part of a more extensive process to benchmark the success of all secondary candidates. The vision for this

approach to assessment paying particular attention to GPA, and written and oral communication skills. Additionally, the performance based assessment process used in all elementary and secondary Professional Development Schools will continue to be evaluated and checked for validity over the next five years.

**National Science Teachers Association
Program Review Matrix**

Name of Program(s) Biology and Secondary Biology Certification Level(s) UG

1.0 Rationale. State the rationale for the content organization and structure of the program and explain how and why the conceptual content in each licensure area (if appropriate) has been selected.

The Biology Department has developed an exciting, innovative curriculum in which most majors' biology courses include integrated classroom and laboratory (or seminar) experiences. We feel that this approach is pedagogically sound when teaching the concepts and facts of modern biology. Having courses of an integrated nature helps to blur the lines between lecture and lab, and between facts and application. The Council on Undergraduate Research (CUR) recommends this approach. In the Biology Department curriculum, *framework* courses generally consist of a stronger classroom component with integrated laboratory and/or seminar exercises. *Experiential* courses consist of a stronger laboratory component with integrated lectures. We believe that this curricular feature helps students to (1) better see theory in practice, (2) teach one another, (3) become more active participants in their own education, and (4) develop a greater sense of academic community. The general biology curriculum broadly trains future biologists in the three areas of the life sciences (cellular/molecular, organismal, and population biology); integrates the life sciences with the physical and mathematical sciences; and places the sciences within the context of social and cultural values. The curriculum is also flexible in the requirements of our major. This flexibility allows students to individualize their curriculum to suit their academic and career goals. The requirements for a minor in secondary teaching certification in biology follow the same rationale as those for the major, and are included in the descriptions of the program standards. The Biology Department curriculum helps to prepare our students as academicians, for "life after Loyola," and as learners for life.

The Biology Department program prepares of students to be independent scientific thinkers, nurturing their abilities in four areas:

- First, students need to understand the current factual content of the discipline and how to organize the large quantities of new scientific information into a meaningful framework.
- Second, students are taught about the process of conducting research; how to ask scientific questions; design an experiment; and analyze and interpret the data that they collect.
- Third, students are trained to become proficient in communication through verbal, written, and symbolic (mathematical) channels; to be able to read and understand a scientific article; write a paper in scientific format; discuss scientific experiments in a group; present results verbally or in poster format; and use computer packages.
- Finally, students are exposed to the discussion of ethical issues surrounding the practice and direction of biological research.

2.0 Program Structure. Provide program indicators, practices and assessments in the table below, making sure that related items begin on the same	Indicator(s)	Learning Experiences	Assessments and Performance Data
<p>Program Standard 2.1 Content</p> <p>The program prepares candidates to structure and interpret the concepts, ideas and relationships in science that are needed to advance student learning in the area of licensure as defined by state and national standards developed by the science education community.</p> <p>Content refers to:</p> <p>Concepts and principles understood through science.</p> <p>Concepts and relationships unifying science domains.</p> <p>Processes of investigation in a science discipline.</p> <p>Applications of mathematics in science research.</p>	<p>1. Know the basic concepts of the three areas of the life sciences (cellular/molecular, organismal, population biology).</p> <p>2. Identify and use themes to unify science and scientific principles across disciplines.</p> <p>3. Investigate an open-ended problem requiring data processing and analysis in each of the three identified domains of the life sciences</p> <p>4. Use basic statistics in the analysis of data and understand basic concepts of statistics in order to communicate them to students and other scientists.</p>	<p>1. Three, required three credit courses distributed in the subdisciplines of the life sciences (BL121, BL122, BL123). See syllabi, pages 66-75 of appendix.</p> <p>2. Two, three credit courses in the life sciences that specifically help to unify science across disciplines (life science laboratories BL124, BL125; see syllabi, pages 76-79 of appendix); four, three credit courses (CH101, CH102, CH301, PH101), and four, one credit laboratories (CH105, CH106, PH191) in the physical sciences; and one, three credit course in the mathematical sciences (MA251 or MA252 or MA265).</p> <p>3a. Multiple small group research projects in BL124 and BL125. See pages 76-79 of appendix.</p> <p>3b. Seminar research project in BL124 and in BL125. See pages 76-79 of appendix.</p> <p>4a. Required, three credit course (MA251 or MA252 or MA265).</p> <p>4b. Statistical analysis module in BL124. See page 78 of appendix.</p>	<p>1. Standard exams with comprehensive final exams, writing assignments, and projects. All students must earn passing grades in each course, with an overall proficiency of 70% or better at the conclusion of a student's sophomore year for admission into the major. See pages 67, 69-70, 74-75 of appendix.</p> <p>2. Laboratory reports, formal scientific written paper, poster presentation, laboratory notebooks. See pages 76-79 of appendix.</p> <p>3a. Laboratory reports and laboratory notebook. See page 77 of appendix.</p> <p>3b. Formal scientific paper and poster presentation. See pages 77 and 79 of appendix.</p> <p>4a. see Math Matrix</p> <p>4b. Computer assignments and utilization of statistics to analyze data from lab experiments, small group research projects and semester projects (BL124 and BL125). See pages 78 and 79 of appendix.</p>

Program Standard	Indicator(s)	Learning Experiences	Assessments and Performance Data
<p><u>2.2 Nature of Science</u> The program prepares teachers to engage students in activities to define the values, beliefs and assumptions inherent to the creation of scientific knowledge within the scientific community, and contrast science to other ways of knowing. Nature of science refers to: Characteristics distinguishing science from other ways of knowing. Characteristics distinguishing basic science, applied science and technology. Processes and conventions of science as a professional activity. Standards defining acceptable evidence and scientific explanation.</p>	<p>1. Know the basic principles of scientific investigation: formulation of hypotheses, designing experiments to test predictions based on hypotheses, use of results to support or disprove hypotheses.</p> <p>2. Use the correct format of scientific papers in writing up research projects.</p> <p>3. Ability to construct a poster and defend it at a poster session.</p> <p>4. Ability to prepare an organized and informative oral presentation about a scientific topic.</p> <p>5. Use appropriate repetition in performing experiments, coupled with statistical analysis to show significant support, or lack of support, for hypothesis.</p>	<p>1a. Research projects in BL124 and BL125. See pages 78 and 79 of appendix.</p> <p>1b. Class discussions in BL121 and BL122. See pages 66-70 of appendix.</p> <p>2. Research projects in BL125. See page 79 of appendix.</p> <p>3. Research projects in BL124 and BL125. See pages 76-79 of appendix.</p> <p>4. Group presentations in BL122 and BL123. See pages 70, 73, 75 of appendix.</p> <p>5. Research projects in BL124 and BL125. See pages 76-79 of appendix.</p>	<p>1a. Formal scientific paper. See pages 78 and 79 of appendix.</p> <p>1b. Essay questions on exams covering conceptual understanding and application topics. See pages 66-67 and 69-70 of appendix.</p> <p>2. BL125 lab reports in format of scientific paper. See page 79 of appendix.</p> <p>3. Poster session with question and answer session. See pages 76-79 of appendix.</p> <p>4. Faculty, self, and peer evaluation of oral presentation. See pages 70, 73, 75 of appendix.</p> <p>5. Graded lab reports, posters and lab notebooks. See pages 76-79 of appendix.</p>
<p><u>Program Standard</u> <u>2.3 Inquiry</u> The program prepares candidates to engage students regularly and effectively in science inquiry and facilitate understanding of the role inquiry plays in the development of scientific knowledge. Inquiry refers to: Questioning and formulating solvable problems. Reflecting on, and constructing, knowledge from data. Collaborating and exchanging</p>	<p><u>Indicator(s)</u></p> <p>1. Ability to design and implement an independent experiment.</p> <p>2. Ability to interpret the results of an experiment and explain their significance to the larger body of scientific information.</p>	<p><u>Learning Experiences</u></p> <p>1a. Research projects in BL124 and BL125. See pages 76-79 of appendix.</p> <p>1b. In class discussions in BL121. See pages 66-67 of appendix.</p> <p>2a. Research projects in BL124 and BL125. See pages 76-79 of appendix.</p> <p>2b. In class discussions in BL121. See pages 66-67 of appendix.</p>	<p><u>Assessments and Performance Data</u></p> <p>1a. Graded lab reports, posters, lab notebooks. See pages 76-79 of appendix.</p> <p>1b. Essay exam questions on in class projects and written homework assignments. See pages 66-67 of appendix.</p> <p>2a. Graded lab reports, posters. See pages 76-79 of appendix.</p> <p>2b. Essay exam questions on in class projects and written homework assignments. See pages 66-67 of appendix.</p>

<p>information while seeking solutions.</p> <p>Developing concepts and relationships from empirical experience.</p>	<p>3. Ability to work effectively in a group.</p>	<p>3a. BL125 research projects, BL123 group presentations, BL123 group designated problem sets. See pages 73, 75, 79 of appendix.</p>	<p>3a. Graded posters, lab reports submitted by pairs; faculty, self, and peer evaluated group presentations, problem sets where students allowed to work in designated groups, but must submit individual answers. See pages 73, 75, 79 of appendix.</p>
	<p>4. Understand and develop scientific concepts.</p>	<p>3b. BL124 dissections and paired presentations, research projects in groups of four. See pages 76-78 of appendix.</p> <p>4. BL122 reading and class discussion. See page 68 of appendix.</p>	<p>3b. Faculty, self, and peer evaluated group projects and presentations. See pages 76-78 of appendix.</p> <p>4. Multiple choice and essay exam questions, and in-class discussion of open-ended questions. See pages 68-70 of appendix.</p>
<p>Program Standard 2.4 Context of Science</p> <p>The program prepares candidates to relate science to the daily lives and interests of students and to a larger framework of human endeavor and understanding. The context of science refers to:</p> <p>Relationships among systems of human endeavor including science and technology.</p> <p>Relationships among scientific, technological, personal, social and cultural values.</p> <p>Relevance and importance of science to the personal lives of students.</p>	<p>Indicator(s)</p> <p>1. Understand the relevance of basic biology to technological advances.</p> <p>2. Understand the ethical and cultural issues associated with scientific and technological advances.</p>	<p>Learning Experiences</p> <p>1. BL121 small group discussions on issues such as cancer; BL123 group presentations on topics such as genetic engineering of crops; BL125 class discussions of recombinant DNA technology, genetic engineering. See pages 66, 73, 79 of appendix.</p> <p>2a. BL121 small group discussions on issues such as cancer; BL123 group presentations on issues such as cloning and class discussions on current advances as they arise (e.g. human embryonic stem cell research); BL122 oral presentations and paper on conservation issues; BL124 class discussion on the use of animals in science. See pages 66, 70, 73, 78 of appendix.</p> <p>2b. Required core curriculum course on ethics.</p>	<p>Assessments and Performance Data</p> <p>1. BL121 essay exam questions; BL123 graded group presentations, comprehensive exams. See pages 66-67, 72-75 of appendix.</p> <p>2a. BL121 essay exam questions; BL123 graded group presentations; BL124 assessment of participation by the instructor; BL122 graded group presentations and papers. See pages 66-78 of appendix.</p> <p>2b. Assessment tools determined by the ethics course and faculty member.</p>

3. Understand the relevance of basic biology to personal issues such as disease.

3. BL121 small group discussions on topics such as heart disease; BL123 group presentations on topics such as cancer and AIDS, BL125 class discussions on antibiotic resistance; BL122 class discussions on the intrinsic value of nature. See pages 66-67, 69, 75, 79 of appendix.

3. BL121 essay exam questions; BL123 graded group presentations, comprehensive exams; BL125 we discuss these things, but it really isn't graded in any way at this point; BL122 graded short essays and essay exam questions. See pages 66-67, 69, 75, 79 of appendix.

Program Standard
2.5 Skills of Teaching

The program prepares candidates to create a community of diverse student learners who can construct meaning from science experiences and possess a disposition for further inquiry and learning. Pedagogy refers to: Science teaching actions, strategies and methodologies. Interactions with students that promote learning and achievement. Effective organization of classroom experiences. Use of advanced technology to extend and enhance learning. Use of prior conceptions and student interests to promote new learning.

Indicator(s)

1. Ability to teach a topic to the class.
2. See Chemistry Matrix (1) for additional discussion.

Learning Experiences

1. BL123 group presentations, students are given a topic and instructed on the main points they need to convey to the class, strategies of teaching are discussed in a mandatory meeting with the instructor prior to the presentation. See page 75 of appendix.

Assessments and Performance Data

1. BL123 graded group presentation and comprehensive exam testing material that the students have presented. See page 75 of appendix.

Program Standard
2.6 Curriculum

The program prepares candidates to develop and apply a coherent, focused science curriculum that is consistent with state and national standards for science education and appropriate for addressing the needs, abilities and

Indicator(s)

1. Develop and write or adapt a unit plan suitable for use in student teaching, incorporating state science outcomes.
2. Identify and use a variety of

Learning Experiences

1. Review curriculum from local school systems to become familiar with system expectations for units. Internship in a profession Development School. See page 129, 133-140 of appendix.
2. Demonstrate skill and use of

Assessments and Performance Data

1. Write or adapt the unit plan. Teach lessons from the unit plan. Adapt lessons based on student learning. Assessment of the written unit plan. See page 129 of appendix.
2. Evaluation of bulletin board design.

interests of students. Science curriculum refers to:
An extended framework of goals, plans, materials, and resources for instruction.
The instructional context, both in and out of school, within which pedagogy is embedded.

Program Standard

2.7 Social Context

The program prepares candidates to relate science to the community and to use human and institutional resources in the community to advance the education of their students in science. The social context of science teaching refers to: Social and community support network within which occur science teaching and learning. Relationship of science teaching and learning to the needs and values of the community. Involvement of people and institutions from the community in the teaching of science.

Program Standard

2.8 Assessment

The program prepares candidates to use a variety of contemporary assessment strategies to evaluate the intellectual, social, and personal development of the learner in all aspects of science. Assessment refers to:
Alignment of goals, instruction and outcomes.

academic and community resources including persons, places, materials (print and non-print), and professional organizations to enrich science instruction.

Indicator(s)

1. Identify and use a variety of academic and community resources including persons, places, materials (print and non-print), and professional organizations to enrich science instruction.
2. Develop an understanding of the student population by studying demographic information, cultural and ethnic composition, and other aspects of the community that effect education support for adolescents. Choose from a variety of instructional strategies and resources in order to obtain desired objectives.

Indicator(s)

1. Select from a variety of assessment procedures those that fit particular objectives and situations. Examine and analyze standardized and teacher made tests as instruments for the evaluation of student performance and progress; develop alternative methods of assessing student achievement. Engage in thoughtful reflection and analysis of a school in the context of a

instructional resources such as bulletin boards, computer software, laboratory activities, AV equipment, and materials. Internship in a profession Development School. See page 129, 133-140 of appendix.

Learning Experiences

1. Demonstrate skill and use of instructional resources such as bulletin boards, computer software, laboratory activities, AV equipment, and materials. Internship in a professional Development School. See page 129, 133-140 of appendix.
2. Internship in a professional Development School. See pages 133-140 of appendix.

Learning Experiences

1. Develop a long range unit plan incorporating Maryland School Performance Goals. Write daily lesson plans. Develop and write quizzes, unit tests, and other evaluation tools. Provide written reflection on the validity and outcome of teaching strategies and assessments. Internship in a Professional

Performance based assessment process. See pages 128-129, 133-140 of appendix.

Assessments and Performance Data

1. Evaluation of bulletin board design. Performance based assessment process. See pages 128-129, 133-140 of appendix.
2. Performance based assessment process. See pages 121, 123, 128, 133-140 of appendix.

Assessments and Performance Data

1. Performance based assessment process. Develop an appropriate performance assessment with equipment and materials fitting into a shoe box. See pages 128-129, 131 of appendix.

Measurement and evaluation of student learning in a variety of dimensions. Use of outcome data to guide and change instruction.	school system to include an awareness of the structure, goals, and policies, human and instructional resources, school-wide and system-wide instructional assessment programs, and guidelines.	Development School. See pages 121, 123, 129, 133-140 of appendix.	
<p>Program Standard <u>2.9 Environment for Learning</u> The program prepares candidates to design and manage safe and supportive learning environments reflecting high expectations for the success of all students. Learning environments refers to: Physical spaces within which learning of science occurs. Psychological and social environment of the student engaged in learning science. Treatment and ethical use of living organisms. Safety in all areas related to science instruction.</p>	<p>Indicator(s) 1. Understand the nature of investigations in a laboratory setting.</p>	<p>Learning Experiences 1. Experimental design and laboratory methods in BL 124 and BL 125. See page 76 of appendix.</p>	<p>Assessments and Performance Data 1. Quizzes, presentations, and lab practical assessments. See page 76 of appendix.</p>
<p>Program Standard <u>2.10 Professional Practice</u> The program prepares candidates to participate in the professional community, improving practice through their personal actions, education and development. Professional practice refers to: Knowledge of, and participation in, the activities of the professional community. Ethical behavior consistent with the best interests of students and the</p>	<p>Indicator(s) 1. Describe a code of ethics for secondary teachers. 2. Develop an understanding of being a reflective practitioner, construct a teaching philosophy, explore professional resources, professional development opportunities, professional responsibilities and colloquial relationships. 3. Demonstrate professional attitudes and behavior.</p>	<p>Learning Experiences 1. Internship in Professional Development School. See pages 133-140 of appendix. 2. Provide written reflection and logs. Internship in Professional Development School. See page 123, 133-140 of appendix. 3. Internship in Professional Development School. See pages 133-</p>	<p>Assessments and Performance Data 1. Performance-Based Assessment Process. See pages 121, 128, 133-140 of appendix. 2. Performance-Based Assessment Process. See page 128, 133-140 of appendix. 3. Performance-Based Assessment Process. See pages 133-140 of</p>

community.
 Reflection on professional practices and continuous efforts to ensure the highest quality of science instruction.
 Willingness to work with students and new colleagues as they enter the profession.

3.0 Goals and Self Analysis
 Discuss the data collected from candidate analysis and other sources. Briefly identify and discuss changes you have made or will be seeking to make related to this program standard as a result of your analysis.

4. Develop individual objectives, reflecting personal needs and interests as the course proceeds; read supplementary texts according to need or interest.

The ultimate goal of the secondary science certification program is for the candidates to translate their understanding of the workings of scientific research into appropriate classroom curriculum and learning experiences for their students. Everything flows from this goal. Over the next five years, the Science and Education departments will refine the curriculum required of future teachers so that it is aligned with the INTASC standards and NSES standards. One particular focus will

140 of appendix.
 4. Complete readings from texts and handouts as assigned. Internship in Professional Development School. See pages 129-130, 133-140 of appendix.

be on performance based assessment. Additional benchmarks need to be considered for both secondary minor candidates as well as for post-baccalaureate secondary candidates. The Praxis series, particularly Praxis I, is currently under discussion for use in the spring of the second year as one means of identifying the basic skills deficiencies of the candidates. The Praxis I test would become a part of a more extensive process to benchmark the success of all secondary candidates. The vision for this

appendix.
 4. Curriculum review , final exam, and article critique. Performance-Based Assessment Process. See pages 128, 130, 133-140 of appendix.

benchmark includes a holistic approach to assessment paying particular attention to GPA, and written and oral communication skills. Additionally, the performance based assessment process used in all elementary and secondary Professional Development Schools will continue to be evaluated and checked for validity over the next five years.

**National Science Teachers Association
Program Review Matrix**

Name of Program(s) _____ Physics and Secondary Physics Certification _____ Level(s) UG _____

1.0 Rationale. State the rationale for the content organization and structure of the program and explain how and why the conceptual content in each licensure area (if appropriate) has been selected.

The overarching goals of the Physics major program are to develop in the students a thorough understanding of the fundamentals of physics as a discipline, to insure that the students have a firm ability to solve problems and assimilate novel information, to link the conceptual and intuitive understanding of physics with the mathematical level of understanding in the student's mind, and to provide the students with hands-on laboratory experience that reifies the lessons learned in the abstract mathematical courses. These goals are achieved within the context of a set of disciplinary courses that cover the major core areas in physics: mechanics, electromagnetism, thermodynamics, optics, and quantum theory. The requirements for a minor in secondary teaching certification in physics follow the same rationale as those for the major, and are included in the description of program standards.

The organization of the content is in multiple levels that build on each other in a coherent fashion. Mechanics is introduced in General Physics I and then done at an advanced level in Classical Mechanics. Electromagnetism is introduced in General Physics II and then done at an advanced level in the two-semester Electricity and Magnetism course. Quantum theory is introduced in Waves and Modern Physics and then done at an advanced level in the two-semester Quantum Physics course. Thermodynamics and Optics are each done in a single-semester format, at the sophomore and senior levels, respectively. Simple laboratory techniques are introduced in the General Physics Laboratory, along with content reinforcement for the accompanying course. More advance laboratory techniques, including computer interfacing of experiments, are presented in the two-semester Methods of Instrumentation course. Application of these techniques to high-level physics content occurs in the Modern Physics Laboratory and the Optics Laboratory.

2.0 Program Structure. Provide program indicators, practices and assessments in the table below, making sure that related items begin on the same	Program Standard	Indicator(s)	Learning Experiences	Assessments and Performance Data
2.1 Content				
The program prepares candidates to structure and interpret the concepts, ideas and relationships in science that are needed to advance student learning in the area of licensure as defined by state and national standards developed by the science education community.		1. Know basic physical principles of mechanics, electricity, magnetism, and waves at a basic introductory level.	1. General Physics I, PH 201, and General Physics II, PH 202. See syllabi, pages 80-85 of appendix.	1. Three 50-minute exams, comprehensive final exam, quizzes and/or graded homework. See sample exams, pages 108-109 of appendix.
Content refers to:		2. Know thermodynamics and statistical mechanics at an intermediate level.	2. Intermediate Thermal Physics, PH 318. See syllabus, page 94 of appendix.	2. Two 50-minute exams, comprehensive final exam, graded homework. See sample exam, page 112 of appendix.
Concepts and principles understood through science.		3. Know analytical dynamics at a sophisticated enough level to determine and solve equations of motion for a given physical problem	3. Classical Mechanics, PH 316. See syllabus, page 93 of appendix.	3. Two 50-minute exams, comprehensive final exam, graded homework. See sample exam, page 111 of appendix.
Concepts and relationships unifying science domains.		4. Know basic ideas of Theory of Relativity.	4. Waves and Modern Physics, PH 301. See syllabus, pages 88-92 of appendix.	4. Three 50-minute exams, comprehensive final exam, graded homework. See sample exam, page 110 of appendix.
Processes of investigation in a science discipline.		5. Know Maxwell's Equations and their applications.	5. Electricity and Magnetism I, PH 427, and Electricity and Magnetism II, PH 428. See syllabi, pages 103-104 of appendix.	5. Two 50-minute exams, comprehensive final exam, graded homework. See sample exams, pages 118-119 of appendix.
Applications of mathematics in science research.		6. Know historical foundations of wave mechanics.	6. Waves and Modern Physics, PH 301. See syllabus, pages 88-92 of appendix.	6. Three 50-minute exams, comprehensive final exam, graded homework. See sample exam, page 110 of appendix.
		7. Know Schrodinger's Equation and its applications to atomic and molecular physics, and know how this equation fits into formal structure of quantum theory.	7. Quantum Physics I, PH 411, and Quantum Physics II, PH 412. See syllabi, pages 99-100 of appendix.	7. Two 50-minute exams, comprehensive final exam, graded homework. See sample exams, pages 114-115 of appendix.
		8. Be able to solve novel problems based on fundamental physical principles.	8. Laboratory investigations, problems sets, exams, PH 201, PH 202, PH 291, PH 292, PH 301, PH 316, PH 318, PH 394, PH 396, PH	8. Exams, investigations, and homework. See sample exams, pages 108-120 of appendix.

Program Standard	Indicator(s)	Learning Experiences	Assessments and Performance Data
<p>2.2 Nature of Science The program prepares teachers to engage students in activities to define the values, beliefs and assumptions inherent to the creation of scientific knowledge within the scientific community, and contrast science to other ways of knowing. Nature of science refers to: Characteristics distinguishing science from other ways of knowing. Characteristics distinguishing basic science, applied science and technology. Processes and conventions of science as a professional activity. Standards defining acceptable evidence and scientific explanation.</p>	<p>1. Understand the nature of physics as a deductive science based on a small number of fundamental postulates.</p> <p>2. Be able to relate phenomena in the laboratory to general physical principles.</p> <p>3. Be able to describe coherently the results and meaning of a laboratory investigation.</p>	<p>411, PH 412, PH 421, PH 422, PH 427, PH 428, PH 460, PH 490. See syllabi, pages 80-107 of appendix.</p> <p>9. Methods of Applied Mathematics I, PH 421, and Methods of Applied Mathematics II, PH 422 (see syllabi, pages 101-102 of appendix); selected applications in 300 and 400 level courses (see syllabi, pages 88-107 of appendix).</p> <p>10. Optics, PH 460, and Optics Laboratory, PH 490. See syllabi, pages 105-107 of appendix.</p> <p>1. All non-laboratory courses, especially PH 316, PH 318, PH 411-12, and PH 427-28. See syllabi, pages 93-94, 99-100, 103-104 of appendix.</p> <p>2. General Physics Laboratory I, PH 291 and General Physics Laboratory II, PH 292 (and their corresponding courses), Modern Physics Laboratory, PH 396, and Optics Laboratory, PH 490 (plus corresponding course). See syllabi and representative materials, pages 86-87, 97, 106 of appendix.</p> <p>3. Modern Physics Laboratory, PH 396, and Optics Laboratory, PH 490. See pages 97-98, 106-107 of appendix.</p>	<p>9. Three 50-minute exams and a comprehensive final exam. See sample exams, pages 116-117 of appendix.</p> <p>10. Two 50-minute exams, comprehensive final exam, graded homework. See sample exam, page 120 of appendix.</p> <p>1. Exams and quizzes. See sample exams, pages 111-112, 114-115, 118-119 of appendix.</p> <p>2. Written laboratory reports, quizzes in PH 291-2, and some exam questions especially in PH 201-2 and PH 301. See samples, pages 86-87, 108-110 of appendix.</p> <p>3. Written laboratory reports. See pages 97 and 106 of appendix.</p>

Program Standard**2.3 Inquiry**

The program prepares candidates to engage students regularly and effectively in science inquiry and facilitate understanding of the role inquiry plays in the development of scientific knowledge. Inquiry refers to:

- Questioning and formulating solvable problems.
- Reflecting on, and constructing, knowledge from data.
- Collaborating and exchanging information while seeking solutions.
- Developing concepts and relationships from empirical experience.

Indicator(s)

1. Be able to engage in collaborative group efforts in problem solving.
2. Be able to conceive and execute an independent project.

Learning Experiences

1. Encouraged in a variety of settings; see, for example, syllabi for PH 201-2, PH 318, PH 411-12, and PH 427-8 (pages 80-85, 94, 99-100, 103-104 of appendix).
2. Projects have been formally included in individual courses under specific circumstances (PH 292, PH 395, PH 422 are examples; see page 87 of appendix). Research opportunities are available to all students during the summer (funded by stipends).

Assessments and Performance Data

1. In-class problems and homework sets. See pages 99-100 and 103-104 of appendix.
2. Independent projects and research done within the context of a course are graded based on written and/or oral presentations (see page 87 of appendix); summer research is not formally assessed.

Program Standard**2.4 Context of Science**

The program prepares candidates to relate science to the daily lives and interests of students and to a larger framework of human endeavor and understanding. The context of science refers to:

- Relationships among systems of human endeavor including science and technology.
- Relationships among scientific, technological, personal, social and cultural values.
- Relevance and importance of science to the personal lives of students.

Indicator(s)

1. Be able to relate the foundational content of individual sub-disciplines of physics to the common methodological principles found in all sub-disciplines, and to the ongoing research problems in physics and related fields.

Learning Experiences

1. Laboratory investigations, problems sets, exams, PH 201, PH 202, PH 291, PH 292, PH 301, PH 316, PH 318, PH 394, PH 396, PH 411, PH 412, PH 421, PH 422, PH 427, PH 428, PH 460, PH 490. See syllabi, pages 80-107 of appendix. Also, students are strongly encouraged to attend the Physics Department Seminar Series.

Assessments and Performance Data

1. Selected exam questions (pages 108-120 of appendix).

Program Standard**2.5 Skills of Teaching**

The program prepares candidates to create a community of diverse student learners who can construct meaning from science experiences and possess a disposition for further inquiry and learning. Pedagogy refers to: Science teaching actions, strategies and methodologies. Interactions with students that promote learning and achievement. Effective organization of classroom experiences. Use of advanced technology to extend and enhance learning. Use of prior conceptions and student interests to promote new learning.

Indicator(s)

1. Be able to use symbolic manipulation techniques to solve problems.

2. Be able to use modern computerized data acquisition methods in instructional laboratories.

3. See Chemistry Matrix (1) for additional discussion.

Learning Experiences

1. Employed in teaching and assigned as homework in a variety of courses. See, for example, syllabi for PH 316 and PH 427-28 (pages 93, 103-104 of appendix).

2. Introduced in PH 291-292 and continued in PH 396 and PH 490. See syllabi, pages 86-87, 97-98, 106-107 of appendix.

Assessments and Performance Data

1. Take-home exam problems in applicable courses. See page 111 of appendix.

2. Skills needed to accomplish laboratories, but not assessed explicitly and separately.

Program Standard**2.6 Curriculum**

The program prepares candidates to develop and apply a coherent, focused science curriculum that is consistent with state and national standards for science education and appropriate for addressing the needs, abilities and interests of students. Science curriculum refers to: An extended framework of goals, plans, materials, and resources for instruction.

Indicator(s)

1. See 2.1 Content of this matrix.

2. See Chemistry Matrix (1) for additional discussion.

Learning Experiences**Assessments and Performance Data**

The instructional context, both in and out of school, within which pedagogy is embedded.

Program Standard

2.7 Social Context

The program prepares candidates to relate science to the community and to use human and institutional resources in the community to advance the education of their students in science. The social context of science teaching refers to: Social and community support network within which occur science teaching and learning. Relationship of science teaching and learning to the needs and values of the community. Involvement of people and institutions from the community in the teaching of science.

Indicator(s)

1. Be able to engage in collaborative group efforts in problem solving.
2. Engage in attempts to bring physics to local academic and civic communities.
3. See Chemistry Matrix (1) for additional discussion.

Learning Experiences

1. Encouraged in a variety of settings; see, for example, syllabi for PH 201-2, PH 318, PH 411-12, and PH 427-8 (pages 80-85, 94, 99-100, 103-104 of appendix).
2. Encouraged through activities of the Society of Physics Students chapter.

Assessments and Performance Data

1. In-class problems and homework sets. See pages 99-100 and 103-104 of appendix.
2. N/A

Program Standard

2.8 Assessment

The program prepares candidates to use a variety of contemporary assessment strategies to evaluate the intellectual, social, and personal development of the learner in all aspects of science. Assessment refers to: Alignment of goals, instruction and outcomes. Measurement and evaluation of student learning in a variety of dimensions. Use of outcome data to guide and

Indicator(s)

1. Select from a variety of assessment procedures those that fit particular objectives and situations. Examine and analyze standardized and teacher made tests as instruments for the evaluation of student performance and progress; develop alternative methods of assessing student achievement. Engage in thoughtful reflection and analysis of a school in the context of a school system to include an awareness of the structure, goals, and policies, human and instructional resources, school-wide and system-

Learning Experiences

1. Develop a long range unit plan incorporating Maryland School Performance Goals. Write daily lesson plans. Develop and write quizzes, unit tests, and other evaluation tools. Provide written reflection on the validity and outcome of teaching strategies and assessments. Internship in a Professional Development School. See pages 121, 123, 129, 133-140 of appendix.

Assessments and Performance Data

1. Performance based assessment process. Develop an appropriate performance assessment with equipment and materials fitting into a shoe box. See pages 128-129, 131 of appendix.

change instruction.

Program Standard

2.9 Environment for Learning

The program prepares candidates to design and manage safe and

supportive learning environments reflecting high expectations for the success of all students. Learning

environments refers to:

Physical spaces within which learning of science occurs.

Psychological and social environment of the student engaged in learning science.

Treatment and ethical use of living organisms.

Safety in all areas related to science instruction.

wide instructional assessment programs, and guidelines.

Indicator(s)

1. Understand basic safety rules in laboratories (for high temperature, high voltage, etc.).

Learning Experiences

1. Taught in all laboratories, but especially in PH 396. See syllabus, pages 97-98 of appendix.

Assessments and Performance Data

N/A

Program Standard

2.10 Professional Practice

The program prepares candidates to participate in the professional

community, improving practice through their personal actions, education and development.

Professional practice refers to:

Knowledge of, and participation in, the activities of the professional community.

Ethical behavior consistent with the best interests of students and the community.

Reflection on professional practices and continuous efforts to ensure the highest quality of science instruction.

Indicator(s)

1. Understand the basic ethical canons of the scientific community.

2. Realize the norms and procedures of science as an institution.

3. See Chemistry Matrix (1) for additional discussion.

Learning Experiences

1. Modeled by faculty actions; in laboratories, emphasis on the accurate and honest reporting of results.

2. Exemplified in the practice of scientific research, which is available to all students through courses and stipend-supported summer work.

Assessments and Performance Data

1. Accurate and honest reporting of results a component of grading for laboratory reports. See pages 87, 99-100, 103-104 of appendix.

2. Written reports of research results for courses and summer work.

Willingness to work with students and new colleagues as they enter the profession.

3.0 Goals and Self Analysis

Discuss the data collected from candidate analysis and other sources. Briefly identify and discuss changes you have made or will be seeking to make related to this program standard as a result of your analysis.

The ultimate goal of the secondary science certification program is for the candidates to translate their understanding of the workings of scientific research into appropriate classroom curriculum and learning experiences for their students. Everything flows from this goal. Over the next five years, the Science and Education departments will refine the curriculum required of future teachers so that it is aligned with the INTASC standards and NSES standards. One particular focus will

be on performance based assessment. Additional benchmarks need to be considered for both secondary minor candidates as well as for post-baccalaureate secondary candidates. The Praxis series, particularly Praxis I, is currently under discussion for use in the spring of the second year as one means of identifying the basic skills deficiencies of the candidates. The Praxis I test would become a part of a more extensive process to benchmark the success of all secondary candidates. The vision for this

benchmark includes a holistic approach to assessment paying particular attention to GPA, and written and oral communication skills. Additionally, the performance based assessment process used in all elementary and secondary Professional Development Schools will continue to be evaluated and checked for validity over the next five years.

Professional Development Schools

Secondary Minor candidates at Loyola have the opportunity to take part in an internship in a Professional Development School.

Since the mid-80's, continuing discussions regarding educational reform at national, state, and local levels have focused on the professionalization of teaching. In 1991, the Maryland Higher Education Commission charged a blue ribbon task force with recommending a comprehensive approach to the education of teachers that combined a solid foundation of academic preparation with the most promising developments of professional practice. Recommendation 6 of the Task Force Report stated, "Every teacher candidate should do an extensive internship in a specially designed Professional Development School."

In responding to this recommendation, the Teacher Education Program at Loyola College sought to meet this goal by establishing Professional Development Schools in Baltimore City and in surrounding counties. The Professional Development School is a collaborative effort between the local school and the Education Department of Loyola College. Working within the governmental structures of the school systems and the Education Department of Loyola College, a steering committee develops, implements, and evaluates the policies and procedures related to the specific Professional Development School. The steering committee membership includes: college faculty and administration; school faculty and administration; parents; business and community members; and interns.

The mission of a Professional Development School (PDS) collaboration is seen as a means to improve the quality of education for all involved - interns, teachers, and students K-12, by providing an extensive internship for prospective teachers; continued professional development for teachers; and the opportunity to conduct action research regarding teaching, learning and innovative instructional practices.

The ultimate goal of the Loyola faculty and the participating school(s) is to develop a model of excellence through a collaborative effort that includes:

- providing an extensive internship experience which integrates theory and practice;
- conducting an application process that ensures equity and is open to any student who meets specific requirements;
- ensuring that teacher candidates become integral members of the school's professional community;
- providing the candidate with opportunities to experience other teaching styles;
- governing itself through a steering committee;
- ensuring a planning process that consists of a needs assessment, goal setting, an action plan and an evaluation;
- engaging in formulating, utilizing and evaluating instructional approaches, methodologies and techniques;
- providing professional development for teachers;
- engaging in action research as identified by school needs.

Each Professional Development School links its efforts to both school improvement and teacher education reforms in order to become a learning community for all.

The effectiveness of a Professional Development School depends upon the ability of those involved to fulfill their responsibilities as a collaborative working unit. It is important that the administration in the local school and at Loyola College support the concept and seek resources to enable it to develop. Frequent and open communication is essential between and among the candidate, the mentor, the site-based coordinator, the PDS school coordinator, the Teacher Education Program coordinator, the local school steering committee, and the Loyola College steering committee. Consequently, Loyola College only establishes these partnerships in schools where the administration and at least 80% of the school's faculty are committed to forming this learning community.

APPENDICES ARE CURRENTLY UNAVAILABLE