

SUNY Potsdam

*Student Learning Outcomes Assessment Plan – Science Middle/Secondary Education
BA*

Department Name: Science Middle/Secondary Education BA

Date Submitted and Academic Year: Fall 2011 for AY 2011-2012

Department Mission Statement:

All SUNY Potsdam education programs are aligned with our conceptual framework, *A Tradition of Excellence: Preparing Reflective and Creative Educators*. Recognizing that the development of professional knowledge, skills and dispositions is essential to the preparation of educators for our public school, all programs and courses seek to develop our candidates' attributes as *Well-Educated Citizens, Reflective Practitioners, and Principled Educators*. (See program of studies attachment)

Well-Educated Citizen: Through their academic major, graduates of the Secondary School Science Education Grades 7-12 program acquire a broad and deep knowledge of the subject matter they will be teaching. They develop appropriate modes of inquiry for their discipline(s) through observing a variety of appropriate instructional and assessment techniques modeled by their teachers, both Instructors and Mentor Teacher. They learn to model the skills, attitudes, and values of inquiry appropriate to their discipline while developing a life-long love and curiosity for the subject. Their strong science majors insure that as secondary science education graduates, they have the content knowledge to support the New York Learning Standards appropriate for their certification area.

Reflective Practitioner: Disciplined inquiry begins with helping pre-service teachers develop a sense of themselves as learners. Early in their program they are asked to articulate their philosophy of education and are given the opportunity to identify their own preferred learning styles. By examining their own strengths, weaknesses, and beliefs about learning, they will be better able to provide appropriate instruction for their students. Building on a strong liberal arts foundation, the secondary science teacher education program provides its candidates with an understanding of the pedagogical skills related to effective instruction. These best teaching practices are research-based and represent both general and content-specific teaching methodology. Throughout a candidate's program of study they are exposed to research-based models of instruction and assessment, including direct instruction and inquiry learning. They are required to demonstrate their ability to use multiple and effective strategies to teach students with a variety of learning needs and to collaborate with peer professionals and if applicable collaborating with parents. They demonstrate the ability to effectively select and use technology to assist and engage student learning. Throughout the program, they are regularly asked to reflect on their own learning and performance as a way of promoting professional development throughout their careers. Carefully developed sequences of education courses and field-based experiences provide the best learning experiences for pre-service teachers. Working closely with our public school partners, essential experiential opportunities are developed to help teachers to connect the theoretical and realistic aspects of teaching. Written and oral self-reflection on the candidates' own experiences is an integral part of field experience and practicum requirements.

Principled Educator: The secondary science education programs are committed to developing teachers that have professional attitudes, values and dispositions required to positively influence the lives of all of their students. Pre-service teachers must recognize that their teacher education program is the beginning of their journey toward becoming a model teacher. If the journey is to be successful, they must continue to develop as a teacher, be comfortable with uncertainty, be flexible, and be willing to take risks throughout their careers. They must also demonstrate the ability to work well with others and to take responsibility for their own actions. Throughout our programs, we model for our candidates the practices associated with life-long learning, including action research and use of the environment as a pedagogical tool.

Faculty Member Completing this Form: Melissa Cummings

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Intended Student Learning Outcome #1

Students will demonstrate acceptable levels of content knowledge in Biology, Chemistry, Earth Science and/or Physics

Measurable Criteria and Assessment Method(s)

Direct Assessment #1: Content Specialty Tests

The Content Specialty Tests and the Assessment of Teaching Skills-Written assess several of the NSTA standards. The Content Specialty Tests align with the following NSTA Standards:

• **Standard 1:** Content

Biology, Chemistry: Subtests 2-6

Earth Science and Physics: Subtests 2-5

• **Standard 3:** Inquiry

Biology, Chemistry: Subtests 1 and 7

Earth Science and Physics: Subtests 1 and 6

Direct Assessment #2: Course Grades

Biology:

BIOL 151 Biology I

BIOL 152 Biology II

BIOL 300 Ecology

BIOL 311 Genetics

One of the following:

BIOL 407 Cell Physiology

BIOL 440 Vertebrate Physiology

BIOL 410 Human Physiology

One of the following:

BIOL 303 Organization/Functions of Plants

BIOL 325 Morphology of Lower Plants and Algae

BIOL 326 Morphology of Higher Land Plants or approved Botany course

Biology Cognate Requirements:

CHEM 105 General Chemistry I

CHEM 106 General Chemistry II

CHEM 341 Organic Chemistry I

Chemistry Required Courses:

CHEM 105 General Chemistry 1

CHEM 106 General Chemistry 2

CHEM 341 Organic Chemistry 1

CHEM 342 Organic Chemistry 2

CHEM 311 Quantitative Analysis

CHEM 451 Physical Chemistry 1

CHEM 452 Physical Chemistry 2

Chemistry Cognate Requirements:

MATH 151 Calculus I

MATH 152 Calculus II

*PHYS 103 General Physics I

PHYS 204 General Physics II

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Geology Required Courses:

GEOL 103 Physical Geology
GEOL 104 Historical Geology
GEOL 301 Sedimentology-Paleontology- Stratigraphy I
GEOL 302 Sedimentology-Paleontology- Stratigraphy II
GEOL 311 Mineralogy
GEOL 321 Optics and Petrology
GEOL 405 Structural and Field Geology
GEOL 407 Geophysics I
GEOL 420 Geochemistry

Geology Cognate Requirements:

CHEM 105 General Chemistry I
CHEM 106 General Chemistry II

Physics Required Courses:

PHYS 103 General Physics I
PHYS 204 General Physics II
PHYS 305 General Physics III
PHYS 306 Modern Physics

Physics Cognate Requirements:

CHEM 105 General Chemistry I
CHEM 106 General Chemistry II
MATH 151 Calculus I
MATH 152 Calculus II

Direct Assessment #3: Science major seminar

Biology:

Course description: This current topics offering is designed to explore topics related to learning. Students complete two requirements with the successful completion of this course as it meets the major's current topics and general education SI (Speaking Intensive) requirements. The structure of the course will include lectures and student presentations. Students will present current topic papers related to the theme of the course. Topics may include any of the topics in the schedule, specific of teaching and learning in the sciences, and other instructor-approved topics.

Each student will complete three class presentations. Each presenter will be provided with 15 minutes of presentation time. This is the approximate amount of time allowed presenters at most scientific meetings. With the exception of the first few presentations, and some special topics, they must find the new literature. Restricted searches to information published from 1995 to the present to keep the Current Topics course current. When possible, present the most recent paper on the assigned topic. They must provide a copy of the paper to the instructor at least a week ahead of the scheduled presentation. They must present a copy of the abstract to the class on the week before your presentation and a one to two page summary handout for each student. This should include; title, author, main ideas and conclusions, and important images (graphs, tables, etc.). They must ask questions of the presenting student. Questions are open to all, but required of the student preceding and following the current presentation.

Chemistry

Chemistry Topics (CHEM 308) is a required course for the chemistry major. The emphasis of CHEM 308 is on the use of the chemical literature. Students will become familiar with modern methods of searching the chemical literature and are required to research a literature topic and write a paper on that topic. CHEM 309 is considered to be a continuation of CHEM 308 where

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students will present a seminar on the CHEM 308 literature topic. The course will focus on the development of information retrieval and communication skills in chemistry, with emphasis on writing a scientific paper in chemistry. Chemists from academia and industry will visit the department to present seminars, usually within their area of research which should serve as models for the CHEM 309 seminar. They are required to write a paper on a topic selected from the primary chemical literature. The chemistry faculty who will also serve as mentors for the papers will submit the topics. The topic selected determines the mentor for the paper and the seminar topic for CHEM 309 in the spring. The "Listing of all Literature Sources Found to Date" must include the title of the article, the author(s) and the complete journal reference. The "Annotated Bibliography" is a listing of sources; title, author(s) and journal reference, along with your *brief* (2 - 3 sentence) description of the contents of each reference. The "Summary of Key Sources" is a *short* summary of each key references; each should be no longer than one page (200 – 300 words).

Earth Science/Geology:

GEOL 480 – Geology Research: Original research designed to give practical experience in any area of geology. Open primarily to upper-division geology majors and only on advisement. Research conducted in cooperation with a geology professor. Graded S*/U*. Students select a topic which in turn determines the professor whom they will be working with. Students carry out research in current areas of research in geology.

Physics:

Physics Research I and II courses: “Designing, performing, interpreting, and summarizing research project in a field of pure and applied physics”. It is open and they may get feedback from other faculty members to hear from their perspectives. Students get first hand research experience (appropriate for undergraduate) in the courses. Physics Research I is offered in the fall and Physics Research II in the spring. Students work under the direction of faculty to select a suitable research project and meet regularly during the week to discuss the continuation of the project. They do library search, learn advanced math tools, read articles and work already published in the area by their group or others as they pursue their own research. Students complete both computational and experimental projects. Students often make presentations of their work at the national, regional, local and campus meetings. They have also published their work at the Proceedings of the National Conference of Undergraduate Research and have co-authored articles with faculty.

Direct Assessment #4: Research paper and presentation

Research paper: This assessment provides data to support assessment of our candidates with respect to NSTA standards (2011:1b-c, 2a-b, 3a, 4a, and 7a). In the program, these rubrics evaluate the candidate’s contribution to class members understanding of inquiry processes, tenets, assumptions and goals distinguishing science and technology from other ways of knowing. Candidates are also evaluated for their understanding of socially important science and technology issues and the processes used to analyze issues and make informed decisions.

Data Source/Results & Analysis

Direct Assessment #1: Content Specialty Tests

The science education program analyzes the results of the required state content assessment Content Specialty Test for this assessment. The New York State Teacher Certification Examination Content Specialty Tests (CST) for biology, chemistry, earth science, and physics are comprehensive, multi-tiered tests composed of multiple choice question sections and a

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constructed response section which is used to determine that the New York State science educator (biology, chemistry, earth science, or physics) has the content knowledge and skills necessary to teach effectively in New York State public schools.

[Note: The Content Specialty Test is required for certification, but not for graduation. Candidates graduating December 1012 or prior must also pass the Assessment of Teaching Skills-Written (Secondary Level), a test of pedagogical and pedagogical content knowledge, and the Liberal Arts and Sciences Test, a general education assessment, to become certified. However the tests are changing for May 2013 graduates.]

Direct Assessment #2: Course Grades

This assessment includes an analysis of grades earned in all courses required for completion of the undergraduate major.

Direct Assessment #3: Science major seminar

Students complete a research course during the completion of their science major. The course is a semester-long course in research and investigation of a topic within the major. Students select a topic and carry out research collecting information from the most recent research in the field. They analyze their data create graphs, probability tables, statistical analysis charts, and or data tables to interpret and explain their findings during their report.

Direct Assessment #4: Research paper and presentation

This assessment is composed of a research paper and its presentation, completed as part of the requirements for GRED 502: Science-Technology-Society

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Intended Student Learning Outcome #2

Students will demonstrate pedagogical and professional knowledge, skills and dispositions.

Measurable Criteria and Assessment Method(s)

Direct Assessment #1: Interdisciplinary Inquiry-Based Science Unit and Curriculum Plan

The interdisciplinary science unit has several functions and addresses the NSTA standards of inquiry (Fall 2011: 3a and b), curriculum (Fall 2011: 6a and b), general skills of teaching (Fall 2011: 5a-f) and assessment (Fall 2011: 8a-c). This assessment familiarizes candidates with the inquiry-based method of instruction. The majority of candidates have not been taught with this method of instruction in their high school or college experiences. Therefore we feel very strongly that candidates need to replace the teacher-driven strategy of lecture and notes with the student-driven strategy of scientific inquiry. The *5e's model* of instruction provides a structure for carrying out inquiry-based lessons that allows candidates to design and carry out investigations that will provide data from which they can develop concepts and relationships from their interpretation of their data. (NSTA Fall 2011: 3a, 3b). It also helps candidates realize that science should not be taught in a vacuum. Candidates come to understand that the majority of activities described within the lessons of their science units help their students learn through reading, listening, written presentation, observations, hands on activities, data collection, organization of written material, and oral presentation. Candidates also learn that by combining the content areas of math, social studies, ELA and technology, their students' learning will have a much greater depth, leading to much greater retention. (NSTA Fall 2011: 6b)

It familiarizes candidates with the New York State content area standards in their particular subject area as well as the areas of math, English language arts, social studies, and technology. They learn how to access these standards as well as to understand how they can be arranged to enhance their ability to plan short range and long range learning units. (NSTA 2011: 6a)

Through assignments, candidates learn how to plan units of instruction that are consistent not only with their individual goals and objectives but also with reference to the school wide curriculum. They understand that planning their individualized classroom curriculum is only one part of the larger school-wide curriculum and that they must plan not only with the content in mind but also with the goals and objectives of the larger curriculum in mind. (NSTA 2011: 6b) Finally, our candidates find that using five stages of instruction (The 5 E's) provides them the opportunity to use five different instructional strategies and to carry out five different assessments throughout the unit, thereby increasing dramatically their students' ability to be successful at learning science. The variety of assessments allows the candidates to evaluate their teaching based on student learning but also allows students to self-evaluate their learning (NSTA 2011: 5a-f, and 8a-c)

The curriculum plan addresses NSTA 2011: 6a and 6b. It requires that candidates create a year-long curriculum plan for the instruction of science in their certification area. Through the completion of this requirement teacher candidates demonstrate their understanding of curriculum as not only content but as a plan based on school wide philosophies, goals, and strategies. It also provides them with the opportunity to demonstrate their ability to identify, access and or create resources and activities for science activities in Secondary/Middle School classrooms that are consistent with the standards. Teacher candidates are also able to describe the ways in which they will meet the variety of needs and abilities of their students.

Direct Assessment #2: Science Form 5

This assessment is currently aligned with the ten principles of the "Model Standards in Science Beginning Teacher Licensing and Development", established by the Interstate New Teacher

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Assessment and Support Consortium (INTASC) Standards Drafting Committee. By addressing each of the criteria comprising each of the ten principles, the teacher candidate is also able to address the following National Science Teacher Association Standards for Teacher Preparation (Fall 2011) :

- 3a-b Inquiry
- 5a-f General Skills of Teaching
- 6a-b Curriculum
- 8a-c Assessment
- 9a-d Safety and Welfare
- 10a-d Professional Growth.

Direct Assessment #3: Classroom/Laboratory Safety Plan

The completed classroom/laboratory safety plan will demonstrate the teacher candidate's knowledge in the areas of teacher responsibility, emergency procedures, knowledge of proper and safe techniques and the proper care of living things as well as their ability to plan for the instruction of their students in these same areas. The successful accomplishment of this assignment is directly aligned with NSTA Fall 2011 Standards 9a-d Safety and Welfare and provides evidence for addressing these standards.

Data Source/Results & Analysis

Direct Assessment #1: Interdisciplinary Inquiry-Based Science Unit and Curriculum Plan

This assessment is composed of two parts, completed during SECD 472: *Science Curricula, Programs and Standards* and demonstrating the candidates' ability to engage in mid-level and long-range planning: This ***interdisciplinary inquiry-based science unit*** is composed of a minimum of five individual lesson plans representing the stages of the ***5e's instructional model***. Candidates must integrate science content with English Language Arts content and the inclusion of math, social studies, and technology content standards is strongly encouraged. The student candidate must also create a year-long ***curriculum plan*** for their planned instruction in a future public school classroom.

Direct Assessment #2: Science Form 5

The student teaching assessment form, "Form 5," is used to assess the teacher candidates' application of the instructional concepts and skills in the student teaching placement. It is completed in its entirety 4 times during the student teaching placement, at the 4th, 8th in the first placement, and again at the 12th, and 16th weeks in placement 2. The 4th and 12th weeks are used for formative assessment, and the 8th and 16th weeks are summative.

[Note: The Form 5 is organized around the NSTA standards with cross-referencing to the INTASC standards.]

Direct Assessment #3: Classroom/Laboratory Safety Plan

During GRED 673: Secondary Science Field Experience candidates create a classroom/laboratory safety plan during the practicum experience using information from the public school administration, mentor teacher, and research of applicable documentation. It outlines the emergency procedures, safety regulations, and other safety-related issues associated with instruction in science classrooms and laboratories.

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Intended Student Learning Outcome #3

Teacher candidates will demonstrate effects on student learning.

Measurable Criteria and Assessment Method(s)

The teacher work sample is composed of 7 sections, which each in turn addressing one or more of the NSTA standards:

- Contextual Factors section addresses standards (**Fall 9c and 9d**) as teacher candidates explore district, school, and classroom factors as a guide to instructional planning.
- Learning Goals/Objectives section addresses standards (**Fall 1a-c, 2 a -b, 6a -b, and 7a- b**) as teacher candidates identify their learning goals and objectives based on their content knowledge, the relationship of this knowledge to the national and local content standards used in their planning, and the discussion of their appropriateness for student knowledge and skill levels.
- Assessment Plan section addresses standard (**Fall 8a and b**) as teacher candidates plan a variety of assessment tools and the use of the results to guide future instructional decisions.
- Design for Instruction addresses standards (**Fall 2c, 3a and b, 5a-f and 7a and b**) as teacher candidates plan a variety of instructional activities, taking into account the content, inquiry processes, and the students' prior knowledge of their communities and environments along with consideration of students individual needs.
- Instructional Decision-Making section addresses standard (**Fall 5a**) as teacher candidates describe how they have modified their instructional technique during ongoing instruction based upon student feedback.
- Analysis of Student Learning section addresses standards (**Fall 8a and b**) as the teacher candidates use multiple types of assessment to collect data on student learning and then analyze this data to determine the effect of their instruction on student learning; they also disaggregate the data to discover any differential impacts.
- Reflection and Self-Evaluation again address standard (**Fall 8b and 10**) as the teacher candidates further analyze their assessment results with an eye towards the correlation between their intended instructional goals and objectives and the actual learning accomplished by their students. They also identify professional development goals for themselves based on this analysis.

Data Source/Results & Analysis

Successful teacher candidates illustrate their ability to support student learning by designing a Teacher Work Sample that employs a range of strategies and builds on each student's strengths, needs, and prior experiences. Teacher candidates must score at least a 3 on each section of the TWS to receive a passing grade. The teacher work sample is composed of 7 sections:

- Contextual Factors
- Learning Goals/Objectives
- Assessment Planning
- Instructional Design
- Instructional Decision-making
- Analysis of Student Learning
- Reflection and Self Evaluation.

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<i>Summary of Action Plans for upcoming Academic Year _____</i>
1.
2.
3.
4.
5.
6.
7.
8.

Closing the Loop

The science education program uses Task Steam, a web-based software program to collect all student teaching data. We have found that for individual courses within the program, the portfolio system provides an efficient system to collect and evaluate data.

Content knowledge:

The secondary science education program relies on the School of Arts and Sciences to provide the teacher candidates of our program with a deep and broad understanding of the major concepts, principles, theories, laws, and interrelationships of their chosen field in science. This content information is provided through the required content courses, which make up the science major programs. As the data from this coursework has been evaluated for the purpose of admittance and continuance in the teacher education program, we have accepted grades as representing the successful completion of each of these courses and meeting the standards of the National Science Teacher Association, with particular focus on NSTA Standard 1.

Previously it became apparent that more information in two areas which would be helpful in the improvement of our programs. The first of these areas needing to be addressed would be acquiring rubrics and other course assessment, scoring guides/descriptions. Knowing this information would provide a clearer picture of the information that our students have learned and allow us to create more specific performance indicators within the student teaching and fieldwork assessment documents with regard to content knowledge. The second area would be determining the instructional method being applied to teach the content courses and if any courses were being taught through an inquiry based model of instruction. This information would allow us to support the inquiry-based methods that we are attempting to impart to our teacher candidates in our methods courses. The plan for accomplishing these goals will be through direct contact with the department chairs of each of the four science majors and a thorough study of course descriptions. Then contact with each of the faculty members who are delivering a required course within the major in an Inquiry based model of Instruction.

Professional and pedagogical knowledge, skill, and dispositions:

After analyzing and reflecting upon the data from the variety of assessments within our program, as well as communicating with mentor teachers and student teacher supervisors, it is apparent that our students have a relatively high level of understanding with regard to their pedagogical knowledge and skills. Dispositions indicate that the teacher candidates are conducive to their becoming excellent classroom teachers.

It is apparent according to data that during the process of creating/organizing gates to regulate the progress of candidates through the different phases of our program, we have been able to create a solid set of parameters to guide our students and set expectations for them. Previously we focused more on the overall parameters than on the specific teacher candidate performance indicators in

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an effort to create the framework within which teacher candidates would work. This did allow us to create the gates' framework, but it became necessary to refine the specific performance indicators that make up each of the National Science Teacher Association standards with an eye towards making these indicators easier to interpret and use to assess teacher candidates' progress. Therefore our plan is to continue the process of simplifying and refining the performance indicators within our rubrics, scoring guides and directions. We have provided examples for each performance indicator describing what the performance indicator should look like in practice. This established a set of performance indicators that very simply and clearly set expectations and provide directions for our teacher candidates as well as reducing the degree to which an evaluator will have to interpret a given performance indicator in their efforts to assess our students.

Impact on Student learning:

Teacher candidates also provide a reflective piece, the Teacher Work Sample, in which they directly evaluate/reflect on their teaching methods and skills with respect to their students' learning. Previously after reviewing the assessment data on teacher candidates within our program and having communicated with mentor teachers and student teacher supervisors, it became apparent that directions and other scoring guides within our programs needed to be reviewed and/or refined. We created new assessments that have much more clearly defined performance indicators. We need to continue to create assessments in which there is little of no room for error when determining if a specific indicator has been met/satisfied regardless of the evaluators' field of expertise.

General program overview:

Through our various assessments and conversations with individuals either directly or indirectly associated with the assessment of our students, we feel that our science education programs are strong and provide our teacher candidates with good to excellent training. We have worked hard to create programs that are clear and provide a solid core of pedagogical knowledge and skills that are essential to becoming excellent classroom teachers. Faculty work in the public schools, which is being carried out in accordance with Professional Development Schools development processes, has yielded benefits in increased communication and trust between public schools and the college, increased opportunities for professional development for public school science teachers, increased support for the use of inquiry-based methods from mentor teachers and an overall better understanding of what an excellent science teacher should look like. Science teachers in the public school are also gaining an increased understanding of SUNY Potsdam's programs and goals, as well as a better awareness of the National Science Teacher Association standards and the New York State Math, Science, Technology Frameworks core curricula in science and their relationship to school-wide and departmental curriculum plans. Over the course of the last few years there has been a general trend demonstrating that the selection of students with the highest content and overall GPAs has resulted in teacher candidates that are highly flexible, good risk-takers, and much more able to interpret student responses as well as being able to adjust instruction spontaneously. The situation used to be that we had more teacher candidates than we had mentor teachers. This situation has now reversed itself and we consistently have many more mentor teacher volunteers than we have teacher candidates. We will need to continue these interactions in the future.