1. **Course Title and # of Credits**: CISE 535 Science Methods in Secondary Schools (3 graduate credits).

2. **Course Description**: This course introduces post-baccalaureate students to methods of teaching science through inquiry processes and constructivist approaches. Teacher candidates will organize learning experiences that include inquiry processes and knowledge construction fundamental to learning science in middle school and high school. K-12 curriculum coherence, maintenance of a safe, supportive learning environment for diverse learners, and use of technology are emphasized. Teacher candidates are required to demonstrate competence in planning instruction with thematic integration, learning cycles, and multiple assessments. Relationships among science, technology and society, issues of equity and multiculturalism, positive dispositions for teaching science, and science teachers’ collaborative roles within schools and with parents, university educators, scientists, and community partners are stressed. In addition, science education research literature will be explored to identify best practices for teaching science from a constructivist point of view.

3. **Prerequisites**: SOC 540, CISE 505, CISE 510, CISE 512, CISE 514
   **Co-requisites**: CISE 520, CIRL 522, CISE 530

4. **Course Objectives**:
   In this course teacher candidates will:
   1. Identify current goals of school science and appropriate student learning outcomes, curriculum, instructional models, and science teacher roles and responsibilities consistent with national and state science education standards.
   2. Identify characteristics, behaviors, and needs of adolescents in a multicultural society; promote appreciation of student diversity in contemporary learning environments, and identify practices that support meaningful learning of students with diverse characteristics (learning styles; academic and physical abilities; language, ethnic, and socio-economic backgrounds).
3. Become aware of the science teacher’s legal and ethical responsibility in providing a physically and emotionally safe learning environment that adheres to ethical treatment of all living organisms and conservation of the physical environment; develop awareness of legislation and educational guidelines that affect science teachers’ legal and ethical responsibilities.

4. Plan coherent, active, and effective curriculum that promotes scientific literacy for all students as recommended by current science education standards, professional teaching standards, educational literature, and educational/professional organizations.

5. Identify effective skills and strategies for science instruction and assessment, appropriate communication tools and techniques, and appropriate technology to facilitate meaningful learning of all students, and receive feedback about their instruction and assessment efforts, their use of communication tools/techniques and their use of technology.

6. Identify resources at the national, state, and local levels that provide formal and informal experiences that contribute to the goal of scientific literacy among students, citizenry and workforce.

7. Engage in ongoing reflection and self-evaluation with respect to their science content knowledge and skills, pedagogical knowledge and skills, professional dispositions and needs for ongoing professional development.

8. Explore research on best practices in teaching.

5. **Student Learning Outcomes**

Teacher candidates will be able to:

1. Demonstrate knowledge, skills, and dispositions needed for conducting scientific inquiry and facilitating scientific inquiry in the classroom by reflecting on a major research project they completed and discussing ways in which they may apply their experiences of scientific inquiry as a teacher of middle school and/or high school students.*

2. Demonstrate knowledge of national and state standards for curriculum, instruction, and assessment by writing reflective papers on assigned topics, collecting a file of teaching resources that support the standards, and planning, collaboratively, a thematic unit that supports the recommendations of national and state standards.*

3. Plan and teach an interdisciplinary, inquiry-based science lesson (pertaining to the thematic unit topic), which engages diverse learners, reflects accurate subject matter, employs appropriate assessments and technology, adheres to safety guidelines, and facilitates an understanding of science content identified in the national and state science standards (unifying concepts, nature of science, inquiry, science and technology; community connections).*
4. Demonstrate knowledge of legal and ethical responsibilities of science teachers; demonstrate knowledge of appropriate facility features and social tone of a safe learning environment for active learning of diverse students (consistent with student-centered philosophy and science education standards) by providing a science classroom/laboratory facility plan with rules and guidelines for interactions in the learning environment and by completing a science safety assessment.*

5. Reflect on and evaluate their understanding of subject matter knowledge and pedagogical practices; reflect on their professional dispositions and views about learners and learning; consider how their views and dispositions affect learners and assess their need for change and ongoing professional development.


Correlation of Student Learning Outcomes with National and State Standards

<table>
<thead>
<tr>
<th>Student Learning Outcome</th>
<th>NJ Prof. Teaching Standards</th>
<th>NSTA NCATE Standards</th>
<th>NJCCCS Standards</th>
<th>COE Competencies</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Demonstrate knowledge, skills, and dispositions for conducting scientific inquiry and facilitating inquiry in the classroom by reflecting on a research project completed in the undergraduate program using a designated rubric.*</td>
<td>1</td>
<td>1, 2, 3</td>
<td>5.1-5.10 (2004)</td>
<td>2</td>
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<tr>
<td>2. Demonstrate knowledge of national and state standards for curriculum, instruction, and assessment by writing reflective papers on assigned topics, collecting a file of teaching resources that support the standards, and planning, collaboratively, a thematic unit that supports the recommendations of national and state standards.*</td>
<td>2; 3</td>
<td>1; 2; 3; 4; 6;7</td>
<td>5.1-5.10 (2004)</td>
<td>3A; 6A; 5A-D; 19; 20B</td>
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<tr>
<td>3. Plan and teach an interdisciplinary, inquiry-based science lesson (pertaining to the thematic unit topic), which engages diverse learners, reflects accurate subject matter, employs appropriate assessments and technology, adheres to safety guidelines, and facilitates an understanding of science content identified in the national and state science standards.*</td>
<td>1; 2; 3; 4; 5; 7; 8</td>
<td>1; 3; 5; 9</td>
<td>5.1-5.10 (2004)</td>
<td>2; 3; 4; 5;6;12;16; 17; 20A</td>
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</tr>
<tr>
<td>4. Demonstrate knowledge of legal / ethical responsibilities of science teachers; demonstrate knowledge of appropriate facility features and social tone of a safe middle school learning environment for active learning of diverse students (consistent with student-centered philosophy and science education standards) by providing a science classroom/laboratory facility plan and rules and guidelines</td>
<td>3; 6; 11</td>
<td>5, 9</td>
<td>5.1-5.10 (2004)</td>
<td>7; 8; 11; 13; 14; 15;</td>
</tr>
</tbody>
</table>
for interactions in the learning environment and completing a science safety assessment.*

| 5. Reflect on and evaluate their understanding of subject matter and pedagogical practices; reflect on their dispositions and views about learners and learning; consider how their views and dispositions affect learners, and assess their need for change and ongoing professional development.* | 1; 2; 3; 10; 11 | 10 | 5.1-5.10 (2004) | 5.1-5.4 (2009) | 9; 10D; |


*NCATE Critical Assessment
http://www.wpunj.edu/coe/resources/standards.dot
Visit the above site to access NJ Professional Teaching Standards, NCATE SPA Standards, NJ Core Curriculum Content Standards, and WPU College of Education Competencies.

6. **Course Content**

1. **Personal Experiences and Conceptions of Science and Science Teaching**
   (A) Participants’ Shared Science Memories
   (B) Views generally held by adolescents and adults
   (C) Views held by uninformed and informed teachers

2. **The Nature of Science and Implications for School Science**
   (A) What is Science?
   (B) Characteristics that distinguish science from other ways of knowing
   (C) Standards defining acceptable evidence and scientific explanation (c)
   (D) Characteristics that distinguish basic science, applied science, and technology
   (E) Interdependence of Science, Technology, and Society
   (F) Inquiry processes and conventions of science as a professional activity
   (G) Science as a Global and Multicultural Activity

3. **Current Science Education Initiatives and Standards**
   (A) Goals, Purpose, and Practices in the 1950s and 1960s
   (B) Goals, Purpose, and Practices from 1980 to 1989
   (C) Science Education Goals in the 1990s and Beyond: Preparing for Scientific Literacy in the 21st Century
      (1) Project 2061
      (2) Scope, Sequence, and Coordination
      (3) National Science Education Standards
      (4) NJ Core Curriculum Standards (Adoptions and Revisions)
      (5) NSTA/NCATE Standards for Teacher Preparation

4. **Overview of Science Education Recommendations for Curriculum and Instruction**
(A) Making Connections (curriculum coherence, interdisciplinary approaches, thematic units)
(B) Incorporating Technology
(C) Instructional Models
(D) Cooperative Learning Strategies
(E) Variation of Teaching Strategies to Meet the Needs of Learners
(F) Accommodation of Diverse Learning Styles
(G) Broadened Role of Assessment
(H) Inquiry
(I) Less is more
(J) Model Middle School Curricula
(K) Model High School Curricula
(L) Procedures for Evaluating and Designing Curriculum

5. Characteristics, Dispositions, and Professional Responsibilities for Teaching Science
   (A) Inclination toward Inquiry
   (B) Knowledge and Understanding of Subject Matter
   (C) Enthusiasm
   (D) Knowledge and Understanding of Learners and Concern for Student Success
   (E) Relevance
   (F) Legal and Ethical Responsibilities toward all learners

6. Teaching Skills
   (A) Introduction
   (B) Directions
   (C) Questions
   (D) Teaching Aids
   (E) Management
   (F) Closure
   (G) Assessment

7. Teaching Strategies
   (A) Lecture
   (B) Discussion
   (C) Demonstration
   (D) Lab Work
   (E) Use of Reading Materials
   (F) Group Work
   (G) Simulations / Games
   (H) Computers / Internet
   (I) Recitation

8. Teaching Techniques
   (A) Note taking
   (B) Writing summaries
(C) Identifying similarities and differences
(D) Concept mapping
(E) Practice and Feedback
(F) Motivation

9. **Assessment**
(A) Traditional models and purposes
(B) New models, purposes, conditions for best results
   (1) Observations - (cognitive and affective)
   (2) Concept mapping
   (3) Creative assessment
   (4) Journals and oral interviews
   (5) Projects
   (6) Portfolios
   (7) Practical assessments
   (8) Authentic Assessments
   (9) Diagrams and Pictorial
   (10) Reflection and Self evaluation

10. **Understanding and Responding to Diverse Learners**
(A) Psychological basis for effective science teaching
(B) Student and Teacher Demographics
(C) Equity Issues
   (1) Factors Linked to Success in Science
   (2) Beliefs about Cultural Influences
   (3) Multicultural Science Education
   (4) Multiculturalism and Universalism in Science
   (5) Cultural and Linguistic Diversity
   (6) Gender Inclusiveness
   (7) Learning Disabilities
   (8) Physical Disabilities

11. **Cognitive Approaches and Instructional Models for Meaningful Learning**
(A) Constructivist views of learning
(B) Conceptual Change and Concept Development
(C) Contradiction and Equilibration
(D) Meaningful Learning Strategies
   (1) Concept Mapping
   (2) Images
   (3) Analogies
   (4) Models

12. **Inquiry and Teaching Science**
(A) Elements of Inquiry, Distinctions, and Concerns
(B) Instructional Approaches
   (1) Learning Cycles
(2) Asking Questions
(3) Science Process Skills
(4) Discrepant Events
(5) Inductive Activities
(6) Deductive Activities

(C) Lesson Plan Formats for Meaningful Learning (Learning Cycles)
   (1) 4/5E’s
   (2) 4MAT
   (3) Conceptual Change
   (4) Science Investigation

(F) Designing Curriculum Units

13. Safety and Ethics in the Classroom and Laboratory
   (A) Safety, Ethics, and the Law
   (B) General Safety Responsibilities
   (C) Personal Safety Practices and Guidelines
   (D) Specific Guidelines for Subject Areas
       (1) Biology
       (2) Chemistry
       (3) Earth Science

14. Uses of Computers and Electronic Technologies
   (A) Computer Assisted Instruction
   (B) Computer-based Labs;
   (C) Multimedia Presentations
   (D) Video
   (E) Internet Inquiries and Projects
   (F) Central Science Websites

15. Science Learning beyond the Classroom
   (A) Problem based learning
   (B) Research Projects
   (C) Science Fairs,
   (E) Apprenticeships
   (G) Field Work and Field Trips
   (F) Family Science
   (G) Community-based Resources and Projects

7. **Course Teaching/Learning Methods:**
   1. Hands-on Science Investigations (cooperative groups)
   2. Lecture
   3. Demonstration Lessons (instructor and students)
   4. Reading and writing assignments
   5. Library and Internet
   6. Video, CDs; power point
7. Field work (surveys and interviews)
8. Use of blackboard (bb) and e-mail correspondence

8. **Assessment (Performance Based):**
   1. SLO #1: Rubric for Reflecting on Science Research*
   2. SLO #2: Rubrics (Reflective Papers, Science Resource File)
   3. SLO #3: Lesson Plan and Thematic Unit Plan Rubric*
   4. SLO#4: Learning Environment Rubric; Science Teacher Safety Assessment*
   5. SLO #5: Rubric for reflective writing on assigned topics
   6. SLO #6: Portfolio Rubric

9. **Recommended Texts/Readings:**


10. **Prepared by:** Dr. Sondra B. Akins (January, 2010)

11. **Original Department Approval Date:** December 7, 2004

12. **Reviser’s Name and Date:** Dr. Sondra B. Akins (January 30, 2010)

13. **Department Revision Approval Date:** Spring, 2011

14. **Bibliography**


**Periodicals**


**Websites**

National Science Education Standards  
http://www.nap.edu/openbook.php?record_id=4962

NJ Core Curriculum Content Standards (Link)  
http://www.state.nj.us/education/cccs/2009/final.htm

National Science Teachers Association  
http://www.nsta.org/

NJ Science Teachers Association  
http://njsta.org/

National Association of Biology Teachers  
http://www.nabt.org/

NJ Earth Science Teachers  
http://www.njesta.org/

Middle School Science Teacher Resources  
http://www.middleschoolscience.com/teachers.htm

American Chemical Society Resources for Chemistry Teachers  
http://www.hschem.org/Resources/ACSResources.htm

National institute of Science Education  
http://archive.wceruw.org/nise/
Museum of Science, Art and Human Perception
http://www.exploratorium.edu/

Science Net Links
http://www.sciencenetlinks.com/

Nebraska Educators Really Doing Science
http://nerds.unl.edu/

Physics Demonstration Resources Online
http://www.ph.utexas.edu/~phy-demo/resources/resources.html

NASA Education Program
http://www.nasa.gov/offices/education/about/index.html

New York Science Teacher Resources

Discovery Channel
http://dsc.discovery.com/

Khan Academy
http://www.khanacademy.org/

National Science Foundation
http://www.nsf.gov/index.jsp

STEM
http://www.stemedcoalition.org/

Women in Science, Technology, Engineering and Mathematics on the Air!
http://www.womeninscience.org/

Biology Labs online
http://www.biologylab.awlonline.com/
Choose a course from your undergraduate curriculum in which you completed a project or in which all of your coursework was geared toward planning and conducting scientific investigation. Reflect on a science investigation that you carried out and provide a copy of the completed project. Use the following rubric to evaluate your work.

Knowledge of Research and Investigation in Science (NSTA Assessment #7)

<table>
<thead>
<tr>
<th>Scientific Investigation Rubric</th>
</tr>
</thead>
<tbody>
<tr>
<td>Rubric for Assessing Reports of Scientific Investigation</td>
</tr>
<tr>
<td>The minimum acceptable score is a 2 on each part.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Investigation parts</th>
<th>Not acceptable (1)</th>
<th>Acceptable (2)</th>
<th>Target (3)</th>
</tr>
</thead>
<tbody>
<tr>
<td>A. Research problem (NSTA 1d)</td>
<td>Stated problem is unclear or too broad</td>
<td>Stated problem is clear, key variables are identified.</td>
<td>A clear statement of the intent of the research with the problem narrowed to a manageable scope.</td>
</tr>
<tr>
<td>B. Literature review (NSTA 1d)</td>
<td>Missing or inadequate review of literature for the investigation</td>
<td>Literature review adequate for the specific investigation (including primarily peer-reviewed articles).</td>
<td>Thorough literature review that identifies the need for and the method by which the research is being conducted.</td>
</tr>
<tr>
<td>C. Experimental design (NSTA 1d)</td>
<td>Experimental design is incomplete or unclear.</td>
<td>Experimental design is generally clear and supports the research question. Variables are controlled.</td>
<td>Experimental design is clear and supports the research question. Includes a clear description of procedure with both controlled and extraneous variables.</td>
</tr>
<tr>
<td>D. Data collection and organization (NSTA 1d)</td>
<td>Data are absent, poorly organized, and/or inappropriately displayed.</td>
<td>Data are organized and appropriately displayed using graphs, charts or tables.</td>
<td>Data are organized to allow for analysis and interpretation. Graphs and charts should be utilized for this organization.</td>
</tr>
<tr>
<td>E. Analysis and interpretation of data (NSTA 1d, 1e)</td>
<td>Inappropriate techniques used in data analysis and interpretation. Little or no evidence of the use of appropriate mathematics.</td>
<td>Appropriate techniques, mathematical and otherwise, used in data analysis and interpretation.</td>
<td>Thorough analysis and interpretation of data using appropriate mathematics for processing and interpreting data. The interpretation of data is presented in relationship to findings from previous studies.</td>
</tr>
<tr>
<td>F. Final conclusions (NSTA 1d)</td>
<td>Conclusions are absent or not clearly related to the problem or supported by the data.</td>
<td>Conclusions are related to the problem and supported by the data.</td>
<td>Conclusions are based on the above analysis and are clearly related to the problem and previous studies.</td>
</tr>
<tr>
<td>G. Discussion (NSTA 1d)</td>
<td>Discussion of the research project is absent or minimal and poorly thought out.</td>
<td>Discussion of the research project includes suggestions for improvements or refinement to experimental design.</td>
<td>Discussion of the research project includes suggestions for improvements, refinement, and/or new approaches to experimental design and includes a discussion of future research questions.</td>
</tr>
<tr>
<td>H. Report (NSTA 1d)</td>
<td>Research is not reported or is incomplete.</td>
<td>Report of research is complete (literature review, procedures, data, analysis, conclusions).</td>
<td>Report of research is complete (literature review, procedures, data, analysis, conclusions) and includes presentation and discussion with peers.</td>
</tr>
<tr>
<td>TOTAL POINTS</td>
<td></td>
<td></td>
<td>TARGET =24 -21 total points; ACCEPTABLE =20 – 15 total points; UNACCEPTABLE =14 – 0 total points</td>
</tr>
</tbody>
</table>
NCATE Assessment 3: Assessment of Candidate Ability to Plan Instruction

3A - Lesson Plan Format - Inquiry Lesson Plan

Name ____________ School______ Grade/Functional Level of Students______

I. Subject Area(s):__________________________________________________________

II. Topic and Core Standard (CPI):

III. The Concept (To be invented/explored):____________________________

IV. Essential Question: ________________________________________

V. Objectives/Student Learning Outcomes: (Include also objectives based on IEP’s as app.)

A. The students will be able to recall..describe..write..compare..create..solve ..judge

VI. Teacher Actions:

Pre-Planning Questions to ponder: “Why am I teaching this lesson?” What do students already know about this topic? Are there any safety or health issues I need to consider?

Materials/Resources: “What print materials, visual aids, technology, and other resources do I need? What community resources can be tapped? How can parents help? How can lesson extend to experience beyond the classroom” (NSTA 1c, 4, 7)

Launch Teaching / Learning Cycle (5E’s) (NSTA 3)

1. Engage: (In this stage help students to make connections between past and present learning experiences and lay the foundation for activities ahead. Stimulate involvement in the activities ahead by asking a question, defining a problem, showing a surprising event, or acting out a problematic situation.)

2. Explore: (In this stage get students directly involved with phenomena and materials by working together in teams. Act as a facilitator by providing materials and guiding the students’ focus. Allow the students’ inquiry process to drive instruction).

3. Explain: (In this stage allow learners to put the previous abstract experiences into a communicable form. Students use language skills to sequence events into a logical formal. Communication occurs among peers. Learners support each other’s learning by articulating their observations, ideas, questions, and hypotheses. The teacher introduces labels after the students have had direct experiences.)

4. Elaborate: (In this stage help students to expand on the concept that was constructed through the exploration and explanation stages.)

5. Evaluate: (Evaluation and assessment can occur throughout all stages, but is emphasized in the final stage. Tools might include observation structured by checklist, interviews, project and problem-based learning products, lesson reflection, songs, oral presentation, laboratory report. Create a rubric for evaluating the performance. Link your performance tasks to the NJCCCS indicators.) (NSTA 8a, 8b, 8c)

VII. Accommodations: Additional strategies for students working below grade level, ELL or with special needs.

VIII. Role of Auxiliary Personnel What do you want support personnel in the room to do?

IX. Summary of Assessment Data (NSTA 8)

State the total number of students who completed the assessment task.
State the # and % of students who were “Proficient,” “Satisfactory” and, “Needs Improvement.”

Family/Community How have you involved family/community in this lesson? (NSTA 7)

Reflection/Self Evaluation How has this lesson improved my teaching practice? What impact did this lesson have on P-12 learners? How will student performance on this lesson influence tomorrow’s lesson?
### 3A - Science Methods Inquiry Lesson Plan Rubric

<table>
<thead>
<tr>
<th>COMPONENTS</th>
<th>TARGET 3 points</th>
<th>ACCEPTABLE 2 points</th>
<th>UNACCEPTABLE 1 point</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>1 Content</strong></td>
<td>The lesson plan accurately represents important science content that supports the unit plan and shows strong evidence of background research. (NSTA 1a, 1b)</td>
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</tr>
<tr>
<td><strong>2 Objectives/ Essential Question/Standards</strong></td>
<td>Lesson objectives are clearly written and linked to the essential question and state/national content standards. (NSTA 6)</td>
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</tbody>
</table>
| **3 Constructivist/Inquiry-based Format** | The lesson plan incorporates a logically sequenced lesson format including the following: (NSTA 3)  
- Effective motivating technique to initiate the lesson (engagement). (NSTA 3)  
- Effective questions to access prior knowledge, promote inquiry, problem-solving, and critical thinking (NSTA 3)  
- Opportunities for active student participation (exploration/investigation/collaboration) (NSTA 3)  
- Opportunities for students to use technology in learning activities. (NSTA 1c)  
- Explanation and elaboration of the content to be learned. (NSTA 6)  
- Learner reflection / self-evaluation (NSTA 6)  
- Evaluation (Assessment of Learning outcomes) (NSTA 8c) | | |
| **4 Diverse Learners** | Lesson strategies accommodate diverse learners / learners with special needs. (NSTA 4) | | |
| **5 Enrichment** | Lesson content is enriched with two or more of the following connections:  
- interdisciplinary /intra-disciplinary; (NSTA 1b)  
- cross-cultural connections; (NSTA 4)  
- history and nature of science; (NSTA 2a, 2b)  
- personal and social issues; and (NSTA 4)  
- science, technology, society relationships. (NSTA 1b, 2c) | | |
| **6 Instructional Technology** | The lesson plan includes appropriate use of instr. Technology (NSTA 1c) | | |
| **7 Assessment** | The lesson plan included assessment aligned with objectives and a clear assessment rubric. (NSTA 8b) | | |
| **8 Safety** | The lesson was planned with safety / humane treatment of animals in mind. (NSTA 9d) | | |
| **9 Community Resources** | Planner made appropriate use of community supports. (NSTA 7) | | |
| **Category Points** | | | |
| **Total Points** | | | |
SLO #4 Learning Environment and Safety

Safety, Legal Issues and Ethical Treatment of Living things in the Science Classroom (Assessment #6)

A. Safety Module

To learn the appropriate knowledge to manage a safe science classroom, the pre-service teacher could create a portfolio of safety information suitable for the age he/she will be teaching. The individual parts should include:

**A. Guidelines** for students to have for working safely in the science classroom. These could be in the form of a booklet of rules and regulations that should be taught to students or in a series of posters that could be displayed in the classroom.

**B. A safety quiz/test** about the rules of safety in the classroom and what to do in various emergency situations.

**C. A design/plan of a typical science classroom/lab that pinpoints safety issues**, such as chemical storage, projected traffic of students in the classroom, living organism placement, emergency exit information, eyewash, shower, fire extinguishers, fire blanket and similar information.

**D. A safety contract** that explains the basic safety procedures and features of the science classroom. This contract should be constructed for the signature of parents and students. This can be patterned after the contract Flinn Scientific has created.

**E. An information packet explaining the safe, ethical and humane treatment of living organisms in the classroom as well as in the natural world.** This should include a review of rules and regulations for collecting organisms in the field and experimentation in the classroom based on local, state and national laws/regulations. The concepts of protected and endangered species as well as the role of parks and reserves should be included.

**F. A safety plan explaining safe storage, handling and disposal of chemicals.** A list of typical chemicals for an appropriate grade level should be generated with copies of MSDS sheets for the 20 most common chemicals used at this level. Specific guidelines for chemical use should be included stock solutions and measuring of chemicals.

**G. A plan for behavior management of students in a science classroom.** This would include special precautions, special rules for handling chemicals and lab equipment, proper behavior in lab conditions and working with living or non-living organisms, positive/negative consequences for behavior, use of safety equipment and other pertinent information. This is a pro-active plan to prevent behavior that would be unsafe.

**H. As final evidence of safety knowledge by the pre-service teacher, evidence from a supervising and/or cooperating teacher who has seen the candidate teach for a number of weeks, should be submitted.** This could be from field experience/student teaching forms of observation or a special note about observing the candidate’s use of safe science practices.
### Science Safety Project Rubric

Each part of project must receive a minimum 2, for a minimum score of 16 points.

<table>
<thead>
<tr>
<th>Scoring for parts</th>
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</table>

**A. Guidelines/rules for working safely in the science classroom** including: use of chemicals, goggles, using flames, glassware usage, proper clothing, safe behavior, working with animals etc.

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<th>Scoring for parts</th>
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</table>

**B. Safety quiz or test** including: chemical usage, glassware use, safety materials, emergency procedures, proper clothing, working with living organisms, safe behavior etc.

<table>
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<tr>
<th>Scoring for parts</th>
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</table>

**C. Safety plan for a typical science classroom** including: Use, storage and disposal of chemicals, use and placement of living organisms, safety equipment in place, treatment for emergencies, safe storage of non-chemical equipment, safe movement of students in lab work etc.

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<th>Scoring for parts</th>
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</table>

**D. Safety contract** including: all the basic rules, regulations regarding science equipment/chemicals and working with living organisms, all previous listed guidelines for a safe science classroom.

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<tr>
<th>Scoring for parts</th>
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</thead>
</table>

**E. Safe, ethical, and humane treatment of living organisms in and out of the classroom** including: Humane and safe treatment of living organisms in the class as display or experimenting, limitations of collecting in the field, role of parks and reserves, protected and endangered species etc.

<table>
<thead>
<tr>
<th>Scoring for parts</th>
</tr>
</thead>
</table>

**F. Safety plan for safe storage, handling and disposal of chemicals** including: Specific guidelines for use, storage and handling of all types of chemicals, guidelines for safe and legal disposal of chemicals, specific safety equipment used, MSDS sheets for 20 most used chemicals etc.

<table>
<thead>
<tr>
<th>Scoring for parts</th>
</tr>
</thead>
</table>

**G. Plan for behavior management** including: Specific desired behaviors for a safe science lab, key rules and consequences for each rule plus special guidelines and consequences for working with living organisms.

<table>
<thead>
<tr>
<th>Scoring for parts</th>
</tr>
</thead>
</table>

**H. Evidence of candidate's safe teaching in the field.** A signed form from supervising or cooperating teachers attesting to safe science teaching.

<table>
<thead>
<tr>
<th>Scoring for parts</th>
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<table>
<thead>
<tr>
<th>Professor’s score/Signature</th>
</tr>
</thead>
</table>

**TARGET =24 -21 total points; ACCEPTABLE =20 – 16 total points; UNACCEPTABLE =15 – 0 total points**

**Scoring for each part of safety module:**

1. 1 point for unsatisfactory coverage of the part, lacking in substance and detail, missing many important issues.
2. 2 points for an adequate coverage of the part, including all major parts of the information of the topic.
3. 3 points for excellent coverage of the part, including all parts of the information of the topic explained in a clear and thorough way.

16 points is the minimum acceptable grade. No part may receive less than 2 points or it will be redone to a value of 2 points.

**C. Model safety project**

The candidate should, ideally, create a unit or different lesson plans that teach safety to science students. In the course of designing such a plan, the pre-service teacher would learn enough about safety to responsibly manage a science classroom. Every lab designed should have a safety portion to instruct and caution students about safety issues. If lesson plans are not selected for this unit, other useful parts would have to be devised such as developing a safety manual, designing a lab/stockroom, making posters etc. These could also be a part of a lesson plan with students generating these items. Safety is not a “hot button” issue that
draws students’ attention so creativity is important in whatever methods are used to learn and teach classroom safety.

Examples of parts of such a unit:
* Proper use and storage of chemicals, including responsible disposal (stock solutions, pouring and mixing of solutions, safe placement of chemicals, ordering chemicals etc.).
* Techniques for safe handling of science supplies (titration, Bunsen burner, glassware etc.)
* What to do in case of an emergency (fire, chemical splash, cuts etc.)
* Why we have to have special “lab regulations” with suggested rules, posters and safety contracts.
* The humane handling and collection of living organisms (limits and laws about collecting, dissection, humane treatment, allergies to living things etc.)

Much latitude can be allowed for creativity of such safety projects, but they must emphasize good practice and teaching safety to students.
# Rubric for Science Safety Module

A minimum of 2 must be met on each topic, or it must be redone. Minimum of 18 points.

<table>
<thead>
<tr>
<th>Topic covered</th>
<th>Not acceptable (1)</th>
<th>Acceptable (2)</th>
<th>Target (3)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Chemical safety and storage</td>
<td>Only cursory information on chemical use and storage</td>
<td>Includes all basic safety information needed for safe handling and storage of chemicals</td>
<td>All basic plus extra useful information useful for advanced use and storage of chemicals</td>
</tr>
<tr>
<td>Safe use of lab materials</td>
<td>Limited explanations of use of basic lab techniques</td>
<td>Includes all basic procedures used in typical labs with safety in mind</td>
<td>Thorough explanations of all key lab procedures for a safe lab</td>
</tr>
<tr>
<td>Design a safe science lab</td>
<td>Several safety features for the lab omitted</td>
<td>All basic lab safety issues portrayed in lab design</td>
<td>Complete coverage of all safety issues for a science lab</td>
</tr>
<tr>
<td>Safety guidelines for science class and handling emergency situations</td>
<td>Incomplete list of guidelines for typical science lab – few emergency situations covered</td>
<td>Major science rules considered for a safe lab operation and basic emergency situations covered</td>
<td>All safety issues covered with clarity and thoroughness as well as all typical emergencies</td>
</tr>
<tr>
<td>Safety quiz</td>
<td>Quiz is too basic with little substance</td>
<td>Good basic coverage of major safety points in quiz</td>
<td>Thorough coverage of all important safety issues in quiz</td>
</tr>
<tr>
<td>Posters for safety</td>
<td>Too little substance or coverage of safety issues in class</td>
<td>Posters were well thought out covering all basic safety issues</td>
<td>Creative and eye-catching posters covering all important issues</td>
</tr>
<tr>
<td>Ethical/humane treatment of organisms</td>
<td>Does not cover basic issues of humane treatment</td>
<td>Covers how to treat typical animals with respect</td>
<td>Complete covering of humane and ethical treatment of typical organisms in class</td>
</tr>
<tr>
<td>Legal collecting and keeping of organisms</td>
<td>Incomplete covering of regulations governing collecting, handling and keeping organisms</td>
<td>Good general coverage of regulations in local area collecting and keeping organisms</td>
<td>Complete coverage of typical regulations that students could be involved in up to national level</td>
</tr>
<tr>
<td>Liability</td>
<td>Information of little consequence on liability issues in classroom</td>
<td>Basic coverage of liability issues with key examples</td>
<td>Multiple examples of liability issues in the classroom with insightful comments</td>
</tr>
</tbody>
</table>

**Professor’s score:**

**Signature:**

TARGET =27 -22 total points; ACCEPTABLE =21 – 15 total points; UNACCEPTABLE =14 – 0 total points

A minimum of 15 points is a passing project with no part less than 2 points. 27 is the most points possible.