Request Form for General Education Certification:
Natural Science Requirement (Please include a syllabus)

Faculty Member(s):
Course Number:
Course Name:
This Course is currently Listed in the Undergraduate Catalog  Yes____  No____
(If your answer is “No”, please explain the status with the curriculum committee)

Department of faculty member(s):

Course Description:

I. Explain how the proposed course satisfies each of the following Approval Criteria for Natural Science:

1. Have as its primary purpose the study of fundamental principles of natural or physical science.

2. Provide experience in the practice of science as part of a coordinated 2-course sequence, both with accompanying labs to provide appropriate depth.

3. Apply physical/natural principles to analyze and solve problems.

4. Any proposed sequence should provide an appreciation for the impact science has on society.
II. Please provide an example of a signature assignment that the proposed course would use to enable assessment of each of the three natural science learning outcomes, using the evidence and grading rubric for the respective outcomes

Student Learning Outcome 1: Students apply physical/natural principles to analyze and solve problems. (List SLO 1 on syllabus.)

Evidence: - Students will generate a written document (paper, poster, etc.) in which they:
  - Identify the information or data needed to address a particular problem or issue.
  - Design or utilize an appropriate discipline-based approach to solve or address the problem.
  - Provide an appropriate analysis of data or information, either provided or generated, to make conclusions relative to the original question.

Standard At least 80% of students score 3 or 4 on each dimension of rubric.

Rubric for SLO 1

Problem Analysis and Solving Signature Assignment Rubric

Definitions

Problem solving is the process of designing, evaluating and implementing a strategy to answer an open-ended question or achieve a desired goal and which covers a wide range of activities that may vary significantly across disciplines. In the natural sciences problem solving involves a process of exploring ideas, natural phenomena or works through the collection and analysis of evidence or observations that results in informed conclusions or judgments based on natural science principles. Analysis is the process of breaking complex topics or issues into parts to gain a better understanding of them while being cognizant of the theoretical and methodological limitations inherent to the natural sciences.

Framing Language

Because of methodological/pedagogical limitations in classes which focus in various scientific disciplines an effort has been made to use broad language which reflects multiple approaches and assignments while addressing the fundamental elements of sound inquiry and analysis (including topic selection, existing, knowledge, design, analysis, etc.). The rubric language assumes that the inquiry and analysis process carried out by the student is appropriate for the discipline required. For example, if analysis using statistical methods is appropriate for the discipline then a student would be expected to use an appropriate statistical methodology for that analysis. If a student does not use an appropriate discipline-based process for any criterion, that work should receive a performance rating of "1" or "0" for that criterion.

In addition, this rubric addresses the products of analysis and inquiry, not the processes themselves. The complexity of inquiry and analysis tasks is determined in part by how much information or guidance is provided to a student and how much the student constructs. The more the student constructs, the more complex the inquiry process. For this reason, faculty are
encouraged to adapt the essence and language of each rubric criterion to the disciplinary or interdisciplinary context to which it is applied.

**Glossary**
*The definitions that follow were developed to clarify terms and concepts used in this rubric.*

- **Contextual Factors**: Constraints (such as limits on cost), resources, attitudes (such as biases) and desired additional knowledge which affect how the problem can be best solved in the real world or simulated setting.
- **Methodology**: An approach designed to arrive at a solution or which will yield valid/trustworthy/reliable conclusions.
- **Solution**: An appropriate theoretically/conceptually-based response to a problem.
- **Conclusions**: A synthesis of key findings drawn from research/evidence.
- **Theoretical Framework**: The disciplinary “lens” through which the evidence is analyzed and conclusions/solutions are drawn.
- **Limitations**: Critique of the methodology, approach or evidence.
- **Implications**: How inquiry results apply in a larger disciplinary context or to larger interdisciplinary issues/topics/problems/questions.
- **Capstone**: Exemplary work at the level of a student who has completed two semesters of a natural science course.

**Rubric For SLO 1**
*Evaluators are encouraged to assign a zero to any work that does not meet the benchmark (cell 1) level of performance.*

<table>
<thead>
<tr>
<th>Dimension</th>
<th>Benchmark</th>
<th>Milestones</th>
<th>Capstone</th>
</tr>
</thead>
<tbody>
<tr>
<td>Defines, introduces or frames the problem or question/hypothesis</td>
<td>Demonstrates a limited ability in using relevant knowledge or contextual factors to define the problem or frame question/hypothesis.</td>
<td>Demonstrates ability in using relevant knowledge or contextual factors to define the problem or frame question/hypothesis but problem statement is not comprehensive.</td>
<td>Insightful, clear and comprehensive use relevant knowledge or contextual factors to define the problem or frame question/hypothesis. Some aspects of the problem statement may lack clarity or the larger significance of the problem is lacking.</td>
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<tr>
<td>Identifies and utilizes discipline-specific knowledge to address the problem or to inform the hypothesis, methodology and significance of the question</td>
<td>Attempts to presents information to justify approach but it is from irrelevant sources or representing limited points of view or approaches.</td>
<td>Presents information to justify approach from relevant sources but represents limited points of view or approaches.</td>
<td>SYNthesizes in depth information to justify approach from relevant sources and which represents various points of view or approaches.</td>
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<tr>
<td>Incorporates or articulates problem-solving approach</td>
<td>Methodology demonstrates a misunderstanding of</td>
<td>Critical elements of the methodology, relevant concepts or</td>
<td>Critical elements of the methodology, relevant concepts or</td>
</tr>
<tr>
<td>(experimental or research methods)</td>
<td>the methodology, relevant concepts or theoretical framework.</td>
<td>theoretical framework are missing, incorrectly developed or unfocused.</td>
<td>theoretical framework are appropriately developed; however, more subtle elements are ignored.</td>
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<tr>
<td>Analyses</td>
<td>Evidence or relevant conceptual ideas are presented but is unorganized, poorly presented and/or unrelated to the focus of the problem</td>
<td>Organized presentation of evidence or relevant conceptual ideas which is generally related to the focus of the problem but the use of evidence/ideas is conceptually inaccurate or is not effective at revealing important patterns.</td>
<td>Organized presentation of evidence or relevant conceptual ideas which is specifically related to the focus of the problem and the use of evidence/ideas is conceptually accurate and/or is effective at revealing important patterns.</td>
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<tr>
<td>Evaluates the problem solution(s) or significance of results.</td>
<td>Solution discussion or study conclusions are ambiguous, illogical or unsupported from findings. Limitations or avenues of further study are not discussed.</td>
<td>Solution discussion or study conclusions and limitations or avenues of further study are discussed but they are not focused on or specific to the inquiry methodology or findings.</td>
<td>Solution discussion or study conclusions and limitations or avenues of further study are discussed and are specific to the inquiry methodology or findings.</td>
</tr>
</tbody>
</table>
**Student Learning Outcome 2:** Students develop an understanding of the impact that science has on society. *(List SLO 2 on syllabus.)*

**Evidence:** Students will use discipline-based knowledge or evidence to defend or critique a proposed solution to a science-related societal issue.

**Standard** At least 80% of students score 3 or 4 on each dimension of rubric.

**Standard Rubric for SLO 2**

**Definition**
Problem solving in the context of this signature assignment will involve the process of evaluating or critiquing a strategy to resolve a science-related societal issue.

**Framing Language**
Problem-solving as it relates to societal issues covers a wide range of activities that may vary significantly depending on the nature of the issue and its relations to scientific disciplines or sub-disciplines. Activities that encompass problem-solving by students may involve problems that range from well-defined, whose solutions are largely agreed-upon by experts within and across disciplines or framed to be more open-ended, controversial, and for which knowledgeable individuals could disagree. This rubric distills the common elements of most problem-solving contexts and is designed to function across all scientific disciplines. It is broad-based enough to allow for individual differences among learners, yet is concise and descriptive in its scope to determine how well students have maximized their respective abilities to practice thinking through problems in order to evaluate proposed solutions. The focus of the rubric is on the quality of the **process** and not on the individual evaluator’s views of the larger society-level quality of the solution critique or defense. However, the extent to which the students’ properly/comprehensively/clearly uses disciplinary knowledge in their defense is considered part of the evaluation of “process”.

**Glossary**
*The definitions that follow were developed to clarify terms and concepts used in this rubric only.*

- **Science-related societal issue** – a problem/issue/query which has direct or indirect implications on the human societies that is directly related to knowledge established in the natural sciences. These include, but are not limited to such issues as confronting climate change, consumer decisions, government funding decisions, educational choices etc...
- **Contextual Factors:** Constraints (such as limits on cost), resources, attitudes (such as biases) and desired additional knowledge which affect how the problem can be best solved in the real world or simulated setting.
- **Evaluation:** Involves analysis and synthesis of a full range of perspectives.
- **Feasible:** Workable, in consideration of time-frame, functionality, available resources, necessary buy-in, and limits of the assignment or task.
- **Solution:** An appropriate response to a challenge or a problem.
Rubric For SLO 2

Evaluators are encouraged to assign a zero to any work that does not meet the benchmark (cell 1) level of performance.

<table>
<thead>
<tr>
<th>Dimension</th>
<th>Benchmark</th>
<th>Milestones 1</th>
<th>Milestones 2</th>
<th>Milestones 3</th>
<th>Milestones 4</th>
</tr>
</thead>
<tbody>
<tr>
<td>A. Framing of problem</td>
<td>Demonstrates a limited ability in identifying a problem statement or related contextual factors.</td>
<td>Begins to demonstrates the ability to construct a problem statement with evidence of most relevant contextual factors, but problem statement is superficial.</td>
<td>Demonstrates the ability to construct a problem statement with evidence of most relevant contextual factors, and problem statement is adequately detailed.</td>
<td>Demonstrates the ability to construct a clear and insightful problem statement with evidence of all relevant contextual factors.</td>
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<tr>
<td>B1. Evaluation of solution</td>
<td>Evaluation of solutions is superficial (lacks depth and comprehensiveness) with respect to some or all of the following: considers history of problem, reviews logic/reasoning, examines feasibility of solution and weighs impacts of solution.</td>
<td>Evaluation of solution is comprehensive in that it explores the following: history of problem, reviews logic/reasoning, examines feasibility of solution and weighs impacts of solution but the critique lacks depth (examines one or more of these at a cursory level).</td>
<td>Evaluation of solution comprehensively and deeply explores the history of problem, reviews logic/reasoning, examines feasibility of solution and weighs impacts of solution.</td>
<td>Evaluation of solution is a comprehensive, deep and elegant (for example contains thorough and insightful explanation) exploration of all of the following: considers history of problem, reviews logic/reasoning, examines feasibility of solution and weighs impacts of solution.</td>
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<tr>
<td>B2. Use of disciplinary knowledge</td>
<td>The evaluation attempts to use disciplinary knowledge to critique the problem solution, but there are significant conceptual errors.</td>
<td>The evaluation use proper disciplinary knowledge to critique the problem solution, but the use of knowledge is incomplete, cursory, or not clearly connected to weighing the validity/feasibility/potential outcomes of the solution.</td>
<td>The evaluation uses proper disciplinary knowledge to critique the problem solution, and this is clearly connected to weighing the validity/feasibility/potential outcomes of the solution.</td>
<td>The evaluation uses proper disciplinary knowledge to insightfully and creatively critique the problem solution, and this is clearly connected to weighing the validity/feasibility/potential outcomes of the solution.</td>
<td></td>
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</tbody>
</table>

In the rubric Dimensions B1 and B2 could be considered together in assigning a cell value to the students’ work.
III. SYLLABUS REQUIREMENT

Syllabi should include the following:
“General Education Student Learning Outcomes” section where the general education outcomes are listed. After listing the outcomes, there should be a clear statement indicating where those outcomes will be assessed “These outcomes will be assessed in…final exam, essay 2, etc.” The name of the…final exam, essay 2, etc., will have to match the one given under Evaluation/Grading Distribution/ and it should indicate clearly the percentage of the grade that the assignment has in the course.

Example:

General Education Student Learning Outcomes

- Students apply physical/natural principles to analyze and solve problems.
- Students develop an understanding of the impact that science has on society.

These outcomes will be assessed on the SHORT ESSAY #3 (you must specify which one!!!)

LATER IN THE SYLLABUS….it should show the weight in the grade

Grades

Grades on individual assignments reflect the quality of your work in terms of how it meets the respective goals for each project. Your final grade will be calculated according to the following formula:

- Homework and Discussion 10%
- Quizzes 10%
- Short Essays (3, 2-3 pgs. each, in-class and take home) 15%
- Midterm Exam 20%
- Comparative Analysis Paper (6-8 pgs.) 20%
- Final Exam 25%
IV. APPROVAL AND SIGNATURES.

1. Signature of Department Chair or Program Director:

__________________________________________ Date: ________________

2. Signature of Academic Dean:

__________________________________________ Date: ________________

3. Signature of Provost:

__________________________________________ Date: ________________

4. Signature of Committee on General Education Chair:

__________________________________________ Date: ________________

5. Signature of Faculty Senate Secretary:

__________________________________________ Date: ________________

Date Approved by Faculty Senate: ________________