Teaching Engineering in the General Education Program at the University of Maryland

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Teaching Engineering in the General Education Program at the University of Maryland

Abstract
The University of Maryland implemented a new general education program for all incoming freshmen in fall 2012. This new general education program was designed with input from the college of engineering and had requirements for courses to be taught by engineering faculty for the broader campus community. For the past 25 years, the college of engineering had minimal participation in the previous general education program at the University. One unique requirement in this new general education program is the *I-Series* courses, a novel set of required courses designed to address important intellectual issues. The development of the *I-Series* courses, enrollment growth and initial learning assessment will be reviewed.

Introduction

A full redesign of the General Education (GenEd) program at the University of Maryland (UMD) was started in 2009 with the implementation of the new program beginning with the entering freshman class in fall 2012. The A. James Clark School of Engineering at UMD now plays a significant role in GenEd and offers courses in a number of areas in the program, a significant departure from the previous general education program that had been in place for more than 25 years and where the engineering college had played only a very minor role. When the University embarked on a redesign of the GenEd program, Provost Nariman Favardin and Associate Provost and Dean for Undergraduate Studies, Donna Hamilton recognized the need for all students to be exposed to the intellectual synthesis that occurs in applied disciplines [1-3]. As stated by the Committee on Public Understanding of Engineering Messages of the National Academy of Engineering: "To be capable, confident participants in our technology-dependent society, citizens must know something about how engineering and science, among other factors, lead to new technologies." [1]. This lead to an expectation that the new GenEd program at UMD would include engineering as an equal partner in planning and implementation along with the rest of the university.

The A. James Clark School of Engineering at UMD now participates actively in the *I-Series*, *Scholarship in Practice*, *Natural Sciences* and *Diversity* components of the GenEd program. The *I-Series* courses are a signature component of GenEd at UMD. The *I-Series* program covers all disciplines at the university and all undergraduate students are required to complete at least two *I-Series* courses as part of their degree program. The "I" in *I-Series* comes from the charge that the courses should: speak to important **issues** that spark the **imagination**, demand **intellect**, **inspiration**, and **innovation** and conclude where feasible with real-world **implementation** [4]. Later in this paper, two examples of engineering *I-Series* courses that count towards the *Natural Sciences* requirement in GenEd will be discussed. The *I-Series* courses have been profiled in the *Chronicle of Higher Education* when they were first being rolled out across the university [5].

For the other GenEd components where the engineering college participates, the *Scholarship in Practice* requirement is two courses where students have the opportunity to experience the authentic work of a discipline with faculty engaging students in the processes of their work to transfer knowledge in a tangible form and the *Diversity* requirement where students take 2 courses covering the areas of *Understanding Plural Societies* and *Cultural Competence* [4].

The *I-Series* courses arose from a previous set of courses started at UMD in 2007 called the *Marquee Courses in Science and Technology*. The success of the Marquee courses eventually led to the formation of the *I-Series* program and expansion of the program to include all disciplines. The creation of Marquee course program was due to the realization of the following issues:

- Many students majoring in non-science/non-engineering disciplines enroll at UMD with sufficient AP or IB credits to place out of all campus requirements in science/technology.
- This was resulting in a significant number of students at the university never taking a science or engineering related class during their entire undergraduate education.
- There was a need for science/engineering courses that non-majors *want to take* on topics of broad interest. These should not be taught as traditional introductory courses for majors but as unique stand-alone courses that expose students to a major problem or question that can be addressed through the underlying discipline.
- The University expects all students to be technologically literate so as future leaders they have the ability to understand and make decisions that involve technological solutions.

These concepts relate closely to the nine goals outlined by DeBoer for the teaching of science and technology in his review paper in 2000, particularly the following 5 of the 9 goals: 1. Teaching and Learning About Science as a Cultural Force in the Modern World, 3. Teaching and Learning About Science That Has Direct Application to Everyday Living, 4. Teaching Students to be Informed Citizens, 8. Preparing Citizens Who are Sympathetic to Science, and 9. Understanding the Nature and Importance of Technology and the Relationship Between Technology and Science [6].

The Marquee courses were successful, reaching 200 students per year at the start of the program and growing to 400-500 students across seven courses after three years. The courses were capped at 80 students per course and often had a waiting list indicating unmet demand from students. Faculty engagement was engendered through "teaching exchange" meetings three times per semester to discuss issues with running group projects, student teaming, peer evaluation and other topics of mutual interest. Assessment of student performance was discussed but proved difficult due to the breadth of the courses in the project spanning engineering, physics, entomology, atmospheric science, agricultural science and geology. This was revisited when the *I-Series* courses were developed (see Tables 1 and 2).

The model of the Marquee courses was presented to the faculty board charged with developing the new GenEd model at UMD and the ideas were incorporated and became the *I-Series* program and the concepts were expanded to include all fields of study at the University.

As the GenEd program was rolled out the engineering college offered about 500 on-campus seats per year across *I-Series* and *Scholarship and Practice* courses and an additional 1000 seats in on-line courses. As inclusion of on-line and flipped classroom teaching are becoming a standard part of course offerings at UMD, the engineering college has seen a steady increase in enrollment in these classes each year. More than 600 standard classroom seats and almost 4000 on-line seats

were offered by the engineering college for non-majors for the 2016-2017 academic year (see figure 1).

The *I-Series* courses offered by engineering over the past 5 years include the following [7]:

- *Managing Natural Disasters: Hurricanes, Floods Earthquakes Tornadoes, Tsunamis, and Fires.*
- *Engineering in the Developing World*
- *Transportation Innovation: Planes, Trains, and Automobiles and their Role in the Advance of Science*
- *The Future of Technology: Sustainable Development or Sensational Disaster?*
- *Engineering and Modern Medicine*
- *Technology Choices*
- *Engineering and Modern Medicine: The Body as a Machine*
- *Entrepreneurial Opportunity: Analysis and Decision-Making in 21st Century Ventures*
- *Materials of Civilization*
- *Bigger Faster, Better: The Quests for Absolute Technology*
- *Building Projects that Last: Failure is not an Option*

All *I-Series* courses for the University are approved by a faculty board that meets twice per semester to review new course proposals. In general for *I-Series* courses in the area of engineering/science (which meet the *Natural Sciences* or *Scholarship and Practice* requirements of the UMD GenEd program) the philosophy has been to teach the topic in the form of "education through science", rather than "science through education" [8]. This has led the faculty board to encourage courses that use interactive learning, group work and engagement through project based learning with content presented to meet the needs of the projects and group work and at least part of the of student assessment done using interactive and dynamic methods rather than standard testing. This follows the findings of Quellmalz et al. who examined the assessment of student science learning using three styles: static (traditional learning and assessment), active (dynamic presentation of material in the form of animations, video, etc.) and interactive (dynamic presentation of material with feedback based on student input) and observed that interactive assessment was more effective at evaluating student learning [9].

A set of course assessment rubrics have been developed for all GenEd required courses by the faculty review boards, example rubrics are shown in Table 2 for the *I-Series*, *Scholarship in Practice* and *Diversity* courses. Formal course assessment began in the spring 2016 semester using these rubrics, although on a limited scale.

Two Example *I-Ser*ies Courses

Materials of Civilization – ENMA150

Materials of Civilization is a general introductory course on materials science taught at the 100 level and designed primarily for non-science or non-engineering majors [7]. The course introduces the role of materials in advancing technology from ancient times with the stone, copper, bronze and iron ages and continues through the development of advanced materials in

the modern age. Students gain hands on experience with unusual materials with two take-home "materials projects" on shape memory metals and super absorbent polymers and followed by a project on the mechanical properties of aluminum, cast iron and polyethylene. In all cases a 3-4 page write up is required of the students on the materials with connections made to applications through the patent literature. The course also utilizes guest speakers to highlight the role of materials science in a range of areas not always associated with the field. These include: forensic metallurgy in disasters (speaker from NIST), materials in biomedical devices (speaker from the FDA), materials investigations in art conservation (speaker from the Smithsonian) and the role of materials in sports equipment and clothing (speaker from Under Armour). The course includes a final group research project on a topic chosen by students with a course poster session for sharing of results from the projects.

Specific course goals include:

- A general understanding of different classes of materials and their structure
- A general understanding of the role of materials on advances in technology, society and civilizations, including the current (modern) age.
- Basic familiarity with technical writing through the 3 take-home materials projects and the final poster group research project. Also, basic familiarity with simple data analysis using Microsoft Excel (or other spreadsheet).

The Body as a Machine - ENEE133

The Body as a Machine is a general course that utilizes simple engineering and science principles to understand how the body works with respect to center of gravity and equilibrium, mechanics and strength of muscles and bones, fluid flow and blood pressure; energy, heat and metabolism, sounds and acoustic waves; electrical signals and the nervous system and current events in human health [7]. Each topic is covered through lecture and hands-on experiments with student participation. Examples include students performing an EEG on themselves and understanding changes in the electrical signals in the brain under simple conditions such as having their eyes open versus closed, measuring blood pressure versus body orientation and measuring reaction time versus mental load.

Specific course goals include:

- The use of spreadsheets and numerical tools (e.g. Matlab)
- The understanding and use statistical inference
- Finding and using relevant technical literature
- Programing simple microcontrollers
- The ability to write about and discuss science and technology

Assessment

Formal assessment of some the courses in the GenEd program started during the spring 2016 semester with a few courses providing feedback. A summary of the assessments for 3 courses taught by the engineering college is given in Table 1. Included are two non *I-Series* courses: ENES472: *International Business Cultures in Engineering and Technology* taught in the *Diversity*: *Cultural Competence* GenEd category and ENES140: *Discovering New Ventures* taught on-line in the *Scholarship and Practice* GenEd category. As the assessment of the learning outcomes has only been occurring in a few courses over two semesters it is too soon to

examine trends or improvements in specific courses based on the campus implementing an overall strategy for assessing the GenEd program. The full suite of assessment rubrics for all GenEd categories were only finalized during the fall 2016 semester.

Summary

In summary, the new GenEd program at the University of Maryland has been designed with the participation of the engineering college to help provide all students in the university with a foundation in engineering and technology. In addition, the redesign of the GenEd program has helped to integrate the faculty in engineering in the overall educational mission of the university. The increasing enrollment from students throughout campus demonstrates the demand for such courses and the contribution that engineering faculty can make in educating all students.

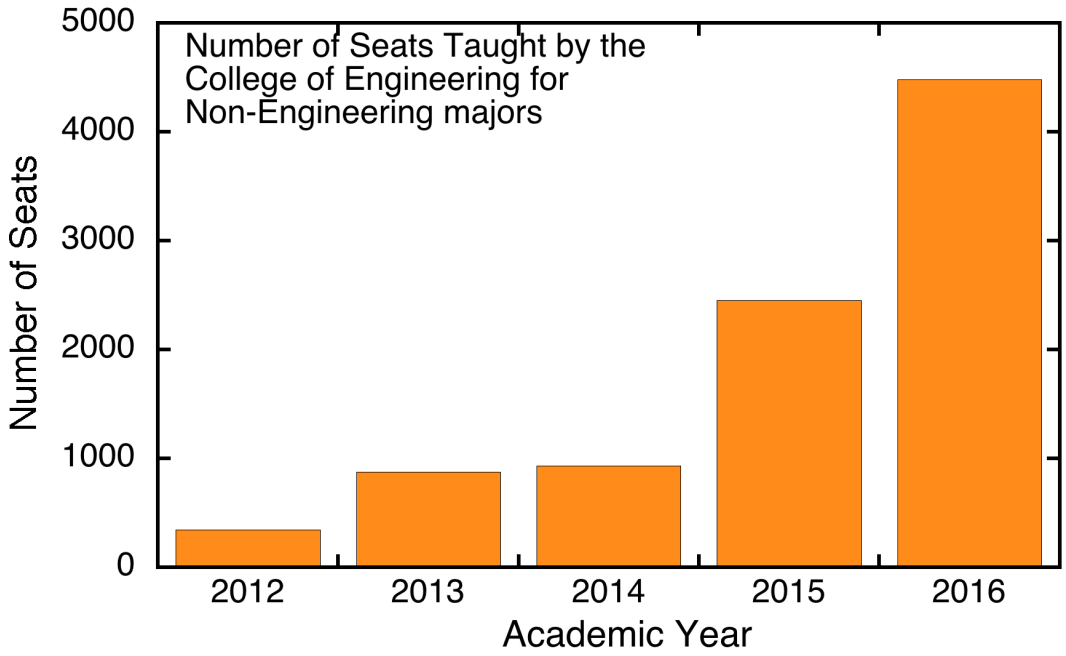

Figure 1: Increase in the number of seats offered by the engineering college for non-engineering students versus academic year as the new GenEd program at the University of Maryland was implemented. Under the previous general education program the number of seats offered to non-engineering students was negligible.

Table 1: GenEd Assessment - Engineering
ENMA150 Materials of Civilization
Fall 2016

General Education Assessment Spring 2016: I Series ENMA150									
Rubric Criterion	Mean Score	Advanced (3)		Proficient (2)		Beginning (1)		Unacceptable (0)	
		Percent of Students	n	Percent of Students	n	Percent of Students	n	Percent of Students	n
1. **The Question:** Engages the I-Series course question	2.49	68.4%	54	29.1%	23	2.5%	2	-	-
3. **The Disciplinary Context**: Represents the disciplinary context of the I-Series course question	2.51	60.8%	48	36.7%	29	2.5%	2	-	-

General Education Assessment Spring 2016: Natural Sciences ENMA150									
Rubric Criterion	Mean Score	Advanced (3)		Proficient (2)		Beginning (1)		Unacceptable (0)	
		Percent of Students	n	Percent of Students	n	Percent of Students	n	Percent of Students	n
1. **The Approach:** Define/Set up the approach	2.56	69.6%	55	30.4%	24	-	-	-	-
2. **The Concepts:** Identify the concepts to be employed in solving the problem	2.49	64.8%	54	29.1%	23	2.5%	2		
3. The Solution: Apply the concepts in a manner that provides a solution to the problem	2.34	45.6%	36	49.4%	39	2.5%	2	2.5%	2

Assessment Score: Advanced=3, Proficient=2, Beginning=1, Unacceptable=0
n: number of students

ENES472 International Business Cultures in Engineering and Technology

Spring 2016

General Education Assessment Spring 2016: Cultural Competence ENES472									
Rubric Criterion	Mean Score	Advanced (3)		Proficient (2)		Beginning (1)		Unacceptable (0)	
		Percent of Students	n	Percent of Students	n	Percent of Students	n	Percent of Students	n
1. Awareness & integration of cultural differences	2.07	11%	5	84%	37	5%	2	-	-

Fall 2016

General Education Assessment Spring 2016: Cultural Competence ENES472									
Rubric Criterion	Mean Score	Advanced (3)		Proficient (2)		Beginning (1)		Unacceptable (0)	
		Percent of Students	n	Percent of Students	n	Percent of Students	n	Percent of Students	n
1. Awareness & integration of cultural differences	2.87	87%	33	13%	5	-	-	-	-

ENES140: Discovering New Ventures

Fall 2016

General Education Assessment Fall 2016: Scholarship In Practice: ENES140	
ENES140	*What did you learn about your course, course assignments, or your students as a result of completing the assessment?*
	Students were proficient in selecting and evaluating areas of scholarship relevant to the practice of entrepreneurship and innovation, to include the integration of the many facets of our course (business, economics, psychology, sociology, and technology). Students were able to apply the methods and frameworks discussed in the course to the modeling of a startup company with commercial potential. The design of the course may benefit from additional opportunities for students to critique entrepreneurship and innovation issues, to include the business models of classmates. While there may be a concern of students with sharing their startup ideas with classmates, for fear of the idea being "stolen", there may be students who see more pros than cons with sharing their idea to get feedback from peers.
	What changes, if any, will you make to your course based on your assessment?
	Based on this assessment, we are exploring ideas to offer an optional peer review activity for the final project. This would provide students interested in peer feedback with that option, while accommodating privacy concerns of those wishing to keep their ideas limited to themselves and the faculty.

Table 2a
I-Series Assessment Rubric

OFFICE OF UNDERGRADUATE STUDIES

Each General Education category is grounded in a set of learning outcomes. For the full set of learning outcomes for I-series courses see: www.gened.umd.edu
This rubric is designed as a tool to assess activities aimed at student gains in the follow learning outcome(s) for the I-Series General Education Category:

At the completion of this course, students will be able to:

- *Identify the major question and issues of the I-Series course topic*

Criterion for review of student work	**Descriptions of levels of student performance**			
	Advanced (3)	**Proficient (2)**	**Beginning (1)**	**Unacceptable (0)**
The Question Engages the I-Series course question	• Engagement in the question is clear and concise, captures the central issue/s of the course, and reveals that the content has been internalized	• Engagement in the question is accurate, the meaning is evident, and is not impeded by omissions.	• Engagement in the question is mundane, rote and requires some interpretation and assumptions for full meaning to be evident.	• Central question or concept is not engaged or is stated inaccurately.
The Issues Reveals complexity of the I-Series course question	• Discussion of issues: • Is comprehensive, insightful and creative • Synthesizes in-depth information from appropriate sources • Considers multiple perspectives (personal and scholarly) • Reveals how answers to the question reflect an assumed perspective • Recognizes enduring nature of the question	• Discussion of issues: • Is adequate to provide the context of the question and to indicate multiple facets pertinent to the question • Presents in-depth information from relevant sources • States multiple perspectives (personal and scholarly) • Recognizes that the question does not have one right answer • Recognizes the relevance of the question	• Discussion of issues: • Is simplistic, naïve or general • Presents information from relevant sources • Provides a superficial and or limited perspective • Suggests that the question does not have one right answer • Is narrow, presented a limited recognition of the relevance of the question	• Discussion of issues: • Is missing or provides no relevant information • Does not include consideration of multiple perspectives or exploration of the complexity of the question • Fails to acknowledge the question

The Disciplinary Context Represents the disciplinary context of the I-Series course question	• Accurately reflects the perceptions of the course discipline/s. • Uses language of course discipline/s in a fluent manner.	• Provides a context that generally reflects the course discipline/s. • Uses course discipline/s terms appropriately.	• Provides a context recognizable to the course discipline/s • Uses course terms in an awkward, or imprecise, and/ or inappropriate manner	• Does not provide context or context is not recognizable as related to the course discipline/s. • Does not use terms or inaccurately uses terms of the course discipline/s

The I-Series Rubric was developed by the I-Series Faculty Board, supported by the Office of Undergraduate Studies and the Office of Institutional Research, Planning, and Assessment with the I-Series instructors upon review of the AAC&U VALUE rubrics and according to standards determined by the I-Series Faculty Board for student performance in the General Education I-Series courses. The rubric defines the standards for student performance in I-Series courses at the University of Maryland.

Table 2b
Scholarship and Practice Assessment Rubric

OFFICE OF UNDERGRADUATE STUDIES

Each General Education category is grounded in a set of learning outcomes. For the full set of learning outcomes for Scholarship in Practice courses see: www.gened.umd.edu
This rubric is designed to assess student gains in the follow learning outcome(s) for the I-Series General Education Category:

At the completion of this course, students will be able to:

- *Select and critically evaluate areas of scholarship relevant to the practice of the discipline.*
- *Apply relevant methods and frameworks to the planning, modeling, and/or preparing necessary to produce a project or participate in the practice in a manner that is authentic to the discipline.*
- *Critique, revise and refine a project, or the practice of the discipline, according the authentic manner of the discipline.*
- *Effectively communicate the application of scholarship through ancillary material (written, oral, and/or visual)*

Criterion for review of student work	**Descriptions of levels of student performance**			
	Advanced (3)	**Proficient (2)**	**Beginning (1)**	**Unacceptable (0)**
Selecting and evaluating Relevant areas of scholarship are selected and critically evaluated by the student	• Engages in in-depth research and insightful evaluation to determine key resources. Explores a broad range of potential resources including non-standard and cross-disciplinary resources. • Critically evaluates credibility, multiple view points, common assumptions, complexities and ambiguities.	• Engages in in-depth research. • Considers credibility, multiple viewpoints, common assumptions, complexities and ambiguities.	• Engages in limited research that results in a superficial selection of resources. • Considers credibility of resources but illumination of complexities and ambiguities is limited.	• No exploration of resources or selection of irrelevant resources. • Does not consider credibility or multiple viewpoints common assumptions, complexities or ambiguities.
Application Relevant methods are applied to practice of the discipline	• All relevant elements of the methodology or frameworks are skillfully and accurately applied.	• Critical elements of methodology or frameworks are appropriately applied although more subtle elements are missing.	• Critical elements of the methodology are missing, incorrectly applied or unfocused. •	• Demonstrates a misunderstanding of the methodology or framework.

Critique / Analysis / Evaluation Project or practice is assessed according to disciplinary standards by the student.	• Analysis of project or practice is deep and elegant. • Results are reviewed relative to the goals with thorough, specific consideration of need for further work. • Discusses in detail relevant and supported limitations and implications.	• Analysis of project or practice is adequate. • Reviews results relative to goals with some consideration of need for further work. • Discusses relevant and supported limitations and implications.	• Analysis of project or practice is brief and lacks depth. • Reviews results in terms of the goals with little, if any, consideration of need for further work. • Presents relevant and supported limitations and implications.	• Analysis of project or practice is superficial. • Reviews results and goals superficially in with no consideration of need for further work. • Presents limitations and implications, but they are possibly irrelevant and unsupported.
Revision and Refinement Project or practice is developed through revising and refining by the student	• Synthesizes feedback to productively develop project or practice. • Revises and refines project or practice in a focused and systematic manner. • Revises project or practice directly toward greater depth, clarity and effectiveness.	• Incorporates feedback directly to productively develop project or practice • Revises and refines project or practice in a systematic manner. • Revises project or practice somewhat directly toward greater depth, clarity and effectiveness.	• Some feedback is incorporated to develop project or practice. • Revises and refines project or practice in an unsystematic manner. • Revises project or practice with limited effect on depth, clarity	• Does not fully understand or incorporate feedback. • Project or practice is either not revised or revisions are ineffective.
Presentation Student's presentation is effective and discipline appropriate	• Purpose, relevance and central point of presentation are obvious. • The presentation is discipline appropriate as gauged by style, format, theoretical premise, and recognition of sources and done at a professional level.	• Purpose, relevance and central point of presentation are evident. • The presentation is discipline appropriate as gauged by style, format, theoretical premise, and recognition of sources and done at a near-professional level.	• Purpose, relevance and central point of presentation are implied. • The presentation is discipline appropriate as gauged by style, format, theoretical premise, and recognition of sources done at a novice level.	• Purpose, relevance and central point of presentation are neither evident nor implied. • The presentation reflects a lack of understanding of the discipline-appropriate norms.

The Scholarship and Practice Rubric was developed by the Scholarship in Practice Faculty Board, supported by the Office of Undergraduate Studies and the Office of Institutional Research, Planning, and Assessment with the Scholarship and Practice instructors upon review of the AAC&U VALUE rubrics and according to standards determined by the Scholarship and Practice Faculty Board for student performance in the General Education Scholarship and Practice courses. The rubric defines the standards for student performance in I-Series courses at the University of Maryland.

Table 2c
Diversity: I-Series Assessment Rubric

OFFICE OF UNDERGRADUATE STUDIES

Each General Education category is grounded in a set of learning outcomes. For the full set of learning outcomes for Cultural Competence courses see: www.gened.umd.edu
This rubric is designed as a tool to assess activities aimed at student gains in the follow learning outcome(s) for the Cultural Competence General Education Category:

At the completion of this course, students will be able to:

1. *Understand and articulate a multiplicity of meanings of the concept of culture.*
2. *Explain how cultural beliefs influence behaviors and practices at the individual, organizational or societal levels.*
3. *Reflect in depth about critical similarities, differences, and intersections between their own and others' cultures or sub-cultures so as to demonstrate a deepening or transformation of original perspectives.*
4. *Compare and contrast similarities, differences, and intersections among two or more cultures.*
5. *Effectively use skills to negotiate cross-cultural situations or conflicts in interactions inside or outside the classroom.*

Criterion for review of student work	**Descriptions of levels of student performance**			
	Advanced (3)	**Proficient (2)**	**Beginning (1)**	**Unacceptable (0)**
Awareness & integration of cultural differences (Assesses learning outcomes 1, 2, and 3)	• Anticipates that power and privilege will influence interpretation of differences across social groups • Attempts to mitigate own zones of unawareness or limitations in perspective • Suggests culturally appropriate responses to all forms of bias • Actively expands perspective by imagining how others may view situations differently	• Recognizes wide range of contributions from others who differ from self • Recognizes blatant forms of bias • Understands that some policies or social norms may lead to unjust treatment or experiences	• Aware that differences exist across social groups • Judges differences negatively if they are widely discrepant from own beliefs or values • Reflexively defaults to own values & perspective when viewing or analyzing situations • Acknowledges that some differences have value	• Denies differences exist in experiences of social groups • Lacks awareness or minimizes the way own beliefs/values may differ from those of others. • Judges others negatively if they do not share own beliefs and values • Imposes own cultural framework to judge others

Cross-cultural communication skills (Assesses learning outcome 5)	• Interacts comfortably & respectfully with others who are different • Recognizes both common and subtle forms of culturally-loaded or insensitive verbal/nonverbal language and understands why it is offensive • Able both to articulate own perspective and solicit others' views to ensure that multiple perspectives are heard • Sensitively & honestly broaches topics on which there may be disagreement	• Interacts, even if awkwardly or formally, with others who are different • Recognizes most common forms of culturally-loaded & insensitive language • Listens to understand others' views • Shies away from difficult or challenging topics on which there may be disagreement	• Minimizes interactions with others who are different from oneself • Is aware of blatant forms of culturally loaded or insensitive language • Uses nonverbal behavior denoting discomfort (e.g., minimal eye contact, clipped interactions, closed nonverbal behavior) • Listens primarily to respond or counter instead of listening for understanding	• Overlooks others who are different from self or engages in stereotyping behavior when interacting with them • Is unaware of use of culturally-loaded or insensitive language • Reacts negatively or angrily to others who differ from self • Asserts own views or position repetitively
Cross-cultural negotiation skills (Assesses learning outcome 5)	• Acknowledges own limitations on cross-cultural interpretations or value judgments • Listens & asks questions to understand others' perspective when in conflict • Responds in ways that acknowledge others' perspectives or grievances • Respectfully challenges disrespectful actions or uninformed statements • Seeks nuanced, integrative resolutions to honor all	• Able to listen when challenged on cross-cultural interpretations or implicit value judgments • Defends views or actions and/or exits situation when cross-cultural conflict emerges • Seeks to justify own perspective before inquiring about others' perspective • Defaults to "split the difference" or compromise approaches	• Is upset and uncomfortable when challenged on cross-cultural interpretations or implicit value judgments • Minimizes conflict or cognitive dissonance by focusing on similarities between self & others • Avoids or is discomforted by emotionally tense discussions • Relies on win/lose or right/wrong approaches	• Personalizes conflict by denigrating people (vs. ideas) when challenged on cross-cultural interpretations or implicit value judgments • Interrupts, seeks to silence or dismisses those whose views or perspectives are in conflict OR fully disengages from others • Seeks to win/dominate discussions at all costs

The Cultural Competence General was developed by the Cultural Competence General Faculty Board, supported by the Office of Undergraduate Studies and the Office of Institutional Research, Planning, and Assessment with the Cultural Competence General instructors upon review of the AAC&U VALUE rubrics and according to standards determined by the Cultural Competence General Faculty Board for student performance in the General Education Cultural Competence General courses.

Table 2d
I-Series Assessment Rubric

OFFICE OF UNDERGRADUATE STUDIES

Each General Education category is grounded in a set of learning outcomes. For the full set of learning outcomes for Natural Sciences courses see: www.gened.umd.edu
This rubric is designed as a tool to assess activities aimed at student gains in the follow learning outcome(s) for the I-Series General Education Category:

At the completion of this course, students will be able to:

- *Solve complex problems requiring the application of several scientific concepts.*

Criterion for review of student work	**Descriptions of levels of student performance**			
	Advanced (3)	**Proficient (2)**	**Beginning (1)**	**Unacceptable (0)**
The Approach Define/Set up the approach	• The approach to the problem: • Is concise, systematic, complete • Includes a justified, detailed prediction/estimate/hypothesis • Includes fluent use of discipline appropriate language (including symbolic, algebraic etc.) • Reflects an analysis of issues/factors/context that contribute to the complexity of the problem • Recognizes the constraints (limits) that may affect how the problem may be solved • Accurately reflects the principles and methods of the course discipline	• The approach to the problem: • Is organized but lacks clarity or intentional structure, is viable, • Includes a justified, broad prediction/estimate/hypothesis • Includes suitable use of discipline appropriate language (including symbolic, algebraic etc.) • Reflects a search for or knowledge of issues/factors/context that contribute to the complexity of the problem • Acknowledges some of the constraints (limits) that may affect how the problem may be solved • Includes few mistakes in presenting the principles and methods of the course discipline	• The approach to the problem: • Is present, inefficient, ineffective • Includes an obvious or trivial prediction/estimate/hypothesis or guess • Is presented with awkward and imprecise use of discipline appropriate language (including symbolic, algebraic etc.) • Reflects a consideration of factors that contribute to the complexity of the problem that is narrow, and focused on the intuitively obvious • Does not identify the constraints that may affect how to solve the problem • Includes a naïve, inconsistent or inappropriate use of the principles and methods of the course discipline	• The approach to the problem: • Is not defined • Does not include a prediction • Does not use language that is appropriate to the discipline

The Concepts Identify the concepts to be employed in solving the problem	• Concepts are relevant to the specific problem. • Selection is complete (all relevant and necessary concepts are identified) • Concept selection reflects a broad consideration of the theories, laws, approaches, and models of the course discipline and of other disciplines (where appropriate) and supports the derivation of a best solution	• Concepts are relevant to the specific problem. • Selection is complete (all relevant and necessary concepts are identified) but may contain extraneous information • Concept selection reflects a consideration of the theories, laws, approaches, and models of the course discipline and of other disciplines (where appropriate) and supports the derivation of a solution	• Not all concepts are relevant to the specific problem. • Selection is not complete (all relevant and necessary concepts are not identified) • Concept selection reflects a limited consideration of the theories, laws, approaches, and models of the course discipline and of other disciplines (where appropriate) and does not directly lead to a viable solution.	• Relevant scientific concepts that would enable the problem to be solved are not identified
The Solution Apply the concepts in a manner that provides a solution to the problem	• Concepts are applied accurately, and in a manner appropriate to the course discipline • Reflects an awareness of context and limits. • Solution is fully reconciled with prediction /estimate /hypothesis	• Concepts are applied accurately, and in a manner appropriate to the course discipline • Reflects a partial awareness of context and limits. • Solution is partially reconciled with prediction/estimate /hypothesis	• Concepts are applied imprecisely, incorrectly and in a manner that is inconsistent with the course discipline • Does not reflect an awareness of context and limits. • Solution is superficially reconciled with prediction /estimate /hypothesis	• Concepts are not applied in a manner that allows for a solution to the problem

The I-Series Rubric was developed by the Natural Sciences Faculty Board, supported by the Office of Undergraduate Studies and the Office of Institutional Research, Planning, and Assessment with the Natural Sciences instructors upon review of the AAC&U VALUE rubrics and according to standards determined by the Natural Sciences Faculty Board for student performance in the General Education Natural Sciences courses. The rubric defines the standards for student performance in Natural Sciences courses at the University of Maryland.

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