DRAFT DOCUMENT 3-4-09 – Work in Progress

The proposed General Education curriculum would consist of ten courses within four broad areas:

I. Intellectual Inquiry
   a. Inquiry in the Humanities
   b. Inquiry in the Natural/Physical/Mathematical Sciences
   c. Inquiry in the Social Sciences
   d. Inquiry in Creativity & the Arts

II. Communication
   a. Writing
   b. Communication II

III. Quantitative Reasoning
   a. Quantitative Foundations
   b. Statistical Inferential Reasoning

IV. Citizenship
   a. U.S. Citizenship
   b. Local-to-Global Citizenship

For each of these courses, a template will outline: a) the general purpose of the course category, b) the core competencies that the course will address, c) at least one type of assessment that will demonstrate these competencies, and d) some general recommendations as to how the course might be delivered (large lecture format, combination of large-lecture and discussion sections, etc.). This last item will be used as the basis for estimating the feasibility and costs of implementation, for this new curriculum. Both the curriculum design and the feasibility issue will be discussed at the April 13th Senate meeting, and will be presented for vote at the May 4th Senate meeting.

A version of these templates will eventually be used by a committee in Undergraduate Studies charged with oversight of the General Education curriculum, and by faculty wishing to submit courses for Gen Ed credit. For this reason, we are working to design templates that are sufficiently specific to create coherence among the courses of a particular area, yet broad enough to invite participation by a variety of disciplines and colleges. While the curricular teams designing these templates are representative of a range of approaches and disciplines, we still need broad faculty input in order to ensure that the templates offer this balance.

The general design of this curriculum, approved in December 2008 by the University Senate, was much improved by faculty input and dialogue. For this reason, the committee members will visit departments and colleges, and seek your feedback on the ten course templates. This document contains the work-in-progress of the ten curricular committees, and the final page contains a list of the membership of each committee.

Please review this outline, or its subsequent updates at www.uky.edu/GenEd, in advance of your scheduled department or college faculty meeting. We encourage you to send your feedback via email to committee convener Susan Carvalho (carvalho@email.uky.edu), or submit comments via the website, or correspond with one of the curricular team members listed at the conclusion of this document. We look forward to your input at this important stage of the process.

Intellectual Inquiry – Humanities

The Humanities are united in their reflection upon the human condition through works of art and literature (including folklore and film), philosophical and religious contemplation and argumentation, and historical narrative. The principal activities of humanists and, therefore, the principal skills to be inculcated in students relate to *interpretation* and *analysis,* and the *evaluation* of competing interpretations of the same or similar texts and phenomena.

A course fulfilling the Humanities Gen Ed requirement should teach students to interpret, evaluate and analyze creations of the human intellect – works of art, literature philosophical and religious systems and arguments, and historical narratives and the activities and events they relate.

Students will demonstrate the ability to construct their own literary,, philosophical, religious, and historical interpretations according to the standards of the discipline.

It is hoped that students be learn to recognize (a) the validity of different points of view – whether these points of view devolve from differences of class, race, gender, nationality or even historical period – and (b) a degree of tolerance and mistrust of dogmatism. Further it is hoped that students will be able to recognize some aspects of human life that might be considered eternal and constant and distinguish these aspects from those which are contingent products of history and culture.,

1) Demonstrate the ability to present and critically evaluate competing interpretations through analysis and argumentation in writing and orally.

2) Demonstrate the ability to distinguish different artistic, literary,, philosophical, religious, and historical schools and periods according to the varying world-views characterized therein. (i.e., it would be good if a student could say something deeper than "the Renaissance happened several hundred years ago, and we got a cool statue of the naked David out of it". What was, for example, "reborn"?).

3) Demonstrate the ability to identify the values and presuppositions that underlie the world-views of different cultures and different peoples over time as well as one's own culture through the analysis and interpretation of works of philosophy and religion, art, folklore, film, literature , historical narratives (or the primary sources of historical research).

4) Demonstrate disciplinary literacy (vocabulary, concepts, methodology) in written work, oral presentations and in classroom discussions.

5) Demonstrate the ability to conduct a sustained piece of analysis of some work of art, folklore, film, literature,, philosophy, religion, or historical event or existing historical narrative that makes use of logical argument, coherent theses, and

evidence of that discipline, with use of library sources when applicable. This work should demonstrate appropriate information literacy in a particular discipline of the humanities, which, depending on the nature of the assignment might include, for example:

-- pose questions that shape an inquiry and identify sources necessary for this purpose

-- identify scholarly publications (monographs, articles, essays)
locate them (library stacks, Internet, other libraries)
cite them (MLA, Chicago styles)

-- find major scholarly publications
evaluate scholarly publications
find book reviews
determine if publication was refereed
search footnotes to learn if others are citing the publication

-- get facts, check facts
get overviews, opposing views, background information, context

-- recognize and find primary sources and distinguish primary from secondary sources

To deliver these courses, which are discussion and writing intensive, each course should contain no more than 30 students. If it is absolutely essential to have larger enrollment courses, the courses should be capped at 60 to allow for no more than 20 students per teaching assistant/instructor in the break-out groups (1 day/large lecture, 2 days of discussion in small groups). This distribution will allow for more intensive writing assignments and involved discussion. It is anticipated that the courses will be offered from the 100 to the 300 levels, although primarily at the 100-200 level. They will be open to non-majors and have no pre-requisites.

Intellectual Inquiry – Sciences

An understanding of the natural world is essential for well-educated citizens who work and live in a world strongly influenced by science and technology. At the heart of this General Education Science Inquiry course is this fundamental idea: Scientists advance knowledge through experimentation. Because this course is designed to convey a general understanding of science and the processes of scientific thinking, it will be taught using strategies that reflect the ways scientists work; students likewise will do basic science, engage its methods, with the goal of attaining some understanding of the way science works in and with the natural and social worlds.

Learning Outcomes

By the end of the course, students should be able to:

1. Describe methods of inquiry that lead to scientific knowledge and distinguish scientific fact from pseudoscience.
2. Explain fundamental principles in a branch of science.
3. Apply fundamental principles to interpret and predict natural phenomena.
4. Demonstrate an understanding of at least one scientific discovery that changed the way scientists understand the world.
5. Give examples of how science interacts with society.
6. Conduct a hands-on project using scientific methods to include design, data collection, analysis, summary of the results, conclusions, alternative approaches, and future studies.
7. Recognize when information is needed and demonstrate the ability to find, evaluate and use effectively sources of scientific information.

Guidelines for syllabi

Each learning outcome is essential to meeting the requirements of a science inquiry course.

While providing for as much flexibility as possible within science disciplines, the syllabus will include the following:

- A demonstrated focus on the processes of science and scientific thinking;
- A required student product (paper, laboratory report, presentation, etc) based on the hands-on project. This requirement is the curriculum-embedded performance-based assessable product and must be a component of the course grade, weighting at discretion of instructor.
- A required student activity that involves information literacy.

Resources

It became clear, from the discussions the Science Inquiry Curricular Team had on the proposal to include a hands-on project requirement, that faculty are worried about the extra workload this will entail for the instructors.

Our Team was won over by a number of positive factors, such as:

- current K-12 science learning outcomes stress the importance of hand-on activities and ours is a simple extension of that curriculum;
- these activities add life to a course that doesn't have a lab component;
- the structure of science is inherently based upon observational methods, so a one-time introductory science class should rightly include this component;
- a science course that involves a project with a written component will strengthen the writing component of the overall curriculum,

The majority of the current USP Science courses are taught as large enrollment courses (150 – 300+ students). Anticipating that the new Gen Ed Science Inquiry courses will also be large enrollment courses (100+ students at a minimum), the Curricular Team members have provided examples of hands-on projects (with anticipated costs) that could be incorporated into a Gen Ed Science Inquiry course.

SAMPLE- Hands-On Projects / Resources Needed

Earth and Environmental Sciences

For Earth and Environmental Sciences courses this could involve utilization of climate data (ice cores, geochemical parameters recorded in the rock record) or earthquake location/intensity data available, e.g., through the U.S. Geological Survey. A hypothetical course might be: Gambling on the Big One: Earthquake Risks and Prediction

The course would focus on seismic hazard risk assessment and prediction. Lectures and readings would provide content background. There would be five blocks of work time (~2 lectures) in which groups of 5 students would first access and download data sets, organize and plot data (depth and spatial distribution of earthquakes in the crust), intensity distribution of earthquakes, determine recurrence intervals of events of various magnitude, and assess precision of all measured parameters. Students would use standard spreadsheet/ statistical/graphing software (Excel).

This would require 20 laptops/ 100 students accessing on-line datasets via the campus the wireless system. One TA / 100 students

Physics

There are many sound-related projects which students can do at home, some of which involve using software available for free on the web. Students have analyzed the sound made by their voice, their guitar, and by birds, for example. Other home projects involve various optical effects students can investigate, such as interference -- observed with soap films on water, diffraction and refraction of light, or a study of the colors of the sunset. Students can obtain and characterize small systems of lenses, or study the effects of using the polarizing lenses in their sunglasses to look at scattered light.

It is estimated that 1 full-time TA would be needed for every 100 students in these classes. Their assignment would be to meet with the students to discuss their project ideas and plans, and to grade the final papers. To maximize efficiency, the project assignments could be staggered across the class over the first half of the term, and collected and graded over the last half. TAs could meet with 15 students for each of the first 7 weeks, and grade the papers of 15 students in each of the final 7 weeks.

Medicine

Biofeedback training and execution

In the near future, neuro-prosthetic interfaces may be used to control devices and machinery, in contrast to mice, joysticks and remote controls. This laboratory will allow students to explore biofeedback as an approach to developing electronic interfaces of the future, whether they are household devices, prosthetic limbs or wearable electronics. Neuro-prosthetic interfaces require a training period to align the biological or neurological responses to the output and an execution phase to implement the device. Students will learn about neuro-prosthetic interfaces, the biology of learning & memory, and the scientific method.
Students will be given the opportunity to integrate biofeedback sensors (EMG, EEG, etc.) with standard computer software.

DESIGN: Groups of 10-15 students would receive an introduction to the biofeedback equipment and train on standard computer interface software. Independently, the groups will choose several variables to manipulate (e.g. position of sensors, direction of the sensors, and difficulty of the task). Quantitative measures will be recorded, including time to criterion performance, number of errors, and permanence of task performance.

OUTCOME: Students will be introduced to the scientific method using biofeedback electronic control that is likely to become more common in the future. Students will gain an understanding of trial and error learning, persistence of learning, and reversibility of learning.

RESOURCES:
1. Small classroom/laboratory setting
2. Biofeedback hardware (sensors, control module)
3. Software

Biology

This activity is used to introduce the students to a soil erosion unit in the Human Ecology (BIO 102) course (current USP course) and involves the students conducting a soil survey of the state. Students collect soil samples from around the state of Kentucky. The students, in groups of 8 – 10, test these samples for nitrogen, potassium, phosphate and pH (using commercially available soil test kits). They also determine the relative fertility of the soil samples, and conduct an animal and microbial inventory of the soil samples. This activity is used to introduce the students to the soil erosion unit of the Human Ecology (BIO 102) course. During later class periods, the results obtained from the soil tests are used as a basis for the lecture. The students use their results to hypothesize on the relationship between the chemical levels and the relative fertility of soil. Each student submits a written report of the activity and each group orally shares their results with the rest of the class.

Another activity focuses on the problems associated with water pollution. In order to sensitize students to the impact of even small amounts of pollutants on water ecosystems, the unit begins with a water pollution experiment. In this activity, students test the effects of common household fluids and waste on water quality. During later class periods, the results obtained from the water pollution tests are used as a basis for the lecture.

Both of these activities have been successfully carried out with 300 students in a lecture hall during a 50-minute class period with the assistance of only one teaching assistant.
Estimated cost $100.00/ 300 students

Rehabilitation Sciences

Topic: Sensory Mapping and Tactile Perception

Goal: Assess the distribution and sensitivity of tactile sensory endings on human skin throughout the body surface using an adjustable two-point discrimination assessment tool.

Procedure: The class is divided into pairs, with each student operating as a subject on one turn and a tester on a second turn. An adjustable 2 pt assessment apparatus (left picture) is touched to the skin site in question and the subject (who is blind-folded) is required to respond with the words "one" or "two" to indicate their perception of the event delivered by the tester. The response is recorded and the testing cycle repeated with a different inter-point distance. Inter-point distances are adjusted in 1 mm steps (up and down) to find a perceptual threshold point, defined as the distance at which a subject is able to detect two distinct points 50% of the time within a pre-determined number of trials. The procedure is repeated for different body parts (leg, arm, back, face, fingers, etc). Data can then be complied across the entire class to build a 2 pt sensitivity map of the body surface. Simple descriptive statistics could be run to provide quantitative insights and the data can be compared to published reports on tactile sensitivity.

Resources: 2-point tools are low-cost items than can be ordered through most science supply catalogs. For a class of 300, you would need 150 sets for each pair of students. Approximate cost for supplies = $5.000. This would be a onetime initial cost, since these devices can be reused in subsequent semesters. Alternatively, a set of 2 pt testers can be made from simple household items if desired. This hands-on project can be performed either in or out of class. A TA trained in 2 pt assessment would be useful to field questions from the students. The TA would only be needed for those class periods or time periods when the project was being conducted during the semester.

Chemistry

Do pesticides break down at the same rate? Does the rate depend on the pH?
This exercise addresses the question of whether chemicals break down at an observable rate in the environment. Depending on the specific focus of the course, students can address the question of whether different chemicals (in this case commercial pesticides) behave in the same manner, whether different soils lead to different rates of chemical degradation, or others.

Students collect soil samples in plastic vials. To one is applied a small amount of a dilute solution of Roundup in water. The other vial functions as a control. After a week or two, the content is analyzed by thin layer chromatography. Ninhydrin stain can be used to visualize the residual compound.

Cost ~$500 for 300 students, plus TA time for preparation of solutions, assistance with the TLC step, and grading.

Summary of resources needed for the SAMPLE projects listed above:

- The majority of the current USP Science courses are taught as large enrollment courses (150 – 300+ students). It is anticipated that the new Gen Ed Science Inquiry courses will also be large enrollment courses (100+ students at a minimum),
- That several "general purpose science labs" be made available for Gen Ed Science Inquiry classes on a rotating basis throughout the semester.
- Laptop computers: 20/100 students
- Consumable supplies (chemicals, test kits): $100 - $500/300 students
- Up-front equipment (other than computers): $5000/ 300 students (one –time costs)
- Teaching Assistant support for all courses (average -1 TA per 100 students)

Curriculum-Embedded, Performance-Based Assessable Product:
The student product (paper, laboratory report, presentation, etc) based on the hands-on project.

Intellectual Inquiry – Social Sciences

Although they vary in terms of content and intellectual traditions, foundational courses in the social sciences promote an understanding, based on living bodies of theory and research, of individuals in the context of social interactions, groups, and societies. Human societies are diverse and varied, with different understandings of the world among them, and with a multiplicity of actors within them who do not necessarily share the same views or goals. As a consequence, human phenomena are not as easily predictable as natural phenomena, and social science inquiry can lead to many plausible answers to any given question. Nevertheless, inquiry in the social sciences is empirical, guided by rigorous but varied theories and methods. Thus, students who complete a General Education course in the social sciences should understand how a discipline's modes of scholarly inquiry have led to the development of the discipline's shared bodies of knowledge and the interplay between a social science discipline and its broader social context. The successful social science course will present a variety of approaches to any given question about social phenomena, preparing students to critically evaluate the variety of social situations with which they may be confronted in their everyday lives.

Students will be able to:

1. Demonstrate knowledge of the theories associated with a social science discipline, either broadly or as applied to an important social science topic.

2. Demonstrate an understanding of methods and ethics of inquiry that lead to social scientific knowledge.

3. Demonstrate an ability to identify and use appropriate information resources to substantiate evidence-based claims.

4. Demonstrate knowledge of how a social science discipline influences society.

5. Demonstrate an ability to pose a well-formulated question pertinent to a social science discipline and to design a research project that would speak to that question.

Recommendations on delivery models:

Departments and multidisciplinary teams offering General Education courses in the social sciences should be encouraged to experiment with varying delivery models, including (but not limited to) (a) large (150 +) lecture sections with varying combinations of discussion or (where appropriate) laboratory sections and assistance from Teaching Assistants, (b) medium-sized (75-150) lecture sections with assistance from Teaching Assistants, and (c) smaller sections. Appropriate delivery may vary by discipline (or multidisciplinary combination), but it will be the case in all departments that instructors of sections of General Education courses in the social sciences cannot reasonably be expected to fulfill expectations for active learning and the development of critical thinking skills without adequate assistance and support. This will include Teaching Assistants as well as access to smart classrooms and other appropriate technical support.

Intellectual Inquiry – Arts & Creativity

Toward Outcomes in Creative Endeavors

Creativity is pertinent to all disciplines. In general education, a focus on creativity adds to the vitality and relevance of learning and will translate into graduates who are better prepared to face the challenges of a dynamic society. Inquiry Courses under this rubric will explore the human need to experience, comprehend, and utilize processes that transcend the conventions of utility, whether that involves the mastery of rules or the decision to break them, the desire to identify and refine the expressible or to recognize and prize the ineffable. The creative process and its products and results are the focus on this course; while they may be taught from the traditional fine arts perspectives, it is expected that courses will also be based on an exploration of the creative and aesthetic aspects of "rational", "scientific" or quantitative disciplines, e.g., the "elegance" of certain scientific/mathematical proofs or the beauty inherent in a well-articulated design.

Outcomes

- Students will personally perform, produce, fabricate or generate an artifact or artifacts that demonstrates their engagement with the creative process (e.g. an object, product, installation, presentation, record of a performance etc.) either as an individual or as part of a collaborative. As part of this process students will:
  - Define and distinguish different approaches (historical, theoretical, and methodological issues) to "creativity" as appropriate to the disciplinary practices specific to the subject, medium, or approach that informs a particular course.
  - Apply the logic, laws, or constraints of the area of study, (e.g, "out of the box" thinking, or the masterful, elegant treatment of given rules or forms).
  - Demonstrate the ability to critically analyze work produced by other students in this course and in co-curricular events using appropriate tools. These analyses should utilize relevant information resources to incorporate historical, theoretical, and or cultural factors.
  - Evaluate results of their own creative endeavors and, using that evaluation, reassess and refine their work.

Guidelines

The primary emphasis of courses in the Area of Inquiry must be on active learning through student performance, expression, and/or production (what is known as "process-focused" creativity). This emphasis should be documented through the number of assignments or class meetings devoted to this work (expressed as a percentage) or through the grading mechanism for the final grade for the course.

Though "process-focused" the course may highlight other approaches to creativity. Students may be expected to explore forms of creativity that are constraint-focused (mastering or overcoming established "laws" or "systems"), product-focused (emphasis

on the originality, utility or value of the thing produced), transformation-focused (risk-taking, willingness to make mistakes, role of chance) or fulfillment-focused (personal or professional accomplishment). Proposals for courses should identify which approaches are present in the syllabi.

Syllabi must incorporate assignments or exercises whose final product reflects a process of analysis, evaluation, reassessment, and refinement.

Syllabi must include projects or exercises that introduce tools or develop information literacy appropriate to the discipline.

Syllabi must incorporate attendance and/or participation in relevant co-curricular activities as part of the course. Students should be required to critically engage with these activities through a written analysis or similar project.

Delivery models/Assessment

Many existing courses (e.g. Art Studio courses, Design courses, creative writing) are currently offered with enrollments of 20 or less. It is expected that this will continue and that many new courses in this area of Inquiry will be in this format.

It is possible that courses can be designed using the large lecture/breakout format.

A majority of the courses will be offered at 100 or 200-level, though we anticipate some courses at 300-level or above.

Most courses in this area will be open to enrollment for non-majors, with no pre-requisites.

Options for assessment include direct and indirect measurements:

Direct: Assessment should be based on artifacts created by students in the course. These artifacts may include records of performance/object or a portfolio in which students document and evaluate the process and products of their work for the course.

Indirect: Assessment could be linked to the current Oswald Creativity contest (an increase in the number of applicants to the competition, an increase in the quality of the applicants work over time)
Assessment could be linked to increased rates of attendance or participation in campus cultural or co-curricular events.
Assessment could be linked to other undergraduate research programs such as eUreKa, Kaleidoscope.

Writing

Writing I is a 3 credit hour course designed to engage students in the practice of writing in an active learning environment. As a General Education course, Writing I participates in the broad goal of developing critical thinking skills within an academic context that emphasizes the real-world problems and decisions that students will confront as educated citizens of the twenty-first century. The Writing I course offers substantial practice in composing and revising written texts for an audience, with an additional goal of developing life-long habits of writing for learning, personal expression, and community participation.

Goals:
• Students will compose written texts that represent a relevant and informed point of view appropriate for its audience, purpose, and occasion in an environment that reinforces the recursive and generative nature of the writing process.
• Students will demonstrate an awareness of strategies that writers use in different rhetorical situations, to employ invention techniques for analyzing and developing arguments, to recognize and address differing genre and discourse conventions, and to document their sources using an appropriate style guide.
• Students will find, analyze and evaluate pertinent primary and secondary sources, using relevant discovery tools, as part of the writing process.
• Students will develop appropriate and effective strategies for organizing, revising, editing, and proofreading writing to improve development of ideas and appropriateness of expression.
• Students will collaborate with peers, the instructor, and librarians to define revision strategies for writing, to set goals for improving writing, and to devise effective plans for achieving those goals.
• Students will engage in a range of writing activities that allow them to explore and express their experiences and perspectives on issues under discussion, with the goal of developing their interest in writing as a life-long activity.

Curriculum-Embedded, Performance-Based Assessable Products:
Formal written texts
Revision plans and/or peer reviews
Journals or other informal writing

Communication II

This is a 3-credit skills and practice integrated communication course based on the principles of oral and visual communication.
Students will demonstrate understanding of the content in graded oral and visual ways with required revision processes to facilitate improvement of their oral, written, and visual communication skills.

Preamble:
We begin with a reminder that the "communication" course description approved by the Senate in December 2008 prescribed a "3-hour integrated communications course focusing on oral and visual communication skills, along with continued development of written communication skills" (see *Learning Outcomes* document on the uky.edu/gened website).

We also believe it is impossible to teach everything about communication in a one-semester 3-credit course. Hence, the committee took seriously the charge of determining the foundational communication skills to be nurtured in the form of a required general education course. We derived the skills from research conducted regarding (a) general education communication goals at other colleges and universities that have recently revised their general education curricula and (b) what employers seek in college graduates based on surveys from several clearinghouses (e.g., the American Society for Training and Development, the US. Department of Labor, National Association of Colleges and Employers, etc…).

Course Objectives:

1. Students will compose (in writing), deliver, and revise effective formal presentations with appropriate visual materials (which includes locating and evaluating appropriate resources, developing breadth and depth of content (with evidence), structuring well-reasoned ideas coherently, delivering messages via effective use of voice and body, as well as constructing and integrating appropriate presentational aids).
   Weight: Minimum 40% of the course and grade

2. Students will critically evaluate public presentations (i.e., self, peer, and professional) based on specific criteria.
   Weight: Minimum 15 % of the course and grade

3. Students will understand the principles of and engage in effective collaboration and feedback in dyads, small groups, and/or teams (based on interdependence and accountability).
   Weight: Minimum 25% of the course and grade

Note: As much as 20% of the course and grade can come from quizzes, tests, and/or exams.

Curriculum-Embedded, Performance-Based Assessable Products

Written documentation (e.g., self and peer evaluations, application and reflection papers, formal outlines, flowcharts, cluster diagrams, generative lists, or other artifacts of planning and shaping messages)
Interpersonal interactions/Simulations/Role Plays
Visual products
Recorded presentations

Resources

The committee believes it is important to note that the Department of Communication cannot service the entire undergraduate student population without substantial additional financial resources (which is, in fact, why the current USP oral communication requirement is suspended). Hence, the objectives of this course must be reasonable so that faculty from a variety of disciplines across the campus ought to feel they can achieve them in their courses.

To achieve this goal in ways that ensure curriculum integrity, the committee recommends the creation of an integrated Communication Center (written, oral, and visual). The center--staffed by communication experts (written, oral, and visual)--would provide training and consultation to faculty who choose to (a) modify existing courses or (b) create a new course to meet this general education requirement. The center would also train graduate teaching assistants (GTAs) and part time instructors (PTIs) who teach courses designed to meet this requirement. Ideally, GTAs and PTIs would come from departments across campus to encourage this communication course to be discipline-specific in terms of content. The Center would also be an ideal venue to train these instructors to incorporate effective information literacy research skills, which are an integral component of both the Communication and Writing I courses. The committee believes the creation of such a unit will be more economically feasible than would be the hiring of many additional communication faculty members to service the entire undergraduate student population.

Implementation/Course Delivery

Because the nature of the course focuses on practicing and improving communication skills, we believe the class size must be small (no more than 25 students per section).

Quantitative Foundations

Quantitative reasoning is a conceptual process that employs one or more of a family of mathematical or logistical methods to analyze and solve problems in a variety of disciplines. Such methods guide both deductive and inductive reasoning in mathematics, the sciences (including physical, life, psychological, social, political, and economic sciences), the humanities and arts as well as in engineering, computer science, and information technology. They also have great utility in helping students clarify and critically evaluate information that is relevant to personal life and to everyday decisions about health, finance, citizenship, and government. When these methods are applied to real-world examples and taught in contexts that engage student interest they have been found to improve the capacity of students to draw sound inferences. For this reason quantitative reasoning is multi-disciplinary and invites a wide diversity of disciplines and departments to offer courses to satisfy this requirement. We describe here the requirements for the first course in Quantitative Reasoning, focusing on Mathematical, Statistical, and Logic Foundations; the second course will focus on Statistical Reasoning and Inference and is described in its own template.

Courses designed to meet this requirement will demonstrate how the course elements (e.g., structure, activities, assignments, projects, homework, papers, and exams) will contribute to the following student learning objectives:

- Students will demonstrate numerical literacy and the appropriate use of functions (relationships between two or more quantities) in everyday life.

- Students will apply fundamental elements of mathematical, logical, and statistical knowledge to model and solve problems drawn from real life. In this modeling process:

    - Students will recast and formulate problems using appropriate mathematical and logistical systems (e.g., algebra, geometry, logic) and representations (e.g., symbolical, visual, graphical, numerical, verbal).

    - Students will apply the rules, procedures, and techniques of appropriate notational or symbolic systems (e.g., algebraic, geometric, logical) to model, analyze, and solve problems.

    - Students will use correct reasoning, arguments, and proofs to validate (or invalidate) their analyses, confirm their results, and consider alternative solutions.

    - Students will interpret and communicate their results in various forms, including symbolical, graphical, numerical, or verbal.

- Students will identify and evaluate arguments containing erroneous or fallacious reasoning, such as incorrect mathematical or logical inferences, limitations of the scope of particular models, and misinterpretations of presentations of data.

- In solving and modeling problems, students will determine the nature and extent of the appropriate information needed, access and use needed information effectively, and evaluate information and its sources critically.

- Students will create at least one assessable product (e.g., the result of modeling and solving a problem) that can be shared with UK's Assessment Office to contribute to the assessment of the General Education program.

Guidance for the Course Designer:

The course should have a central applications-driven, problem-solving focus, with particular attention to problems of potential "real-life" relevance to the students. The students should be actively engaged in modeling and problem-solving. Note that there are various technology tools that can assist in visualizing concepts and making models, as well as reinforcing basic skills. The desire is that the course will develop such quantitative reasoning skills as to be generally useful to students in their further studies, work, and engagement in civic life. [Do we want to provide some sample course descriptions and texts from various disciplines?]

It is to be assumed that students will enter the course with an appropriate mastery of high school mathematics through Algebra I, Algebra II, and Geometry to earn a Math ACTE score of at least 19, or the equivalent.

Implications for Resources:

There are pedagogical implications for such a course that may affect its structure or class size. For example, large lecture format alone may be ineffective. To what extent might current or potential UK courses fulfill this template? What are the implications for resources to develop and pilot new courses?

It will be necessary to examine the learning objectives that the Statistical Reasoning course will assume the students have before enrolling in that second course.

It may not be the case that a student who has taken advanced mathematics in high school can demonstrate the learning objectives mentioned here, though one might hope so. A placement procedure or method of "testing out" may need to be developed, though this is not a trivial task.

Some References that may be Helpful in Designing a Course

Mathematical Association of America, *Quantitative Reasoning for College Graduates: A Complement to the Standards*, **http://www.maa.org/past/ql/ql_toc.html**.

Lynn A. Steen, Editor, *Why Numbers Count: Quantitative Literacy for Tomorrow's America*, College Board, 1997.

Lynn A. Steen, Editor, *Mathematics and Democracy: The Case for Quantitative Literacy*, National Council on Education and the Disciplines, **http://www.maa.org/ql/mathanddemocracy.html**.

Bernard L. Madison, Editor, *Quantitative Literacy: Why Numeracy Matters for Schools and Colleges*, Woodrow Wilson National Foundation, 2003, **http://www.maa.org/ql/qltoc.html**.

Lynn A. Steen, *Achieving Quantitative Literacy: An Urgent Challenge for Higher Education*, Mathematical Association of America, 2004.

Rick Gillman, Editor, *Current Practices in Quantitative Literacy*, Mathematical Association of America, 2006.

Bernard L. Madison and Lynn A. Steen, Editors, *Calculation vs. Context: Quantitative Literacy and Its Implications for Teacher Education*, **http://www.maa.org/Ql/calcvscontext.html**.

The Mathematical Association of America SIGMAA on Quantitative Literacy, **http://pc88092.math.cwu.edu/~montgomery/sigmaaql**.

The National Numeracy Network, **http://serc.carleton.edu/nnn**.

Selected Quantitative Literacy Programs in U.S. Colleges and Universities, January, 2007, **http://www.stolaf.edu/people/steen/Papers/qlprogs.pdf**.

Textbooks: Quantitative Reasoning/Literacy, **http://www.statlit.org/PDF/2006TextbooksQR.pdf**.

Statistical Inferential Reasoning

Courses that would qualify to be one of the "3-hour course(s) devoted to a conceptual and practical understanding of statistical inferential reasoning" should be focused on the student's ability to evaluate the efficacy of claims based on statistical constructs and to understand and articulate important risks that these claims often address, both through the formal science of statistical inference and informal activity of human inference. These courses should not have computations and derivations as their primary focus; neither should they be abstract reasoning courses devoid of numerical data.

Toward that end, it is expected that any course that qualifies must exhibit a syllabus that offers convincing evidence that, upon successfully completing this course, students will be able to:

A. Evaluate common claims arising from the formal statistical inference conveyed in margins of error and confidence intervals. Students must be able to articulate the sense in which margins of error and confidence intervals address and purport to quantify risks that are of practical interest. Although skill in the computation of these quantities is an acceptable by-product, the demonstrated skill set **must not** be confined to, or even largely focused on, the computation of these quantities. In particular, the student must:

1. Be able to connect the uncertainty of sampling variability with margins of error and confidence intervals. This connection needs to be formal in the sense that the student needs to be able to demonstrate an understanding of the roles of sampling distributions, and standard scores, as well as the central limit theorem (non-mathematical treatment) in the production, but more importantly, the interpretation of margins of error and confidence intervals.

2. Be able to demonstrate an understanding that some of the other major sources of uncertainty, such as biased samples and questionnaires that are worded in a biased or misleading fashion are not addressed by margin of errors or confidence intervals.

B. Evaluate common claims arising from the formal statistical inference conveyed in null hypothesis testing associated with statistically designed experiments. Students must be able to articulate the sense in which null hypothesis testing addresses and purports to quantify risks that are of practical interest. Although skill in the actual testing of such hypotheses is an acceptable by-product, the demonstrated skill set **must not** be confined to, or even largely focused on the actual construction of such tests. In particular, the student must

1. Be able to demonstrate a substantive understanding of "statistical significance," and the sense in which p-values and null hypothesis testing

offer a useful and practical articulation of risk assessment. To do this, the student must also be able to demonstrate mastery of the basic language of statistical experimental design and null hypothesis testing, and articulate the role that statistical modeling plays in the development and interpretation of "statistical significance."

2. Be able to articulate the strengths and weaknesses of using classical null hypothesis testing as a decision tool. Students should understand the sense in which common hypothesis testing, and the associated "significance" addressed in media, is intimately related to a perspective that looks for evidence against a claim, and infers about the truth of that claim based on the weight of that evidence

C. Evaluate common claims that arise from statistical constructs, like charts and graphs, tables and numerical summaries, through the important, but informal, act of human inference. Although skill in the actual construction of these constructs is an acceptable by-product, the demonstrated skill set **must not** be confined to, or even largely focused on these constructions. In particular, students must:

1. Be able to demonstrate an understanding of the challenges that confront informal inferences arising from these kinds of statistical entities and offer evidence that they can construct these inferences in a rational and informed manner.

2. Be able to discuss the practical importance of effective conditional reasoning (e.g. false positives, Prosecutor's paradox); the importance of hidden variables and confounding. (e.g. Simpson's paradox); the issue of association versus correlation and correlation and causation; the importance of having the right and/or enough information; and the problem of misinterpreting randomness.

D. Demonstrate information literacy by their measurable ability to independently identify and utilize appropriate information resources from a variety of sources. Instructors will collaborate with librarians to create a course-relevant component developing lifelong learning skills allowing students to identify, utilize, evaluate, apply and communicate information, a critical competency in becoming a contributing member of society.

Curriculum-Embedded, Performance-Based Assessable Products

All students must create at least one assessable product that can be shared with the University's Assessment Office and the course syllabus must make clear what that product is. Individual instructors (or departments) are encouraged to consult with the Director of Assessment at the University, prior to the construction of a new syllabus. Rather than test knowledge or particular techniques, the assessment tool(s) should allow students to demonstrate an understanding of how statistical inference is used in decision making and to appraise the efficacy of statistical arguments that are reported for general

consumption. That is, the assessment, too, should focus upon real world applications of learning outcomes A-D above. We recommend that the tool be validated, structured to allow electronic submission, and that an appropriate assessment rubric be developed based upon these criteria.

Resource and Delivery Comments

The ways in which the course outcomes are achieved, and the contexts in which the concepts are motivated, are the purview of individual departments, colleges, and instructors. However, while many of the concepts discussed in this course category are, at their root, complex mathematical concepts (e.g. the Central Limit Theorem), this course ***is not*** intended to be a mathematically complex course. Rather, the complexity of the course will likely be rooted in the ideas being discussed and the ways in which core concepts in statistical science connect to and surface in activities as common as reading the morning newspaper. With this in mind, the following suggestions are offered:

- The ideal prerequisite for courses in this category is a course in the proposed category of "mathematical, logical and statistical foundations," or the equivalent.
- Large-lecture classes alone are not recommended. Larger lectures, perhaps meeting twice a week, with recitation breakouts are a better solution. Even then, the lecture sessions should not be too large. While this may end up being the purview of individual departments or colleges, it does have implications for the comparability of the different assessments that may be embedded across departments and colleges.
- Teaching assistants will be needed to help staff the recitations. These TAs will need to be trained and departments will need resources to create and sustain effective training programs.

US Citizenship

Conceptions of Community, Culture and Citizenship in a Diverse U.S. Society

Courses in this area lay the foundation for effective and responsible participation in a diverse society by preparing students to make informed choices in the complex or unpredictable cultural contexts that can arise in U.S. communities. These courses should engage students in interactive learning techniques such as debates, simulations, service-learning projects, and digital documentaries, as well as develop their information literacy. Students completing this requirement will achieve the following learning outcomes:

A. Demonstrate an understanding of historical and cultural differences arising from such issues as ethnicity, gender, language, nationality, race, creed, religion, sexuality, and socioeconomic class.

B. Demonstrate a basic understanding of how these differences influence issues of social justice and/or civic responsibility.

C. Recognize relevant historical and cultural contexts.

D. Demonstrate an understanding of at least two of the following:
    a. Societal and institutional change over time
    b. Civic engagement
    c. Comparative regional, national, or international issues
    d. Power and resistance

E. Participate in at least two assessable individual or group projects that focus on personal and/or collective decision-making. The projects should require students to identify and evaluate conflicts, compromises, and/or ethical dilemmas. These projects shall demonstrate a basic understanding of effective and responsible participation in a diverse society.

<u>Global Citizenship</u> (title under discussion)

As part of a two-course requirement of Learning Outcome #4, courses satisfying this requirement will focus attention on the student's civic role and place in the world and the dynamic interaction between locale (place and people) and global processes (international and transnational) that complement his or her civic responsibilities to diversity and social justice issues in the US-based course requirement. As a complement to the non-US based course, this course will have a non-US focus constituting more than half of the content of the course. In order for UK students to be prepared for careers in a globalized world, they must **gain an understanding of and appreciation both for global cultural diversity and for the impacts of current processes of globalization**. Once achieved, this new knowledge and attitude will also result in students' achieving a heightened and more critical awareness of her/his own culture and of the role of the United States in the world. Issues like environmental concerns (e.g., climate change, soil depletion, transboundary pollution.), the built environment (including architecture, urban planning, sustainable design), public health (such as sanitation, local-global disease transfer, nuclear and coal-fired energy risks), economics (e.g., agriculture, industry, and the satisfaction of human needs), and the interaction of local and world cultures (including music, art, religions, literature and folklore) are among the topics that may be explored in the many possible courses for fulfilling this part of the new general education curricular framework. At least part of the course must explore in depth some of the major dimensions of at least one other culture outside the United States, and must bring the exploration or implications of the course's major subject matter into the 21st century context. On the other hand, a studied examination of the historical evolution of such issues or an emphasis upon one prominent time period is not precluded.

The course will:

1. Illuminate the civic (and other) complexities and responsibilities of actively engaging and participating in a diverse, multiethnic, multilingual world community with a focus on non-US or global perspectives. The major elements of at least one other culture outside the U.S. must be explored in depth.

2. Foster an understanding of and appreciation for how local features (economic, cultural, social, political and religious) of cities, ethnicities, nations and regions are often linked to global trends, tendencies, and characteristics that often mutually shape one another.

3. Impress upon students how personal decision making and civic responsibilities often generate ethical dilemmas, conflicts, and trade-offs that must be thoughtfully evaluated, weighed, and resolved.

4. Incorporate at least two of four additional topics (i.e., societal and institutional change over time, civic engagement, cross-national/comparative issues, and power and resistance) into the thematic core of the syllabus, allocating at least 15% of the course to each.

5. Require a project accounting for at least 15% of the course grade that explores a significant issue or problem within a local-global framework.

Delivery:

In satisfying this component of the new General Education curriculum, courses may be offered at the 200-, 300- or 400- levels. Class enrollment size would generally range between 50 and 150 from one department to another. For courses with enrollments of 100 or more, a teaching format involving two lectures and one discussion section per week would be followed and ample TAs would be supplied to cover the discussion sections. All courses meeting this requirement would assign an individual or team project, which would both: (1) be included as part of the final course grade; and (2) act as the means for assessing the courses success in meeting the learning outcomes specified in the new General Education curriculum.

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