UNIVERSITY OF MARY WASHINGTON -- NEW COURSE PROPOSAL
Electronically submit this completed form with PDF attachments to the Chair of the College Curriculum Committee.

**COLLEGE** (check one):  | Arts and Sciences  | x  | Business  | Education
---|---|---|---|---
Proposal Submitted By:  | Debra Hydorn, Marie Sheckels  | Date Prepared: 1/2/2013
Course Title:  | Quantitative Reasoning for the Sciences
Department/discipline and course number*:  | MATH 120

*This course number must be approved by the Office of the Registrar before the proposal is submitted.

| Number of credits proposed: | 3 | Prerequisites: | None |
| Will this be a new, repeatable “special topics” course? (Do you want students to be able to take this new course more than once if the topic changes?) | NO | x | YES |

Date of first offering of this new course: FALL SEMESTER, year  | Spring 2014
Proposed frequency of offering of the course:  | Yearly
List the faculty who will likely teach the course:  | Any member of the Mathematics Department faculty
Are ANY new resources required?  | NO | x | YES | Document in attached impact statement

This new course will be (check all that apply):
- Required in the major  | x |
- General Elective  | x |
- Elective in the major  | |
- General Education**  | x |

**AFTER the new course is approved, a separate proposal must be sent to the General Education Committee.

**Catalog Description:**
Designed to prepare students for success in the sciences by providing them with appropriate mathematics and quantitative reasoning skills. Course topics include measurement and estimation, growth and decay phenomena, scaling transformations, and an introduction to probability and statistics.

**COURSE HISTORY**
Was this course taught previously as a topics or experimental course?  | YES | NO | x

<table>
<thead>
<tr>
<th>Course Number and Title of Previous Course</th>
<th>Semester Offered</th>
<th>Enrollment</th>
</tr>
</thead>
</table>

CHECK HERE if the proposed course is to be equated with the earlier topics or experimental offerings. This means that students who took the earlier “topics” course will only be able to take the new course if they made a C- grade or lower in the earlier course.

**NOTE:** If the proposed course has not been previously offered as a topics or experimental course, explain in the attached rationale statement why the course should be adopted even though it has not been tried out.

**REQUIRED ATTACHMENTS:**
1. Rationale Statement (Why is this course needed? What purposes will it serve?)
2. Impact Statement (Provide details about the Library, space, budget, and technology impacts created by adding this new course. Include supporting statements from the Library, IT Department, etc. as needed.)
3. Sample Syllabus

Department Chair Approval:  |  | Date: 1/4/13  
CCC Chair Approval:  | Bradley A. Hansen  | Date: 1-17-13  
UCC Chair Approval:  |  | Date:  

New Course Proposal Cover Sheet (July 2012)
1. **Rationale statement**
   
   We are proposing this course to meet two separate (but related) goals. First, success in the sciences can depend on the level of mathematics preparation and achievement that students have when they enter a science program. Many students now enrolling in our courses do not have the appropriate mathematics background and skills needed to succeed in the "gateway" introductory science courses. The topics and activities in the proposed course have been chosen specifically to help prepare students for the mathematics and reasoning skills needed in introductory science courses. Second, interest and achievement in science and mathematics can be developed, or hindered, by experiences our students have starting in the elementary grades. Consequently, the level of understanding and interest in mathematics and science concepts held by elementary school teachers is paramount in the development of our future mathematics and science scholars. The topics and corresponding activities for this course are developed with this goal in mind. Elementary school teachers need to share an interest in and understanding of the importance of mathematics and science with their students. This course is being developed to serve as a required course in the new B.A. in Interdisciplinary Science Studies major for students admitted to the M.S. in Elementary Education program. It will serve both the needs of future elementary school teachers and those students who are underprepared for the mathematics and reasoning skills needed for success in the sciences.

   The main resource for the development of this course is the text that we intend to use when teaching the course, *Quantitative Reasoning: Understanding the Mathematical Patterns in Nature*, by Frederick P. Greenleaf. The table of contents and several pages from the Notes to Instructors: Fall 2006 Edition that describe the development and purpose of the course have been included as an Appendix to this proposal. Briefly, the course was developed at New York University in 1993 as part of a three-course math and science sequence *Foundations of Scientific Inquiry*. The course was developed to address a series of problems faced by their students (and instructors) including math anxiety and lack of hands-on experience. It was also specifically created to develop the mathematics and science reasoning skills needed by future elementary school teachers.

   Course content will be supplemented by activities designed to develop students' mathematics skills and understanding. One possible source for additional activities, *Making Fair Comparisons: A Free Textbook for Quantitative Reasoning Courses*, by Mike Caulfield, is suggested in the proposed course syllabus. This web resource consists of six chapters that provide insights and guidance about why we make comparisons and how to do it in fair and unbiased manner. In addition to the text book material, the website contains a large number of activities, many of which provide applications of the material presented in the course text. A copy of the chapter headings is included as an Appendix to this proposal along with a collection of activities from this site that would be appropriate for this course.

   The course will be developed using a problem-solving pedagogical approach. Most class periods will include an exploratory activity where students will be encouraged and expected to develop their own understanding of the mathematics involved and its role in the science or other application involved. To build on students' problem solving skills, they will be asked to complete a project for each of the four main chapters in the course text. While the text includes example projects, individual faculty will likely develop additional projects based on their interests or appropriate "science in the news" topics.

2. **Impact Statement**

   No additional resources are needed for this course. If there is sufficient interest in the course to increase the number and frequency of offerings, the department would reallocate resources for sections of MATH 110 and MATH 115 rather than request additional instructional resources.

3. **DRAFT Syllabus**

New Course Proposal Cover Sheet (July 2012)
Quantitative Reasoning in the Sciences

MATH 120

Spring 2014

Instructor: Dr. Marie Sheckels  
Office: 123 Trinkle Hall, 654-1334, msheckel@umw.edu

Office hours: MWF 11 am to 12 noon, TR 2 to 3 pm and by appointment


Supplemental Materials: Making Fair Comparisons (http://www.makingfaircomparison.us/) free web quantitative reasoning textbook by Mike Caulfield

Goals and Objectives:
Quantitative Reasoning for the Sciences provides students with mathematical and reasoning skills needed for success in the sciences. Upon completion of the course, students will:

- Understand why mathematics is the language of science
- Translate real world problems into mathematics and solve them
- Understand how mathematics is used to model and understand nature
- Make conversions of units in physical formulas
- Model real world phenomena using geometric, exponential and logarithmic functions
- Use logarithms to rescale very large and very small phenomena
- Use the basic sampling principal to make estimates
- Use scaling and similarity transformations and geometric and trigonometric properties to understand and represent size and distance
- Use the basic counting principle and probability rules in science applications

QR Student Learning Outcomes:
1. Students will demonstrate an ability to interpret quantitative/symbolic information.
2. Students will have the ability to convert relevant information into various mathematical/analytical forms (e.g., equations, graphs, diagrams, tables, words).
3. Students will be able to apply analytical techniques or rules to solve problems in a variety of contexts.
4. Students will gain an appreciation for how analytical techniques or rules are used to address real-world problems across multiple disciplines.

Grading: Course grades will be determined using the following criteria

<table>
<thead>
<tr>
<th>Points</th>
<th>%</th>
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<tbody>
<tr>
<td>4 Chapter Tests</td>
<td>300 (75 each)</td>
</tr>
<tr>
<td>8 Homework Assignments</td>
<td>80 (10 each)</td>
</tr>
<tr>
<td>Journal Summaries</td>
<td>40</td>
</tr>
<tr>
<td>4 Chapter Projects</td>
<td>60 (15 each)</td>
</tr>
<tr>
<td>Activity Presentation</td>
<td>20</td>
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</tbody>
</table>

Total 500 100

Chapter Tests: Each of the four tests will correspond to one of the chapters in the course text:

Homework Assignments: Problems will be selected from section exercises in the text.

Journal Summaries: Most class periods will include a short exploratory activity designed to supplement textbook material. These activities will be designed to be interdisciplinary in nature, to emphasize or explain the
importance of mathematics in science and other applications. Each student is expected to keep a journal in which they summarize the activity, the mathematics involved and the role or importance of the mathematics in the application.

**Chapter Projects**: Each chapter will culminate in a project. Example projects are provided in the course text.

**Activity Presentation**: Students enrolled in the elementary education program will choose one of the exploratory activities to present to the class as an elementary school-level lesson plan. Lesson plans will include relevant NCTM (National Council of Teachers of Mathematics) Principles and Standards for School Mathematics and elements from the Common Core State Standards for Mathematical Practice and Grade Level Content. Students who are not enrolled in the elementary education program will choose a science topic to explore through course content. Possible topics include environmental issues and health or medical questions.