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: Leanna Giancarlo			Date Prepared: October 29, 2012			
Course Title:	Foundations of Chemistry					
Department/discipline and course number*:	CHEM 101					

**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**			Fall, 2013		
Proposed frequency of offering of the course:			Yearly during fall semester		
List the faculty who will likely teach the course:			All Chemistry department instructors		
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		General Elective	X
Elective in the major		General Education**	

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

Catalog Description: Foundations of Chemistry is designed to develop fundamental mathematics skills and introduce foundational chemistry concepts underlying this central science. The use of mathematics is stressed in the context of chemical problems involving measurement, atoms, molecules, reactions and solutions. This course prepares students interested in pursuing a science major for the General Chemistry course curriculum. This course does not count toward the chemistry major, minor nor fulfillment of the General Education requirement in the Natural Sciences.

COURSE HISTORY					
Was this course taught previously as a topics or experimental course?	**YES**		**NO**	**X**	
Course Number and Title of Previous Course	**Semester Offered**				**Enrollment**

	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: Leanna Giancarlo **Date:** 10/29/2012

CCC Chair Approval: Bradley Hansen **Date:** 11/9/12

UCC Chair Approval: _____ **Date:** _____

Rationale Statement:

Over the past ten years, the Chemistry Department has observed declining rates of success in our General Chemistry (CHEM 111/112) courses. While the overall enrollment in CHEM 111 has grown during this same time period, the number of students served by CHEM 112 has remained alarmingly constant due to lack of retention (since many students with D's in CHEM 111 enrolling in CHEM 112 do not finish the course). As seen in Figures 1 and 2, the number of students finishing these prerequisite courses for both the Chemistry major and other science majors, including Biology and Earth and Environmental Sciences, with a D or F has been rising.

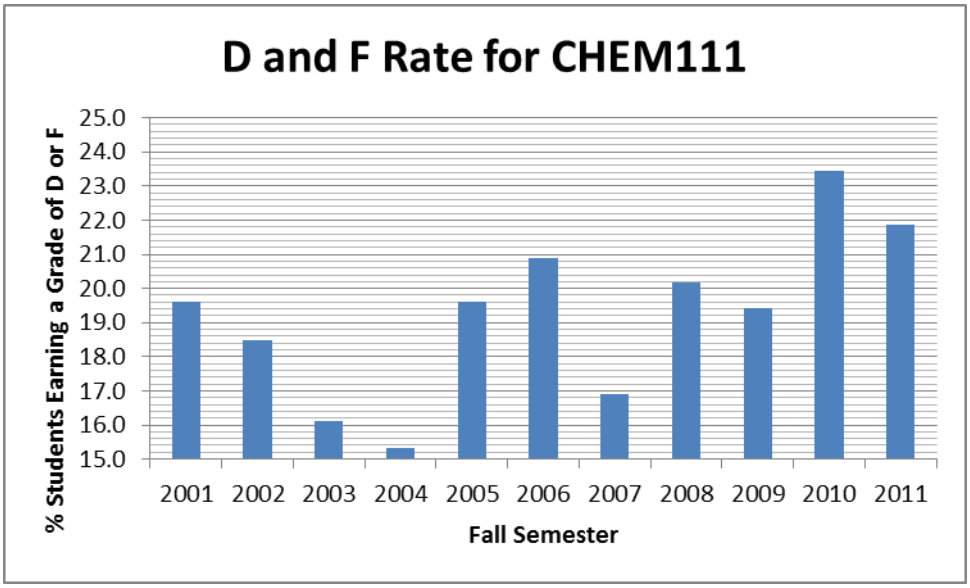

Figure 1. Percentage of student completing CHEM111 (General Chemistry I) with a grade of D or F from fall 2001 to fall 2011.

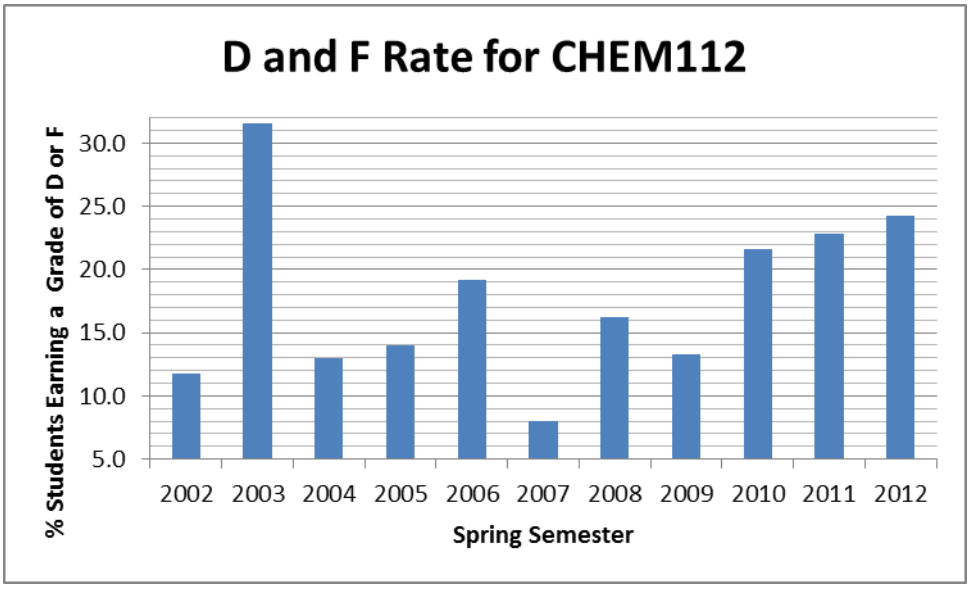

Figure 2. Percentage of students completing CHEM 112 (General Chemistry II) with a grade of D or F from spring 2002 to spring 2012.

Anecdotally, the General Chemistry instructors have seen declines in mathematical reasoning and problem-solving solving skills for the students enrolled in their classes in recent years. This observation is not unique to our institution, and other four-year colleges and universities are beginning to offer preparatory courses to students to aid in their success in courses like General Chemistry.[1,2] Test results for the entering class of 2016, using the Toledo examination from the American Chemical Society, indicate between 20 and 210 students out of 264, based upon differing models of proficiency, are lacking in fundamental chemical concepts, basic math strategies, or both.[2,3] The Chemistry Department sees a need to institute a preparatory course to aid those students with weaker math or chemical science skills.

During the pre-orientation program in the summer preceding their first fall semester, entering freshmen would take the 60 question Toledo examination. Based upon fall 2012 results, students with an overall score of 30 or less (less than or equal to 50% correct) would receive a recommendation to enroll in CHEM 101, Foundations of Chemistry, rather than CHEM 111, General Chemistry, for the upcoming fall semester.[3,4] Using fall 2012 as a guide, this would result in approximately 70 students for this one-semester course. Since CHEM 101 will be offered without a laboratory component, a single section of CHEM 101 could be set as high as 35 in order to accommodate this number of students. Since students would not be "forced" into a particular sequence of Chemistry courses (i.e., students could disregard the recommendation to enroll in CHEM 101 in much the same way as they can disregard their placement suggested by the foreign language exam), this number could be lower.

This course has not been offered as a special topics course, since the course content is a subset of the material in our current General Chemistry curriculum with greater emphasis on mathematical reasoning and problem-solving strategies. As such, it does not seem appropriate to offer it as a special topic when the course is meant to build skills prior to enrollment in the first pre-requisite course in the Chemistry major. In addition to the abbreviated coverage of traditional General Chemistry topics, as suggested by the sample syllabus provided, students taking CHEM 101 will be exposed to greater depth in problem solving and a significant amount of team work strategies. The course will present the fundamental concepts upon which CHEM 111 relies, namely measurement, atomic structure, reactions (emphasizing stoichiometry) and aqueous solutions. (These topics typically comprise the first four chapters of a General Chemistry textbook and are covered in the first four weeks of CHEM 111.) A student successfully completing CHEM 101 could then enroll in CHEM 111, General Chemistry I, for the spring semester presumably with a firmer grasp of the initial material for this course. CHEM 112 could be finished over the summer or during the subsequent spring semester.

Impact Statement:

CHEM 101, Foundations of Chemistry, would not require any additional personnel or resources (library, IT, space, etc.). In fact, this course can be easily staffed by shifting current CHEM 111, General Chemistry, instructors. For example, if placement testing reveals a need for two sections of CHEM 101, then two fewer sections of CHEM 111 will need to be offered, enabling the department to shift instructors from one course to the other. Since CHEM 111 seats are typically filled by entering first-year students, the seats made

available to upperclassmen during pre-registration will see little, if any, impact. During the spring semester, again the "trailer" section(s) of CHEM 111 can be taught by faculty who would have been instructing CHEM 112, since fewer sections of the latter course would be required. Students following a CHEM 101, 111, 112 sequence are only impacted in that they would need to take CHEM 112 during summer in order to meet specific major pre-requisites; however, the Chemistry Department has plans to offer a 10-week CHEM 112 course from May-July to alleviate any delay in completing a science major. In terms of impact on student learning, the CHEM 101 course can serve as a bridge to the STEM (Science, Technology, Engineering and Mathematics) disciplines, including the chemistry major, and may increase the number of students who successfully major in science who might otherwise drop out because they lack the needed basics upon admission to Mary Washington.

---

1. Tom Loveless, *The 2002 Brown Center Report on American Education* (Brookings Institution Press, 2002), 6-12
2. The large difference in these numbers is due to a lack of consistency on what constitutes proficiency in these critical math and science skills. 20 and 210 are derived from the standards at the University of Detriot-Mercy and New Jersey Institute of Technology (NJIT); both utilize the Toledo examination for placement of students in the appropriate coursework within their Chemistry curricula. Ironically, the University of Toledo, which also requires a placement examination for admission into General Chemistry, administers a different vetted assessment. The Chemistry Department at Virginia Commonwealth University has a similar course (CHEM 100, Introductory Chemistry) to what is proposed here. Their CHEM 100 course has been in existence for the past 25 years as a mechanism to provide basic chemistry knowledge and math skills to students with no preparation. In the past, VCU used an in-house examination for placement but did not find that the placements were accurate. At present, advisors examine previous high school chemistry, math SAT scores and high school GPA; however, this is also not always accurate. Some of the current CHEM 100 instructors are now experimenting with ALEKS, an on-line assessment and learning program. In part their course description reads, "A course in the elementary principles of chemistry for individuals who do not meet the criteria for enrollment in CHEM 101 [General Chemistry at VCU]; required for all students without a high school chemistry background who need to take CHEM 101-102. These credits may not be used to satisfy any chemistry course requirements in the College of Humanities and Sciences." VCU serves 400 – 500 students in CHEM 100 and 1200 students in CHEM 101, General Chemistry.
3. The University of Detroit-Mercy **requires** a score of greater than 40 (out of 60 questions) on the Toledo examination or a score of 20 on the mathematics questions (questions 1 – 20 of this assessment are strictly math) for admittance to the equivalent of our CHEM 111 course; NJIT **requires** greater than 42% correct for permission to enroll in their CHEM 111 equivalent. We would be recommending a specific course sequence (CHEM 101,111,112 vs. CHEM 111,112).
4. A comparative analysis between the scores on the first CHEM 111 examination during fall 2012 and scores on the Toledo Exam reveals that only 15 out of 54 students with a 30 or under on the Toledo Exam passed the first in-class CHEM 111 test.

Foundations of Chemistry: Fall 2013
Chemistry 101

Instructor:

Dr. Leanna C. Giancarlo

Office: 341 Jepson

Phone: 654-1407
email: lgiancar@umw.edu
website: http://canvas.umw.edu

Lecture: MWF 9:00 – 9:50 a.m.; Jepson 219

Office Hours:

MW 10:00 am - 12:00 pm
F 10:00 – 11:00 am
or by appointment

Required Course Materials:

Text: Dahm, Donald J. and Nelson, Eric A., *Calculations in Chemistry* Custom edition or 1st edition
CHEM 101 Course Pack

Calculator: with scientific notation and logarithmic/exponential functions; you will use the department's Casio FX260 solar for ALL examinations. Cellular phones are not permitted on exam days
On-line homework: https://www.saplinglearning.com/

Recommended Course Materials:

Ball, David W., *Essential Algebra for Chemistry Students,* 2nd Edition

Course Description and Objectives: Chemistry is a quantitative science and is grounded in a mathematical and experimentally derived description of nature. This course is designed to develop fundamental mathematics skills and introduce foundational chemistry concepts for students intending to major in a scientific field and who will subsequently enroll in General Chemistry. Use of mathematics will be stressed in the context of chemical problems involving measurement, atoms, molecules, reactions (stoichiometry) and aqueous solutions.

The course is centered around development of critical thinking and problem-solving skills, especially those required to successfully navigate the "word problems" that comprise a mathematical and experimental science like Chemistry. Problem-solving skills and strategies are emphasized in accord with the numerical literacy inherent in the discipline. To succeed in this course, these problem-solving skills must be practiced and developed. By attending lectures faithfully and completing the suggested practice problems and

assignments, each student can begin to acquire the skills necessary to become a critical thinker. After completing the course, a student should

- Understand how to extract information from a chemical "word problem"
- Develop fundamental number skills related to solving chemical problems
- Be able to use information to solve problems related to chemical principles involving measurement, atomic structure, reactions (stoichiometry) and aqueous solutions

Grading:

3 Hourly Exams at 150 points each	450 points
Graded Team Activities (10 at 10 points each)	100
Online Homework (best 10 at 10 points each)	100
End of Chapter Quizzes (best 10 of 12 at 10 points each)	100
Cumulative Final Exam at 250 points	250

Students with an exam average of C or less will receive a midsemester report.

Grades will be determined on the following point scale

Points accumulated	**Letter Grade**	**Points accumulated**	**Letter Grade**
≥ 930 points	A	769 – 730 points	C
929 – 900 points	A-	729 – 700 points	C-
899 – 870 points	B+	699 – 650 points	D+
869 – 830 points	B	649 – 600 points	D
829 – 800 points	B-	below 600 points	F
799 – 770 points	C+		

Honor System: All graded work (hourly exams, online exercises, extra credit assignments, *graded* assignments, final exam) must be your own and pledged as such:
I hereby declare upon my word of honor that I have neither given nor received any unauthorized help on this work. *Signed*
Online assignments are deemed pledged by your submission. It is recommended that the *suggested* problems (i.e. not submitted for a grade) be done individually and then as a group when questions arise. **No late assignments will be accepted**. Please, discuss difficulties with the homework problems or lecture material with me.

Class Attendance: Class attendance is highly recommended. The material discussed in lecture frequently has a different emphasis than that provided by the textbook. Also, time has been set aside in the course schedule to discuss example problems. Students are responsible for all covered materials during a missed class. Missed exams **cannot** be made up. Exams will be rescheduled in the event of an excused absence due to an emergency. (Immediate notification of the instructor is mandatory). Lateness to lecture

is distracting, and students should attempt to be on time. Lateness to an exam will result in less time allowed for completion of the exam.

Team Activities: Each Friday, there will be a graded team activity to be completed by students in teams of 3 or 4. Teams will be chosen periodically and teammates will be changed periodically throughout the semester. The team activities are denoted by the "Practice" in the schedule given below. The activities must be submitted by the end of the class period and will be graded; these serve as 10% of your grade. You must also individually complete an evaluation of team work for you and your teammates which will be due at the start of lecture the next Monday. Failure to do so (or complete the assignment as a team) will result in a grade reduction of up to 3 points per assignment.

Online Homework: At the end of each chapter or section of material approximately 10 questions (numerical answer/ fill-in) will be assigned from Sapling Learning (https://www.saplinglearning.com/). These questions will correlate with practice textbook problems. Answers must be submitted through the online program by the due date and time. You may use your textbook and notes to complete the problems; however, you may not consult with anyone other than your instructor, including on-line personas, about them. Electronic submission constitutes your abiding by the Mary Washington Honor Code.

Quizzes: At the end of each chapter there will be a quiz on the material that was presented. These in-class assessments will examine your knowledge of fundamental concepts and math skills and typically take 10 minutes.

Disability Services: The Office of Disability Services has been designated by the University as the primary office to guide, counsel, and assist students with disabilities. You will need to request appropriate accommodations through this office as soon as possible and then make an appointment with me to discuss your approved accommodation needs. I will hold any information you share with me in the strictest confidence unless you give me permission otherwise.

Other "helpful" information:
The tentative schedule that follows is how I see the course arranged. It is not concrete. If there is material that you, as a class, find confusing, we will spend more time on that topic. The exam dates will remain set according to the schedule. If all of the "scheduled" material has not been presented prior to the exam, the exam will include only what has been covered.
Success in chemistry requires considerable work on your part. Successful students typically spend a minimum of 1 hour per day on chemistry. This time is devoted to reviewing notes, attempting the suggested/assigned problems and reading ahead for the next lecture. Some of their "secrets" include (but are not limited to)

- reading the material prior to class.
- attending the lectures.
- taking good notes.

- utilizing the website that is supplemental to your text book. (There are excellent graphics and animations for nearly all of the chapters. This should facilitate your understanding of the "big picture" by providing a visualization of the complicated mathematics associated with physical chemistry.)
- asking questions. (The only "stupid" question is the one that goes unasked.)
- solving the suggested problems for each chapter. (Attempting extra problems is also a great idea. As in all aspects of life, "practice makes perfect".)
- consulting your peers when you are struggling with the solution to a suggested problem. (First, they may have a different slant or see the problem in a different light. Second, scientists typically work in teams. Each member of the team is responsible for a particular aspect of the problem; therefore, each scientist must understand what each of the other members of the team does and have requisite background knowledge.)
- enlisting the aid of the instructor (office hours or appointments, before or after class).
- reviewing the appropriate sections of the text and all notes after class.
- attempting all suggested and assigned (team activity) problems by yourself
- reviewing topics from prerequisite courses.

Course Outline:	**Chapters**
Scientific Notation and Calculators	Chapter 1
Metric System and Units	Chapter 2
Significant Figures	Chapter 3
Conversion Factors	Chapter 4
Word Problems	Chapter 5
Atoms, Ions and the Periodic Table	Chapter 6
Chemical Names and Formulas	Chapter 7
Grams and Moles	Chapter 8
Reactions and Stoichiometry (Moles to Moles)	Chapter 9
Solution Concentration (Molarity)	Chapter 10
Dimensions with Denominators	Chapter 11
Molarity Application (Dilution)	Chapter 12

8/27: Intro/Chapter 1	8/29: Chapter 1	8/31: Chapter 1 Practice
9/3: Chapter 2	9/5: Chapter 2	9/7: Chapter 2 Practice
9/10: Chapter 3	9/12: Chapter 3	9/14: Chapter 3 Practice
9/17: Chapter 4	9/19: Chapter 4	9/21: **Exam #1**
9/24: Chapter 5	9/26: Chapter 5	9/28: Chapters 4 and 5 Practice
10/1: Chapters 6	10/3: Chapters 6	10/5: Chapter 6 Practice
10/8: Chapter 7	10/10: Chapter 7	10/12: Chapter 7 Practice
10/15: FALL BREAK	10/17: Chapter 8	10/19: **Exam #2**
10/22: Chapter 8	10/24: Chapter 8	10/26: Chapter 8 Practice
10/29: Chapter 9	10/31: Chapter 9	11/2: Chapter 9 Practice
11/5: Chapter 9	11/7: Chapter 10	11/9: Chapters 9 & 10 Practice
11/12: Chapter 10	11/14: Chapter 11	11/16: Chapter 11 Practice
11/19: Chapter 11	11/21: BREAK	11/23: BREAK
11/26: Chapter 11	11/28: Chapter 12	11/30: **Exam #3**
12/3: Chapter 12	12/5: Chapter 12	12/7: (Chapter 18) review

Final Exam: Monday, December 10, 2013; 8:30 – 11:00 am

In-Class Exercise on Concentration and Dilution, Chapter 12

Name _____

Teammates_____

1) Units (Chapter 2), metric conversions (Chapter 4) and math review (10 points): The plastic bag has the dimensions 16.5 cm x 14 cm x 2.5 cm.
   a) What is the volume of the bag in cm^3
   b) What is the volume of the bag in mL?
   c) What is the volume of the bag in L?

2) Open the plastic bag containing m&m's or Skittles. DO NOT EAT ANY. Identify the numbers of colored pieces present in your sample

Color	Number of Candies Present
Total number of candies	

(5 points)

3) Each candy piece has a molar mass of 5 g/mol of candy piece. You can assume that the numbers counted above have the units of moles.

   a. Calculate the moles of total candies in the mixture. (Chapter 8 and 9 reviews)
   b. Calculate the moles of red candies in the mixture.
   c. Divide the number of moles of total candies by the volume of the bag from number 1 above. This is the molarity of candies in the sample.
   d. Divide the number of moles of red candies in the mixture by the volume of the bag. This is the molarity of red candies in the sample.

   (20 points)

4) Suppose you pour your candies into a gallon sized Ziploc bag. What happens to the sample and the concentration? Does the number of moles change? Does the volume change? (5 points)

5) Team Evaluation form: to be completed by each team member individually. (10 points)

Team Evaluation Form
Chem 101

Name: _____ Team: _____

Identify the percent contribution of each team member made in this investigation in the table below. List your own name and contribution first.

Name:	Role: (Calculator, Recorder, Communicator, Researcher)	Percent Contribution

Describe your contribution to the completion of the in-class assignment: did you effective fulfill your team role? Did you see places where you could have improved your performance or the team's performance? Did you come prepared to tackle the assignment?

Describe the contributions of each of your team members and your assessment of the effectiveness of those contributions.

Describe what you learned from this project concerning (a) your ability to work in a team and (b) your understanding of scientific concepts, data analysis, etc.

What could you do to improve your learning and the team's learning?