Matter and Motion, 2015-16

Program Syllabus – Fall Quarter

sites.evergreen.edu/mnm1516

Matter and Motion is a full-time three-quarter interdisciplinary program that integrates the study of mathematics, chemistry, and physics and places them in their cultural and historical context as exemplars of human experience, endeavor, and achievement. Calculus and physics will be covered in all three quarters, and chemistry in fall and winter. Upon completion, students will have gained hands-on experience with and a working knowledge of scientific and mathematical concepts and laboratory techniques, an ability to reason critically about and solve applied and fundamental problems in math, chemistry, and physics, and an increased understanding of how issues of power, identity, privilege, and equity intersect with the teaching, learning, and practice of math and science.

Students who successfully complete the fall quarter of this program should achieve process skills and content mastery equivalent to:

- one quarter of differential calculus (suggested course equivalency: 5 credits in Calculus I with Lab);
- one quarter of calculus-based physics (classical mechanics) with lab (5 credits in University Physics I with Lab);
- one quarter of general chemistry (6 credits in General Chemistry I with Lab)

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Required Texts & Materials

You must have access to your own copy of the program texts, as full participation in class activities requires your own copy to work from (electronic versions are acceptable as long as you have the capacity to annotate and keep up with the class discussion).

- ***Chemistry: An Atoms First Approach*** (Zumdahl, 1st edition), ISBN-10: 0840065329, ISBN-13: 9780840065322
- ***Calculus: Single and Multivariable, 6th Edition*** plus **WileyPLUS Registration Card** (Hughes-Hallet 2013, 6th edition), ISBN-10: 1118562402, ISBN-13: 9781118562406). In addition to the textbook, you must also get access to the online system WileyPLUS.
- ***Physics for Scientists and Engineers with Modern Physics, 3rd edition*** plus ***Student Workbook*** plus **MasteringPhysics with eText – Access Card Package** (Knight 2013, 3rd edition), ISBN-10: 0321844351, ISBN-13: 9780321844354. In addition to the textbook, you must also get the student workbook and access to the online homework and tutorial system MasteringPhysics.

- A scientific calculator that, in addition to the basic arithmetic functions, is capable of powers, roots, trigonometric functions (sin, cos, tan), exponential and logarithmic functions, and the inverse of those functions. A graphing calculator is fine, as is one of the many calculator apps (free or inexpensive) available for smartphones.

- 1 pair of lab goggles for chemistry, available for purchase at the Science Support Center on the 2nd floor of Lab 1.

- 3-ring binder.
- 1 bound notebook for math and physics lab notes. We recommend but don't require graph paper pages and pages large enough to attach handouts, printouts, graphs, etc.
- 1 bound notebook for chemistry lab notes.
- Bound notebook(s) for calculus and physics problem sets in their raw and revised versions. We recommend but don't require graph paper pages and pages large enough to attach handouts, printouts, graphs, etc. You may choose to have separate notebooks for calculus and physics problem sets.

Program Learning Goals

Through your work in fall quarter, you will have the opportunity to:

- Improve your ability to articulate and assume responsibility for your own work.
- Strengthen your collaborative skills and the ability to respond in useful ways to the work of colleagues.
- Improve your skills in clear communication of mathematical and scientific ideas, both orally and in writing.
- Improve your ability to read technical textbooks with focus on developing conceptual understanding and procedural skills.

- Explore how issues of power, identity, privilege, and equity intersect with the teaching, learning, and practice of math and science.

- Gain a firm understanding of the concepts of function, slope, and limits, which provide the backdrop for calculus.
- Learn the definition of the derivative and be able to relate it to algebraic, numerical, graphical, or verbal descriptions and data.
- Learn to calculate derivatives using a variety of standard techniques.
- Learn to use derivatives in applied problems, particularly in the context of the physical sciences.

- Utilize the mathematical models that describe and explain motion in the natural world.
- Understand that physics is based on a few key principles that can be applied to a wide range of natural phenomena.
- Use the main ideas of classical mechanics (kinematics to describe motion and changes in motion, and dynamics and conservation principles to understand what causes changes in motion and what limits those changes) to solve fundamental and applied problems.
- Experience that physics is both a mathematical and an experimental science.

- Understand the structure of the periodic table and how it relates to chemical bonding and shapes of molecules.
- Learn about chemical reactions and their products in the context of laboratory and everyday phenomena.
- Learn to use fundamental lab tools and apply these to investigate chemical and physical properties of solids, liquids, and gases.
- Explore lab-based scientific inquiry through making a testable hypothesis, carrying out experiments, and data analysis with comparisons to literature and peer results.

Our work will take place in the context of an Evergreen learning community, and we will be responsible for our interactions within the group as well as our individual learning. In this context, it is important to keep in mind the institutional-level expectations and approaches that form the backdrop of our work together. These are articulated by the College in terms of the “Six Expectations” and “Five Foci”, as follows:

Expectations of an Evergreen Graduate:

- Articulate and assume responsibility for your own work.
- Participate collaboratively and responsibly in our diverse society.
- Communicate creatively and effectively. Demonstrate integrative, independent, critical thinking.
- Apply qualitative, quantitative and creative modes of inquiry appropriately to practical and theoretical problems across disciplines.
- As a culmination of your education, demonstrate depth, breadth and synthesis of learning and the ability to reflect on the personal and social significance of that learning.

Five Foci of Learning:

- Interdisciplinary Study
- Collaborative Learning
- Learning Across Significant Differences
- Personal Engagement
- Linking Theory with Practical Applications

In all areas of the program, credit will be awarded based on: attendance, participation, and effort; timely submission of assignments; and demonstrated understanding of the material. All of these will be evaluated with the program learning goals in mind.

Schedule of Activities, Assignments, and Assessments

- All students will participate in weekly ***Lectures***, ***Labs***, ***Workshops***, ***Problem Sessions*** and occasional ***Seminars***.
- Regular weekly assignments include ***Reading Assignments***, ***Reading Responses***, ***Pre-labs***, ***Post-labs***, and ***Problem Sets***. Each week there will be a ***Quiz***. In weeks 5 and 10, there will be ***Exams*** in each subject area. There will be occasional ***Seminar Writing Assignments***. Throughout the quarter, you will maintain a ***Portfolio*** of your work.

Monday	Tuesday	Wednesday	Thursday
9:00 – 10:00 Quiz CAL West (Lab 2 1223A)	9:00 – 12:00 Physics Lab & Lecture Lab 2 2238	9:00 – 10:00 Physics Lecture Lab 2 2238	9:00 – 12:00 Chemistry Lab Lab 2 2238
10:15 – 11:45 Math Lab CAL West		10:15 – 11:15 Calculus Lecture Lab 2 2238	
		11:30 – 1:00 Chemistry Workshop Lab 2 2238	
1:00 – 1:50 Calculus Lecture Lab 2 2238	1:00 – 1:50 Chemistry Lecture Lab 2 2238		1:00 – 2:00 Physics Problem Session Lab 2 2238
2:00 – 2:50 Chemistry Lecture Lab 2 2238			2:15 – 3:15 Calculus Problem Session Lab 2 2238

	Math	Physics	Chemistry
Sun	Complete Reading Assignment to prepare for week's Lectures; Submit Reading Response via our program website by 8 pm; Study for Mon. Quiz	Complete Reading Assignment to prepare for week's Lecture; Study for Mon. Quiz	Complete Reading Assignment to prepare for week's Lectures; Submit Reading Response via our program website by 8 pm; Study for Mon. Quiz
Mon	*Quiz, Lab, Lecture* start Problem Set problems to prepare for Problem Session; Finish Lab	*Quiz* Submit Reading Response via MasteringPhysics by Monday at 8 pm;	*Quiz, Lecture* Review Reading Assignment to prepare for Tue. lecture; Finish Postlab assignment
Tue	Review Reading Assignment to prepare for Wed. Lecture	*Lab, Lecture* Review Reading Assignment to prepare for Wed. Lecture; Finish physics Lab; start Problem Set problems to prepare for Problem Session;	*Lecture* Submit Post-lab Assignment in class at 9 am;
Wed	*Lecture* Attempt all Problem Set problems to prepare for Problem Session	*Lecture* Attempt all Problem Set problems to prepare for Problem Session	*Workshop* Read lab protocol and complete Pre-lab Assignment
Thu	*Problem Session* Work to complete math homework	*Problem Session* Work to complete physics homework	*Lab* Work to complete chemistry homework
Fri/Sat	Submit calculus Problem Set via WileyPlus by Fri at 9 pm	Submit physics Problem Set via MasteringPhysics by Sat at 9 pm	Submit chemistry Problem Set to box outside faculty office Lab 2 3271 by Fri at 9 am

Activities Overview

Lectures: In our interactive Lectures, we will provide context for the program content and skills, work through conceptual difficulties, make connections between our various topics and texts, and gather questions. You prepare for Lecture by completing the assigned reading before coming to Lecture and taking reading notes. You participate during Lecture by taking lecture notes and engaging in lecture discussion and activities. You follow through on Lecture by preparing for the associated Problem Session and Workshop.

Math and Physics Problem Sessions: A collaborative Problem Session is associated with the Math and Physics Lectures and occurs on Thursday afternoon. A set of homework problems will be assigned for each Problem Session. You prepare for Problem Session by attempting to complete all problems before Problem Session, documenting your work in your problem set notebook, and bringing your complete and incomplete problems to Problem Session. You participate in Problem Session by working in small groups to understand and explain problems that posed particular challenges to you or any group member, with the goal of improving both your private internal understanding and your public external communication of that understanding, and documenting your work in your problem set notebook. The emphasis during Problem Session will be on collaborative learning and communication about math and physics; the goals of the session are as much about mathematics/physics process and discourse as they are about problem-solving. You follow through on Problem Session by updating and completing your problem set notebook and by submitting your Problem Sets (as described below).

Chemistry Workshops: In Workshop you will have the opportunity to work collaboratively on problems that support the Problem Set and Lecture material. The problems presented in Workshop will tend to be more in-depth and open-ended to facilitate group discussion. You will be encouraged to present solutions to the class to reinforce learning and practice your communication skills. Attempting the Problem Set before Workshop is not required but it will help you use Workshop time more effectively. At the end of each Workshop you hold on to your completed problems for study material. Any unfinished problems can be attempted as further practice to prepare for quizzes and exams.

Labs: Labs will give students opportunities to discover or apply mathematics, physics, or chemistry concepts or principles and to develop hands-on experience and transferable skills with equipment and computers in a structured and supportive environment. Labs will emphasize teamwork and communication capacities, observation and record-keeping skills, and problem-solving and analysis. For calculus and physics, you will not need to prepare for lab sessions; exceptions will be clearly noted with sufficient lead time. For chemistry, there will be a weekly Pre-lab Assignment due that the start of the chemistry lab (as described below). You participate in Lab by engaging appropriately in the assigned activities and documenting your work in your notebook. You follow through on Lab by completing any analysis or questions that remain. For chemistry lab, you will complete a Post-lab Assignment (described below).

Seminars: Three or four seminars will be held throughout the quarter with two related goals in mind: to work on Academic Statement writing and to facilitate group discussion about how the issues of power, identity, privilege, and equity intersect with the teaching, learning, and practice of math and science. You will prepare for seminar by completing assigned seminar readings and completing pre-seminar writing assignments.

Assignments and Assessments Overview

Reading Assignments*:* Each week, you will have Reading Assignments from the chemistry, math, and physics textbooks. Details of Reading Assignments are provided at the Calendar links at the program website.

- Math and Chemistry Reading Assignments must be completed in time for you to submit your Reading Response by 8 pm Sunday (see below)
- Physics Reading Assignments must be completed in time for you to submit your Reading Response by 8 pm Monday (see below).

Reading Responses: For each week's Reading Assignment, you will complete a Reading Response for math, chemistry, and physics. The Reading Responses are intended to help you keep up with the reading, orient you to the material for the upcoming week, and to give your instructors feedback on how best to use our class time, based on what you have difficulty with. You are welcome to use your book and other resources to complete the Reading Response, but should take it individually. Reading Responses are due on-line using a form at the program website by Sundays at 8 pm for math and chemistry, and via MasteringPhysics by Mondays at 8 pm for physics. If you don't have web access on Sunday, there are alternatives; please come speak with us.

Problem Sets: Problem Sets in calculus, chemistry and physics give you practice with important basic concepts and calculations, as well as with problems that are generally richer and more complicated, requiring an application of concepts and skills beyond the basics.

- **Chemistry**: You submit neatly written up solutions to the Chemistry Problem Set, due to the faculty office (Lab 2 3271) no later than Friday 9 am.
- **Math and Physics**: You should attempt all problems on the math and physics Problem Sets before the associated Problem Session. You submit selected problems from the week's Problem Set for assessment. For calculus, you submit your answers via WileyPLUS no later than Friday 9 pm. For physics, you submit your answers via MasteringPhysics no later than Saturday 9 pm. In addition, clear and complete written solutions to Problem Sets are required in your Problem Set notebook, which may be checked during the quarter.

Pre-labs: Weekly Pre-lab assignments in chemistry will consist of a few short questions to familiarize you with the material for each week's chemistry lab. The Pre-lab will be posted along with the lab protocol each week on our program website. To complete the Pre-lab, you will be asked to read the lab procedure and describe the measurements to be made. You will also have an opportunity to discuss experimental design and alternative approaches to answering the scientific questions for each lab. Lastly, the Pre-lab assignments will have you connect the lab experiment topics with the relevant Lecture and Problem Set material. The Pre-lab should be completed on its own paper (not in the lab notebook) and submitted 9 am on Thursday at the beginning of lab.

Post-labs: Each chemistry lab will have an associated Post-lab assignment to cover any calculations and analysis not completed in lab. The Post-lap is also an opportunity to synthesize the concepts covered in lab and make connections to broader topics. Error analysis is also an important part of the Post-lab. You will be asked to analyze the reliability of your results and discuss the implications for experimental design. The Post-lab assignment should be completed on its own paper and turned in at the beginning of class on Tuesday 9 am.

Quizzes: There will be an in-class Quiz each Monday at 9 am. The Quiz will cover math, chemistry, and physics material primarily from the previous week. Quizzes will help you and us keep track of your understanding of the material. The quiz problems will often be very similar or identical to homework, workshop, and lab problems from the previous week. To study for the quiz, the most important work you can do is to complete the labs and especially the homework and check your answers against provided solutions. Make use of QuaSR resources and tutors as well as classmates, tutors, and faculty, along with other appropriate resources to be sure you understand the homework problems in advance of the quiz. If you are concerned about your performance on any Quiz, you can revise that Quiz and submit the revision in your Portfolio.

Exams: There will be in-class Exams in weeks 5 and 10 in calculus, chemistry and physics. These exams offer you an opportunity to demonstrate what you have learned through reading, lectures, labs, homework, and other program activities. Details about Exam Revision opportunities will be provided after Exams are returned.

Seminar Writing Assignments: Details of Seminar Writing Assignments will be announced with sufficient advance notice before the occasional Seminars. There will be Pre-Seminar Writing and Post-Seminar Writing associated with the seminar reading, and also writing designed to support Academic Statements.

Portfolio*:* Throughout the program, you will maintain a portfolio of your work consisting of all the above assignments and assessments as well as any notes or other material that reflect your work. The portfolio will be submitted at the end of week 10 and will inform faculty evaluations. It will also provide a lasting record and resource for your own future reference. In addition to the above assignments and assessments, your Portfolio will also include a Self-Evaluation and updated Academic Statement.

- ***Self-Evaluation***: Each student is required to write and submit to faculty an evaluation of their own work and achievements in the program. Short evaluation writing workshops will help you through this process.
- ***Academic Statement***: Each student is required to write and submit to faculty an updated draft of their Academic Statement. We will devote six hours of class time in fall quarter to support students in writing or updating their Academic Statement; this work will also support self-evaluation writing.

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Tentative Schedule of Reading Assignments

(may be subject to change)

Week	Math	Physics	Chemistry	Seminar	Notes
1	p. xi, 1.7, 1.8 (review 1.1 – 1.6)	p. xv-xix, p. xxix - xxi, p. 1, Ch. 1	p. xv, Ch. R - Ch. 1		
2	2.1, 2.2, 2.3	Ch. 2, Ch. 3	Ch. 2		
3	2.4, 2.5, 2.6	Ch. 4, Ch. 5	Ch. 3.1 - 4.10		
4	3.1, 3.2, 3.3	Ch. 6, Ch. 7	Ch. 4.10 - 5.6	TBA	
5	Exam	Exam	Exam		Midterm Exams, all subjects
6	3.4, 3.5, 3.6	Ch. 8, Ch. 9	Ch. 6.1 - 7.3	TBA	
7	3.7, 3.10	Ch. 10	Ch. 7.3 - 7.9		Veteran's Day Holiday – Wed. 11/11 (no class meetings)
8	4.1, 4.2, 4.3	Ch. 10, Ch. 11	Ch. 9.1 - 10.4	TBA	
Thanksgiving Break (Mon. Nov. 23 – Sun. Nov. 29)					No class meetings this week
9	4.4, 4.6, 4.7	Ch. 12	Ch. 10.5, 8.1, 11.1-11.7	TBA	(optional) Linus Pauling Symposium, Sat. Dec. 5 (all day), Oregon State University http://chemistry.oregonstate.edu/2015LinusPaulingMedal
10	Exam	Exam	Exam		Final Exams, all subjects Portfolios due end Fri. Dec. 11
Evaluation Week (Mon. Dec. 14 – Fri. Dec. 18)					Evaluation Conferences begin Wed. Dec. 16