



Course Syllabus Template

New: All Courses = 36 Hours

Spring Term –February 7, 2011 to June 12, 2011

Please complete a full course syllabus using this format. The number of sessions held will depend on how you allocate the 36 hours. This syllabus will be uploaded to the ASPDP web site. Please be sure it is in a word or PDF document format.

Title of Course: Partnership in Experimental Physical Science Education: Summer Workshop

Course Code:

Course Location: Steinman Hall, T312

Instructor's Name: Raymond Tu

Instructor's Telephone #: 212-650-7031 **E-mail:** tu@ccny.cuny.edu

Course Begins: July 5th **Course Ends:** July 15th **Total Hours:** 36

Course Description

Use same course description from catalogue.

This course offering in the physical sciences is designed to enhance participant knowledge and practice of experimental research methods in material science. The content of this course is multidisciplinary, introducing concepts and applications of engineering, chemistry, physics and mathematics through the lens of contemporary research methodologies and guided inquiry. The course is intended for physical science educators who are interested in developing a set of hands-on experimental teaching modules (ETMs) for implementation in high school physical science courses.

The theoretical bases for the proposed ETMs are the pedagogical philosophy of constructivism [Bransford, J.; Brown, A. L.; and Cocking, R. R. 2000], [Brooks, J. G. and Brooks, M.G., 1999] and the methods of directed inquiry and active learning [Their, H., 2001]. Students learn through actively engaging with the relevant concepts and methods in a series of hands-on experimentation to answer open-ended questions that are relevant to current issues in academics and industry. To this end, lessons are structured to develop understanding of key concepts at both fundamental and applied levels. The content of an ETM is constructed to parallel the educational/learning standards for the high school grade level and school system. ETMs are also designed to encourage integration with other subjects in the curriculum. For example, concepts of visco-elasticity can connect the chemistry of polymers with the physics of fluid mechanics. Subsequently, a set of design questions can be introduced where simple mathematical tools can lead students towards the implementation of visco-elastic materials. The fundamental principles are directly applied in the engineering of a variety of materials from drug delivery vehicles to novel light-weight body armor. The long-term goal of the program is to empower science educators to help build collaborative partnerships between teachers, and the university research community to address key education and research objectives recognized by the National Science Foundation. Such partnerships will serve to better prepare students for the rigors of college STEM studies.

Calendar	
Session # 1 Date: July 5 th 2011	Time: 10:00 am – 2:15pm (*15minute break)
Number of hours for this session: 4 instructional hours + 15 minute break	
Topics: List session topic and material, e.g. handouts. Indicate midterm and final exam date.	
(1) Orientation – Goals (20 mins) (2) Review of learning standards for high school science, math, and ELA. (45 minutes) (3) Introduction – Modern materials (30 minutes) (4) Design exercise – Scaffold Design (the power of benchmarking) (25 minutes) *15 minute break (5) Guest Lecture – Jeff Morris “Fluid mechanics and multiphase flow.” (45 minutes) (6) Lab Tour – Multiphase Rheology lab (45 minutes) (7) Lab Notebooks - Reflective writing (30 minutes)	
Objectives: Specify instructional goals and standards for each session.	
Introduction goal – Open questions in materials research Design goal - Height of scaffold design Guest lecture goal – Active research questions at CCNY and University of Chicago Lab Notebook – Organized record of new knowledge and ideas for the classroom (to be turned in at the end of each day).	
Method of Instruction: List the method of presenting: Classroom video or interactive hands-on activity. Include strategies to meet diverse learning needs (differentiated instruction).	
Mixed methods (lecture, lab, interactive learning, team-building exercises, writing exercises)	
Classroom Practice: Specify what skills and strategies the participant will bring back to his/her classroom.	
Participants should learn about the role of benchmarking in the early design process.	
Resources (readings, artifacts, internet sites, videos, etc): Provide the title, author, edition, publisher, cost, and where it is available. If there is a guest speaker, include the presenter’s name and affiliation.	
None	
Guest Speakers:	
Jeff Morris Ph.D. - Professor of Chemical Engineering, The City College CUNY. Education: Georgia Institute of Technology, BS,1989 California Institute of Technology, MS, 1991 California Institute of Technology, PhD, 1996 Areas of Expertise: Suspension mechanics, colloidal suspensions, fluid mechanics and multiphase flow, rheology Current Research Interests: These are in the properties and dynamics of flowing mixtures, with goal of developing a dynamic materials science. A major focus has been to carry scientific understanding of non-equilibrium microstructure and rheology in sheared suspensions to engineering applications through flow modeling.	

Calendar	
Session # 2 Date: July 6 th 2011	Time: 10:00 am-2:15pm(*15minute break)
Number of hours for this session: 4 instructional hours + 15 minute break	
Topics: List session topic and material, e.g. handouts. Indicate midterm and final exam date.	
(1) Quiz: Scaffold Design. (30 minutes) (2) Imaging tools in Material science (45 minutes) (3) Experimental design – Video microscopy and analysis – viscosity (45 minutes) *15 minute break for guest lecture set up. (4) Guest Lecture – Mark Shattuck “Granular Media: Experimental Kinetic Theory” (45 minutes) (5) Lab Tour – Colloid Science (45 minutes) (6) Lab Notebooks - Reflective writing (30 minutes)	
Objectives: Specify instructional goals and standards for each session.	
Imaging goal – Contemporary tools Design goal – Application of video microscopy to determine physical properties (viscosity) Guest lecture goal – Connecting open questions in colloidal science with material design	
Method of Instruction: List the method of presenting: Classroom video or interactive hands-on activity. Include strategies to meet diverse learning needs (differentiated instruction).	
Mixed methods (lecture, lab, interactive learning, method design, writing exercises)	
Classroom Practice: Specify what skills and strategies the participant will bring back to his/her classroom.	
Participants should learn about modern methods in video imaging and analysis.	
Resources (readings, artifacts, internet sites, videos, etc): Provide the title, author, edition, publisher, cost, and where it is available. If there is a guest speaker, include the presenter’s name and affiliation.	
None	
Guest Speakers:	
Mark Shattuck Ph.D. – Associate Professor of Physics, The City College CUNY Education: Duke University, Ph.D., Physics, 1995. Dissertation: Flows in Porous Media: Visualization by Magnetic Resonance Imaging, (Advisor: Professor Robert P. Behringer). M.A., Physics, 1991. Wake Forest University, Winston-Salem, North Carolina M.S., Physics, 1989. Master's Thesis: The Kinetics and Diffusion of Radicals in X-irradiated L- α -Amino-n-butyric Acid Hydrochloride with L-cysteine Hydrochloride as Impurity, (Advisor: Professor Howard Shields). B.A., Physics, 1987. Areas of expertise: Granular Media: Mesoscopic Physics on a Laboratory Scale, Biologically-Inspired Micro-robotics, Complex nonlinear pattern formation and control.	

Calendar	
Session # 3 Date: July 7 th 2011	Time: 10:00 am-2:15pm(*15minute break)
Number of hours for this session: 4 instructional hours + 15 minute break	
Topics: List session topic and material, e.g. handouts. Indicate midterm and final exam date.	
(1) Quiz: Imaging tools and experimental design. (30 minutes) (2) Introduction to viscoelasticity – Fundamentals of rheology and industrial applications (45 minutes) (2) Mini-module development (45 minutes) *15 minute break for presentation set up. (3) Presentations – experimental design and error analysis, feedback and Q&A. (90 minutes) (4) Lab Notebooks - Reflective writing (30 minutes)	
Objectives: Specify instructional goals and standards for each session.	
Introduction goal – Connecting new properties with new materials Mini-module development goal – Answering open-ended questions with inexpensive tools Presentation of module – mock class-room activities	
Method of Instruction: List the method of presenting: Classroom video or interactive hands-on activity. Include strategies to meet diverse learning needs (differentiated instruction).	
Mixed methods (lecture, lab, interactive learning, method design)	
Classroom Practice: Specify what skills and strategies the participant will bring back to his/her classroom.	
Participants should be able to develop a mini-module with inexpensive tools to experimentally measure a new physical property.	
Resources (readings, artifacts, internet sites, videos, etc): Provide the title, author, edition, publisher, cost, and where it is available. If there is a guest speaker, include the presenter's name and affiliation.	
None	
Guest Speakers:	
None	

Calendar	
Session # 4 Date: July 8 th 2011	Time: 10:00 am-2:15pm (*15minute break)
Number of hours for this session: 4 instructional hours + 15 minute break	
Topics: List session topic and material, e.g. handouts. Indicate midterm and final exam date.	
(1) Quiz: Fundamentals of rheology and industrial applications, experimental design and error Analysis (30 minutes) (2) Feedback on mini-modules developed (30 minutes) (3) Introduction to Interfacial Science – Fundamentals of interfacial science and applications in material science (30 minutes) (4) Experimental Design – Surface tension and wettability (30 minutes) *15 minute break for guest lecture set up. (5) Guest Lecture – Alex Couzis and Charles Maldarelli “Engineering materials at the nanoscale” (45 minutes) (6) Lab Tours – Interfacial Science lab (45 minutes) (7) Lab Notebooks - Reflective writing (30 minutes)	
Objectives: Specify instructional goals and standards for each session.	
Introduction goal – Connecting new properties with new materials Mini-module development goal – Answering open-ended questions with inexpensive tools Presentation of module – mock class-room activities	
Method of Instruction: List the method of presenting: Classroom video or interactive hands-on activity. Include strategies to meet diverse learning needs (differentiated instruction).	
Mixed methods (lecture, lab, interactive learning, method design)	
Classroom Practice: Specify what skills and strategies the participant will bring back to his/her classroom.	
Participants should learn about modern methods in interfacial science.	
Resources (readings, artifacts, internet sites, videos, etc): Provide the title, author, edition, publisher, cost, and where it is available. If there is a guest speaker, include the presenter’s name and affiliation.	
None	
Guest Speakers:	
Alex Couzis - Herbert G. Kayser Professor and Chairman, Chemical Engineering, The City College CUNY Education: B.S. (Chemical Engineering), 1987, National Technical University, Athens, Greece. M.S. (Chemical Engineering), 1988, The University of Michigan, Ann Arbor, Michigan. Ph.D. (Chemical Engineering), 1992, The University of Michigan, Ann Arbor, Michigan. Areas of Expertise: Surface Engineering, Templated Crystallization, Biosensors, Surfactant Facilitated Wetting of Hydrophobic Surfaces. Current Research Interests: The technological, environmental and biological importance of adsorption of organic material from solution onto a solid surface	

Charles Maldarelli Ph.D. - Professor Chemical Engineering The City College CUNY

Education:

B.S.(Ch.E.), 1976, M.S.(Ch.E.), 1978, D.Eng.Sc., 1980, Columbia University

Areas of Expertise:

Interfacial and biomembrance phenomena: fluid mechanics and hydrodynamic stability; viscoelasticity.

Current Research Interests:

Specific problems currently under study include multiphase flows in narrow capillaries, mass transfer from moving fluid droplets, thin film instabilities, and biomembrance deformation phenomena.

Calendar	
Session # 5 Date: July 11 th 2011	Time: 10:00am-2:15pm (*15minute break)
Number of hours for this session: 4 instructional hours + 15 minute break	
Topics: List session topic and material, e.g. handouts. Indicate midterm and final exam date.	
(1) Quiz: Modern methods in interfacial science. (30 minutes) (2) Orientation – Define goals for ETMs, The Learning Cycle, The Engineering Design Process, Experimental Teaching Modules (30 minutes) (3) Brainstorming activities and Team Development (30 minutes) *15 minute break for guest lecture set up. (4) Guest Lecture – Ilona Kretzschmar “Novel assembly processes and Particulate systems” (45 minutes) (5) Lab Tours – Patchy-particles lab (45 minutes) (6) Preliminary idea presentation (30 minutes) (7) Lab Notebooks - Reflective writing (30 minutes)	
Objectives: Specify instructional goals and standards for each session.	
Orientation goal – Define ETMs and implementation methodology Team development – Define general areas for module development and working groups Guest Lecture – Learn about novel anisotropic colloidal assemblies	
Method of Instruction: List the method of presenting: Classroom video or interactive hands-on activity. Include strategies to meet diverse learning needs (differentiated instruction).	
Mixed methods (lecture, lab, interactive learning, method design)	
Classroom Practice: Specify what skills and strategies the participant will bring back to his/her classroom.	
Participants should learn about ‘best-practice’ in idea development. Additionally, participants should learn about the application of particle assembly for photonic materials.	
Resources (readings, artifacts, internet sites, videos, etc): Provide the title, author, edition, publisher, cost, and where it is available. If there is a guest speaker, include the presenter’s name and affiliation.	
None	
Guest Speakers:	
Ilona Kretzschmar Ph.D. - Associate Professor, Chemical Engineering, The City College CUNY Education: Diploma (Chemistry), 1996, Technical University of Berlin, Berlin, Germany Ph.D. (Chemistry) 1999, Technical University of Berlin, Berlin Germany Fedeor-Lynen Fellow (Chemistry), 2000-01, Harvard University, Cambridge, MA Postdoctoral Associate (Electrical Engineering) 2002-04, Yale University, New Haven, CT Areas of Expertise: molecular and nanoparticle self assembly, chemical and material modification of nanoparticle surfaces, two- and three-dimensional nanoparticle assembly, vacuum	

Calendar	
Session # 6 Date: July 12 th 2011	Time: 10:00am-2:15pm (*15minute break)
Number of hours for this session: 4 instructional hours + 15 minute break	
Topics: List session topic and material, e.g. handouts. Indicate midterm and final exam date.	
(1) Quiz: The Learning Cycle, The Engineering Design Process, Experimental Teaching Modules (30 minutes) (2) Feedback on EMTs (60 minutes) (3) Module Development (75 minutes) *15 minute break for guest lecture set up. (4) Guest Lecture – Taehun Lee “Computational Multiphase Fluid Dynamics” (45 minutes) (5) Lab Notebooks - Reflective writing (30 minutes)	
Objectives: Specify instructional goals and standards for each session.	
Guest Lecture – Learn about modern computational methods in materials development	
Method of Instruction: List the method of presenting: Classroom video or interactive hands-on activity. Include strategies to meet diverse learning needs (differentiated instruction).	
Mixed methods (lecture, lab, interactive learning, method design)	
Classroom Practice: Specify what skills and strategies the participant will bring back to his/her classroom.	
Participants should learn about the application of computational tools in materials design.	
Resources (readings, artifacts, internet sites, videos, etc): Provide the title, author, edition, publisher, cost, and where it is available. If there is a guest speaker, include the presenter’s name and affiliation.	
None	
Guest Speakers:	
Taehun Lee Ph.D. - Assistant Professor, Mechanical Engineering, The City College CUNY Education Ph.D Mechanical Engineering, The University of Iowa, 2004 M.S. Mechanical Engineering, Seoul National University, 1998 B.S. Mechanical Engineering, Seoul National University, 1996 Research Interests Lattice Boltzmann methods for interfacial transport Finite Element/Spectral Element methods Liquid slip on superhydrophobic surface Drop-on-demand inkjet printing Contact line dynamics in nucleate boiling Marangoni convection in liquid bridges under microgravity Gas-liquid two-phase flow in microchannels Buoyancy-induced intermittent flow phenomena in nuclear reactors	

Calendar	
Session # 7	
Date: July 13 th 2011	Time: 10:00am-2:15pm (*15 minute break)
Number of hours for this session: 4 instructional hours + 15 minute break	
Topics: List session topic and material, e.g. handouts. Indicate midterm and final exam date.	
(1) Quiz: Particle assembly for photonic applications, computational tools in materials design.(30 minutes) (2) Feedback on EMTs (60 minutes) (3) Module Development (75 minutes) *15 minute break for lecture set up. (4) Lecture – Raymond Tu “Biomolecular assembly – Biological Inspirations for Material Design” (45 minutes) (5) Lab Notebooks - Reflective writing (30 minutes)	
Objectives: Specify instructional goals and standards for each session.	
Lecture – Learn about what biology teaches us about materials development	
Method of Instruction: List the method of presenting: Classroom video or interactive hands-on activity. Include strategies to meet diverse learning needs (differentiated instruction).	
Mixed methods (lecture, lab, interactive learning, method design)	
Classroom Practice: Specify what skills and strategies the participant will bring back to his/her classroom.	
Participants should learn about the application of biomimetic tools in materials design.	
Resources (readings, artifacts, internet sites, videos, etc): Provide the title, author, edition, publisher, cost, and where it is available. If there is a guest speaker, include the presenter’s name and affiliation.	
None	
Guest Speakers:	
None	

Calendar	
Session # 8 Date: July 14 th 2011	Time: 10:00am-2:15pm (*15 minute break)
Number of hours for this session: 4 instructional hours + 15 minute break	
Topics: List session topic and material, e.g. handouts. Indicate midterm and final exam date.	
(1) Quiz: Biological Inspirations for Material Design (30 minutes) (2) Feedback on EMTs (60 minutes) (2) Module Development (75 minutes) *15 minute break for guest lecture set up. (3) Guest Lecture – Heinrich Martin Jaeger “Experimental techniques for the study of nanostructured materials” (45 minutes) (4) Lab Notebooks - Reflective writing (30 minutes)	
Objectives: Specify instructional goals and standards for each session.	
Guest Lecture – Learn about a wide array of experimental techniques, including magnetic resonance imaging x-ray tomography and high-speed video for investigations on granular materials, and optical or electron-beam lithography, high-resolution electron and scanning probe microscopies as well as low-temperature (magneto-) transport measurements for the study of nanoscale materials.	
Method of Instruction: List the method of presenting: Classroom video or interactive hands-on activity. Include strategies to meet diverse learning needs (differentiated instruction).	
Mixed methods (lecture, lab, interactive learning, method design)	
Classroom Practice: Specify what skills and strategies the participant will bring back to his/her classroom.	
Participants should learn about phenomena in systems far from equilibrium. Much of what we work on has to do with studying the interactions between many, more or less identical "building blocks" that make up larger, complex structures and exhibit cooperative effects. These building blocks in range from macroscopic particles to colloids that are 10-100 microns in size. They will learn about the various experimental techniques used to study such phenomena.	
Resources (readings, artifacts, internet sites, videos, etc): Provide the title, author, edition, publisher, cost, and where it is available. If there is a guest speaker, include the presenter’s name and affiliation.	
None	
Guest Speakers:	
Heinrich Jaeger Ph.D., Professor of Physics, James Frank Institute, University of Chicago. Education: Ph.D., Physics, University of Minnesota, Minneapolis, 1987 (Thesis advisor: Allen M. Goldman) M.S., Physics, University of Minnesota, Minneapolis, 1982. Vordiplom, Physics, University of Kiel, Germany, 1979. Areas of expertise: Mesoscopic physics, superconductivity, granular materials.	

Calendar	
Session # 9 Date: July 15 th 2011	Time: 10:00am-2:15pm (*15 minute break)
Number of hours for this session: 4 instructional hours + 15 minute break	
Topics: List session topic and material, e.g. handouts. Indicate midterm and final exam date.	
(1) EMT presentations (90 minutes) (2) Wrap-up talk (60 minutes) *15minute break (3) Implementation modes (45 minutes) (4) Classroom assignments (45 minutes)	
Objectives: Specify instructional goals and standards for each session.	
Presentation of final EMTs.	
Method of Instruction: List the method of presenting: Classroom video or interactive hands-on activity. Include strategies to meet diverse learning needs (differentiated instruction).	
Mixed methods (Participant-led interactive presentations)	
Classroom Practice: Specify what skills and strategies the participant will bring back to his/her classroom.	
Participants should finalize EMT design and a team discussion about feasibility and implementation should end the workshop.	
Resources (readings, artifacts, internet sites, videos, etc): Provide the title, author, edition, publisher, cost, and where it is available. If there is a guest speaker, include the presenter's name and affiliation.	
None	
Guest Speakers:	
None	