SUNY EMPIRE STATE COLLEGE LEARNING CONTRACT – Mentor: Fernand Brunschwig
TOPIC OF STUDY: Modeling Instruction in Science – Physics (Mechanics), 3 credits, graduate level, not liberal arts and science.

LEARNING ACTIVITIES:
Students will be expected to be either experienced science teachers or involved in a teacher preparation program. Students will attend 15 full-day sessions of a Modeling Instruction Workshop in Physics (Mechanics). The workshop is organized by PhysicsTeachersNYC, affiliated with the American Modeling Teachers Association (AMTA). The workshop will follow the workshop outline and use the materials developed and published by the AMTA and its predecessor, the Modeling Instruction Program, over the past 20 years, including the *Mechanics Modeling Manual*, which will be provided to participants in digital form and also, at least in part, in hard copy.

The workshop immerses teachers in Modeling Instruction so that participants develop the skills necessary to implement this student-centered, research-informed, standards-based curricular philosophy with their students. The instructors teach by example, guiding participants through labs, activities, discussions, worksheets, and assessments in the mechanics course manual as they would with high school students. In teacher mode, the pedagogical rationales for all aspects of the example instruction are explored as well as accommodating various student populations, class schedules, testing requirements, and laboratory resources. Through readings and discussion, the workshop also delves into cognitive research, pedagogical content knowledge, and the theoretical underpinnings of Models and Modeling that are essential to understanding Modeling Instruction as both a teaching practice and a teaching philosophy. References describing Modeling Instruction and documenting its effectiveness are available at <http://modeling.asu.edu/R&E/Research.html> and at < http://modelinginstruction.org/wp-content/uploads/2011/08/ModInstrArticle_NSELAspr08.pdf>.

The specific topics, as detailed in the mechanics modeling course manual (which is also the foundation for the corresponding secondary or college course) are as follows: 1. Constant velocity (CV) model, 2. Uniform acceleration (UA) model, 3. Free particle (balanced force) model, 4. Unbalanced (net) force model, 5. Projectile motion (combination of CV and UA models), 6. Uniform circular motion, 7. Conservation of momentum, 8. Conservation of energy.

METHODS AND CRITERIA FOR EVALUATION: The workshop leaders (selected for their experience and expertise in content, pedagogy and, specifically, with regard to Modeling Instruction) will evaluate students' work and recommend a final grade to the sponsoring mentor (an Empire State College emeritus faculty member). Evaluation of the students' contributions to the workshop sessions will be based on the following elements: 1. Attendance at workshop sessions, 2. Quality of participation both in student and teacher mode, including relative value of contributions to their designated groups when doing experiments, interpreting results, and presenting to colleagues, 3. Growth in capacity to implement modeling methods as teachers; in other words, capacity to pose engaging challenges, ask productive questions, provide suitable guidance, stimulate discussion, and find ways to get students engaged in talking about the content, posing their own questions, and finding the answers, and 4. Relative mastery and capacity to apply the types of pedagogic content knowledge (PCK) demonstrated and articulated in the workshop.

Students will also be expected to complete a final project demonstrating mastery of modeling instruction methods in mechanics, specifically, by adapting one or more of the units to their own teaching situation. For example, to utilize a specific type of equipment available at their school, to focus on a particular reasoning skill, or to improve one or more of their own existing, successful classroom activities by incorporating some aspect(s) of Modeling Instruction. Students must submit a 2-5 page proposal for this project to the workshop leaders by the end of the 3-week workshop. The final project report must be at

least 10 pages and submitted in writing to the workshop leader along with any additional resources or materials (drawings, graphs, videos, computer programs…) no later than 2 weeks after the end of the workshop. While there are no specific requirements for additional resources or materials, the use and inclusion of "multiple representations" (as explained, demonstrated and promoted in the workshop) is strongly encouraged.

The final project report will be evaluated by the workshop leaders using the following criteria: 1. Adherence to graduate-level scholarly writing standards, including APA format, and the general clarity, coherence and persuasiveness of exposition, 2. Demonstration of mastery of the modeling instruction approach and implementation of methods and ideas, including PCK, from the workshop, 3. Creativity and originality. While there are no specific requirements for references to the literature, students are encouraged to consult outside resources, especially the articles and references included in the *Mechanics Modeling Manual*, and to quote from and refer to them as appropriate.

Students are expected to enroll in Empire State College and pay tuition before the beginning of the workshop. At the outset of the workshop, students enrolled for credit will receive a rubric incorporating the four evaluation elements listed above for the workshop and the three for the final project. The rubric will include a specification of the minimum requirement for receiving a certificate and credit, as well as an explicit method to establish a letter grade (A, A-, B+, B, B-, C+, C, D and no credit, with the understanding that B- is the accepted standard for maintaining satisfactory academic progress at the graduate level). Workshop leaders will have discretion to recommend raising or lowering the letter grade if they articulate a rationale in writing to the sponsoring mentor.