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

LEARNING ACTIVITIES:
Students will be expected to be either in-service science teachers or involved in a teacher preparation program. Students will attend 15 full-day sessions of a Modeling Instruction Workshop in Chemistry (over 90 contact hours, plus additional time for assignments and preparation). The workshop is organized by PhysicsTeachersNYC, affiliated with the American Modeling Teachers Association (AMTA). The workshop will be based on the current version of the *ChemistryCore Curriculum Manual* developed and published by the AMTA and its predecessor, the Modeling Instruction Program, over the past 20 years. The *Manual* will be provided to participants in both print and digital form. Additional materials and resources will be drawn as appropriate from the legacy website of the Modeling Instruction Program <http://modeling.asu.edu> and the current website of the AMTA: <http://modelinginstruction.org>.

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 chemistry course manual as they would with high school students. In teacher mode, the pedagogical rationale 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/researchers/publications/modeling-instruction-an-effective-model-for-science-education/>.

The specific topics, as detailed in the *ChemistryCore Curriculum Manual* (which is also the foundation for the corresponding secondary course) are as follows:1. Physical Properties of Matter (simple particle model), 2. Energy and States of Matter-Part 1 (sticky particle model), 3.Energy and States of Matter-Part 2 (energy storage and transfer model), 4.Describing Substance (Dalton model), 5. Counting Particles (Dalton model), 6. Particles with Internal Structure (Thomson model), 7.Representing Chemical Change (Thomson model + energy) 8. Stoichiometry 1 (mass-mole), and 9.Stoichiometry 2 (volume/molarity-mole). These units form the core of any high school chemistry course.

METHODS AND CRITERIA FOR EVALUATION:

Attendance: You are expected to attend all days of this course. If you miss two classes (13 contact hours), your maximum grade will be a B; if 3, you can earn no higher than a C. Please be on time and ready to go! Report any expected absences to the instructor as soon as possible.

Elements of evaluation:

1. (25%) Keep a course notebook. Teachers have found this notebook to be a valuable resource as they use the curricular materials in their own classes. Consequently you are expected to record notes pertaining to **everything** that we do. When you return home and

do the labs and activities you are not going to remember many of the details that came out in discussions and activities. Place them in your notebook as you work. When we perform labs you are to record notes from the pre-lab discussion, record and evaluate data (include any graphs you make) and summarize the findings of the "class" in your lab notebook. (Summarize means express the relationships verbally and, if applicable, graphically and algebraicially). You are expected to write down notes that will help you when you doing the lab with your students. Some teachers benefit by writing down good questions asked during whiteboarding, but that is up to you.. You should also work out all problems and questions on the worksheets and insert them into your 3-ring binder.

2. (25%) Participate actively and thoughtfully in lab whiteboarding sessions, discussion of readings, activities, and problem-solving whiteboarding. You should focus on developing your capacity to plan ahead and to enact successful responses in real-time to typical classroom situations.
3. (25%) Write and submit short (1-2 pp.) "unit reflections" on each of the nine units. These reflections are expected to articulate an evolving understanding of Modeling Instruction in chemistry.
4. (25%) Write and submit a final paper (at least 5 pages, double-spaced, 12 point font) demonstrating further evolution in your capacity to implement and enact chemistry modeling instruction methods in your classroom. You should focus on specific, content-related practices that have direct applicability in the classroom, and avoid empty generalities. The use and inclusion of "multiple representations" (as explained, demonstrated and promoted in the workshop) is encouraged wherever appropriate. You may wish to focus on one or more of the following questions:

   a) How can Modeling Instruction be implemented in your classroom? In particular, how could one or more of the teaching units in this workshop be used in your specific teaching situation? For example, to utilize a specific type of equipment available at your school, to focus on a particular reasoning skill, or to improve one or more of your own existing, successful classroom activities by incorporating some aspect(s) of Modeling Instruction.

   b) Contrast the classroom procedures used in the modeling pedagogy with those typically used in a conventional teaching approach.

   c) In what ways and to what extent is the non-modeling reformed pedagogy inquiry-based? How does it compare to modeling in this regard – is it more inquiry based than modeling? Less inquiry based? This should be supported with examples, quotes from the materials, or other evidence.

The final paper will be evaluated by the workshop leaders using the following criteria:

1. Depth and extent of understanding of Modeling Instruction, as reflected in capacity to articulate specific, classroom-ready techniques and procedures
2. Level to which issues regarding implementation are thoughtfully addressed.
3. Adherence to graduate-level scholarly writing standards, including APA format, and the general clarity, coherence and persuasiveness of exposition.

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 paper. 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). The course instructor(s) can raise or lower the final letter grade based on a written rationale.