Advanced Physics for Teachers
Weber State University / Southern Utah University
Summer 2012
Adam Johnston, Weber State University

COURSE PHILOSOPHY:
"Advanced physics" can bring to mind at least two images. One could be the latest innovations and advancements and cutting edges to reveal the fibers of string theory or the multiple dimensions of general relativity. Another – this course’s approach to “advanced physics” – is to develop a more genuine and in-depth understanding of the physics principles that are fundamental: concepts regarding matter, motion, forces, and energy. Although this doesn’t at first sound like the most exciting and truly “advanced” physics, what we often find is that this is exactly what we need to understand every other aspect of the physical universe. In addition, it turns out to be fun.

This course is intended to provide the content knowledge for practicing teachers to become experts in the field of physics teaching. To truly serve such a purpose, this course probably should be about 18 months long, but we’ll settle for a one-week workshop! As professional teachers, experts in the field of learning, you realize that this could be problematic. This course will leave much of the responsibility for developing a thorough understanding to you, but will model the process of learning physics by modeling authentic science and inquiry-based learning. The hope is that this will not only enable you to become better prepared in physics, but also to have a foundation for creating curricula in your own classroom.

The greatest assets of this classroom are one another. You are surrounded by teaching and science experts, and we will rely heavily on each other’s experiences and perspectives, both the freshest and the most well aged. You are expected to participate, listen, suggest, volunteer, laugh, deliberate, build, design, interact, etc. – all of the things that you should expect from your own ideal classroom. Knowledge, after all, is not produced in a vacuum, but is a creative and social endeavor that begs your constructive contributions. The one contribution which is not welcome is the one which only serves to bemoan the “system,” government, administrators, mothers-in-law, students, etc. Our discussions and foci will be upon those things that we can control. These things, ultimately, are the ones that will make a difference in our classrooms.

COURSE OBJECTIVES:
This course should enable the student to:
• Evaluate his/her own understanding of fundamental physics content.
• Articulate and apply understandings of core ideas in physics regarding energy, matter, motion, and waves (as described in the NRC “Framework” publication).
• Develop meaningful examples of scientific practices, including questioning, investigating, analyzing, modeling, and communicating (as described in the NRC “Framework” publication).
• Design course curricula for the physics and physical science classroom.

THE DETAILS:
Instructor:
Adam Johnston, Weber State University
(Phone: 801.626.7711; Email: ajohnston@weber.edu; Office: SL 207)
Meeting times: 18-22 June 2012; 8:30 AM – 4:00 PM
Meeting place: LL 230 & SL 225, Department of Physics, Weber State University
Course Web Page: http://physics.weber.edu/johnston/phsxteach
**SCHEDULE:**
Everything below is subject to revision, but at least you can see that there was some semblance of planning that went into this course. If you aren’t told otherwise, expect the following itinerary to hold true.

<table>
<thead>
<tr>
<th>Monday</th>
<th>Tuesday</th>
<th>Wednesday</th>
<th>Thursday</th>
<th>Friday</th>
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<tbody>
<tr>
<td><strong>QUESTIONING</strong></td>
<td><strong>INVESTIGATING</strong></td>
<td><strong>ANALYZING</strong></td>
<td><strong>MODELING</strong></td>
<td><strong>COMMUNICATING</strong></td>
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<td>8:30 – 9:00</td>
<td>Orientation &amp; Problem of the day: diurnal motion</td>
<td>Orientation &amp; Problem of the day: notions of motion</td>
<td>Orientation &amp; Problem of the day: the nature of matter</td>
<td>Orientation &amp; Problem of the day: conservation of energy</td>
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<td>9:00 – 10:00</td>
<td>Small: Measuring a molecule</td>
<td>Moving right along: Motion graphs</td>
<td>Sticky tape and balloons</td>
<td>Conservation of energy: Simple cases</td>
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<tr>
<td>10:00 – 11:00</td>
<td>Big: Measuring the sun</td>
<td>Motion and video analysis: Freefall, harmonic motion, etc.</td>
<td>Electromagnetism: How to light a light bulb</td>
<td>Conservation of energy: Heat and mechanical energy</td>
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<td>11:00 – 12:00</td>
<td>Fast: The speed of sound</td>
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<td>12:00 – 1:00</td>
<td>(12:30) Introductions &amp; Expectations</td>
<td>LUNCH</td>
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<td>1:00 – 2:00</td>
<td>What is Physics? Frameworks and Big Ideas</td>
<td>Back &amp; Forth: Harmonic motion</td>
<td>Collisions &amp; Conservation of energy</td>
<td>Wave-particle duality: Photoelectric effect</td>
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<td>2:00 – 3:00</td>
<td>Bubbleology</td>
<td>Up &amp; Down: Elevator physics</td>
<td>Radioactivity and Half life</td>
<td>Final debriefing, loose ends, and presummatative assessment</td>
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<td>3:00 – 4:00</td>
<td>What questions does physics ask?</td>
<td>Break and brainstorm</td>
<td>Break and brainstorm</td>
<td>Break and brainstorm</td>
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**ASSIGNMENTS:**
You knew that there had to be something in the way of assessment, didn’t you? In addition to your active participation in the course and completion of lab activities, there are two major sets of assignments that you will complete:
- During the week of the course, you will complete multiple labs, contribute to discussions, participate in activities, etc. These will be assessed for completeness daily, and you will be responsible for being prepared for class each day (e.g., reading assignments).
- After the course is completed, you will complete a final “take home” exam. This exam will be open book, open note, etc., but will require your reflection upon the week’s activities and readings. This assessment is meant to measure your understanding of the physics concepts covered during the course. It will be due four weeks after the week of the class (though it isn’t expected that you will need this much time).