This syllabus, suitably revised as necessary, is posted on the class web page: [http://www.physics.umn.edu/courses/](http://www.physics.umn.edu/courses/)

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**OFFICE HOURS:**  By appointment

**TEACHING ASSISTANTS:**
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**STRUCTURE OF THE PET COURSE:**

This is an activity-based and discussion-oriented course with four major goals and objectives:

**Physics Content** - To help you develop a deep understanding of physics ideas that can be used to explain interesting phenomena, and are related to the ideas included in the elementary school science curriculum.

**Nature of Science** - To help you practice and develop an understanding of how knowledge is developed within a scientific community: that doing science involves using evidence and creative thinking, that knowledge is established through collaboration and consensus, and that science knowledge can change over time.

**Elementary Students’ Ideas** - To help you understand the thinking of elementary school children by observing (via video) and analyzing their discourse when they are in the process of learning science.

**Learning about Learning** - To help you become more aware of how your own science ideas change and develop over time, and how the structure of the learning environment and curriculum to facilitate these changes.

There will be very little formal lecturing in this course. The basic aim of the PET format is to allow you to take charge of your own learning, with the instructor and TAs as guides. During class, you will spend most of your time performing experiments, working occasionally with computers, and discussing ideas with your classmates. We expect you to continue your learning at home through a series of carefully designed homework assignments, many involving use of the web. We hope you will find many of our teaching and learning strategies valuable and appropriate for you to use when you begin your teaching career.
The PET curriculum is divided into the following chapters:

Chapter 1: Interactions and Energy
Chapter 2: Interactions and Forces
Chapter 3: Interactions and Systems
Chapter 4: Model of Magnetism
Chapter 5: Electric Circuit Interactions
Chapter 6: Light Interactions

The goal of each chapter is to have you develop a set of ideas that can be used to help explain phenomena that will be explored within that chapter, as well as to consider issues of learning science. There are three types of homework and activities within each chapter. The first several activities are called Developing Ideas activities. During these you will perform experiments to collect evidence in support of ideas that you will develop. The final activity in a Chapter is an Applying Ideas activity. In that activity you will compare your ideas with those developed by scientists, then apply the ideas to explain interesting phenomena. Sprinkled throughout the curriculum are a series of Learning About Learning activities, some done during class, most done for homework. During these LAL activities you are asked to think about your own learning, the learning of children and/or the learning of scientists.

STRUCTURE OF THE PET ACTIVITIES:

Each individual activity consists of several sections with slightly different aims.

**Purpose** - This is a short introduction describing the aims of the activity and how it ties in to the topic. It also poses the *key question(s)* for the activity.

**Initial Ideas** - These are questions that give you a chance to express your own initial ideas on the topic of the activity, before you do any experiments. These initial ideas are important, as they will form the basis on which you build further understanding.

**Collecting and Interpreting Evidence** - Here’s where you do the experiments and record your predictions, observations and data that provide the evidence to support, refine and/or revise your ideas.

**Summarizing Questions** - Working together, the whole class will try to summarize what they have learned in the activity by answering questions.

REQUIRED MATERIALS:

**Text** - Physics & Everyday Thinking, by Fred Goldberg, Steve Robinson, and Valerie Otero (Publisher: It’s About Time, Armonk, NY, 2008). Available in the University Bookstore in Coffman

This is a workbook style text with locations for you to record your observations, and homework pages that you will complete and submit for grading. This workbook contains the six chapters listed above. In addition, there will be some supplementary material provided throughout the course. **You must bring the PET textbook to every class.**
LIBERAL EDUCATION:

This class exposes the student to physical principles and concepts, demonstrates how these principles can be applied to quantitatively describe natural phenomena, and provides the student with an opportunity to perform hands-on experiments and measurements that model how physical knowledge is obtained. Familiarity with the Nature of Science -- methods and findings of the physical sciences -- not only forms a crucial component of a common education, but also prepares students to be scientifically literate citizens. This class is directed towards providing potential elementary education teachers with a solid, hands-on foundation in the physical sciences, covering force, energy, electricity and magnetism, and light. This is an activity-based, discussion-oriented, cooperative learning course that, in addition to physics content, also covers teaching and learning strategies. This is a writing intensive course, including papers that reflect on the Nature of Science and student’s learning process, and the written scientific explanations of knowledge gained through their experimentation.

Because all knowledge in the physical sciences is empirically acquired, the laboratory nature of the course is essential to properly expose students to scientific methods -- the ways of knowing and thinking in the physical sciences. The laboratory experience involves the formulation of predictions by the students based upon their previous knowledge and laboratory exploration, followed by formulation of hypotheses that are then subjected to empirical testing through hands-on experimentation, followed by the refinement of the hypotheses based upon experimental results. Since the language of the physical world is mathematical, quantitative analysis of experimental data is an essential aspect of the course experience. Physics, like all sciences, is a social endeavor; thus the students gain experience in cooperative problem solving and experimentation, working in small groups with other students, in all aspects of the course.

GRADING CRITERIA:

<table>
<thead>
<tr>
<th>Course component</th>
<th>Weight</th>
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<tbody>
<tr>
<td>Four quizzes (9% each)</td>
<td>36%</td>
</tr>
<tr>
<td>Final</td>
<td>20%</td>
</tr>
<tr>
<td>Regular homework + in class work</td>
<td>15%</td>
</tr>
<tr>
<td>3 Children’s Ideas homework assignments</td>
<td>6%</td>
</tr>
<tr>
<td>Learning Commentary</td>
<td>8%</td>
</tr>
<tr>
<td>Physics Ideas Paper</td>
<td>15%</td>
</tr>
<tr>
<td>Total</td>
<td>100%</td>
</tr>
</tbody>
</table>

TENTATIVE GRADING SCALE:

>96%  A+ (recorded as A in University records)  >76%  B-
>92%  A                                           >72%  C+
>88%  A-                                          >68%  C
>84%  B+                                          >64%  C-
>80%  B                                           >60%  D+

Note that the cut-off between each step will not be set at a higher level than the above, but it may be lowered.
S/N grade option - A course grade of S requires the equivalent of a course grade of C- or above.

Incomplete - Incomplete coursework is a major inconvenience for students and instructors. You are expected to do everything in your power to avoid this situation. Legitimate excuses include verified illnesses and family emergencies. No incompletes will be given unless you have a prior written agreement with the course instructor, including an approved plan for completion of the work.

Grading and transcripts - The University utilizes plus and minus grading on a 4.000 cumulative grade point scale.

For additional information about grading, please refer to: http://policy.umn.edu/Policies/Education/Education/GRADINGTRANSCRIPTS.html.

HOMEWORK:

Homework will be assigned almost every class period and, unless otherwise stated, must be turned in at the beginning of the next class. (Children’s Ideas assignments will be due one week after assigned.) Sometimes the homework will be reviewed and discussed during the class period when it is due. In the end, the sum of all homework will be renormalized to count for the proportion of the grade listed under “Grading Criteria”. This is a Writing Intensive course. Your homework answers should consist of complete sentences with correct grammar. Late homework will not be accepted for full credit.

Several homework assignments will require you to run computer simulations on the web. The PET simulator index page is at http://cpucips.sdsu.edu/petsims. Many of the assignments will require you to have access to a computer connected to the internet. If you do not have one at home, there are several computer labs on campus.

The Children’s Ideas homework assignments are more extensive. They will require you to view Quicktime movies of children from grades two through five discussing physics ideas or participating in experiments. You will be asked to make claims about what the students are learning and will use direct quotes from what the children say or pictures they draw as evidence to support your claims. We will spend class time discussing the children’s learning during the periods when the Children’s Ideas assignments are due. Movies and transcripts can be found at www.petpset.net.

It is your responsibility to record observations and answer questions in the workbook. Your entries should be sufficiently clear and legible that you can return to them weeks later and understand them. Moreover, some of your entries will be photocopied and used by you as evidence in a writing assignment, and so they must be understandable to the grader of that assignment. We will occasionally check your workbook during class to be sure that your entries are complete, clear and legible.
EXAMINATIONS:

There will be five examinations during the semester: four quizzes and a final test. Each will be given several days after the completion of one of the chapters:

<table>
<thead>
<tr>
<th>Quiz</th>
<th>Chapter</th>
<th>Date</th>
</tr>
</thead>
<tbody>
<tr>
<td>Quiz 1</td>
<td>Chapter 1</td>
<td>February 8</td>
</tr>
<tr>
<td>Quiz 2</td>
<td>Chapter 2</td>
<td>February 29</td>
</tr>
<tr>
<td>Quiz 3</td>
<td>Chapters 3&amp;4</td>
<td>March 30</td>
</tr>
<tr>
<td>Quiz 4</td>
<td>Chapter 5</td>
<td>April 18</td>
</tr>
<tr>
<td>Final Exam</td>
<td>Chapter 1 - 6</td>
<td>May 4</td>
</tr>
</tbody>
</table>

Because of the nature of the course, the quiz dates may change. Each quiz will be approximately 60 minutes long. The final exam will be three hours long.

Note that NO MAKE-UP examinations will be given, except in the case of certain University-sanctioned activities which are officially exempted from this policy (primarily designated intercollegiate competition; check to be sure). If you are exempt, you must notify the instructor well in advance, with official documentation, and make arrangements for making up the exam or taking the exam while away.

If an exam is missed for a valid, documented reason, you must schedule a MAKE-UP exam with your instructor on the day of your return. Valid, excused absences include illnesses which prevent attendance (documented by a physician or equivalent), funerals (documented by dated notice), and car break-downs (documented by an auto repair or tow service). If in doubt, ask.

**INTERCOLLEGIATE ATHLETES** must provide their official University of Minnesota athletic letter containing the approved competition schedule to their instructor and the staff in office 148. Away exams will be arranged with the athletic adviser traveling with the team. Accommodations will be made for official university sports only (i.e. no accommodations will be made for intramurals, club sports, etc.)

**DISABILITY SERVICES:** If you have accommodations for this course, please provide the staff in office 148 with a copy of your accommodation letter for the current semester. Exams will be arranged according to accommodations and sent to the testing center for administration.

**WRITING ASSIGNMENTS (2):**

Physics 3071W is a writing intensive course and part of your grade is based on your writing. In addition to the writing in homework and exams, there are two writing assignments as described below. The University provides resources to help you with writing. Information on the Center for Writing can be found at: [http://writing.umn.edu/sws/index.html](http://writing.umn.edu/sws/index.html)

The student writing guide can be found at: [http://writing.umn.edu/sws/assets/pdf/2010swg.pdf](http://writing.umn.edu/sws/assets/pdf/2010swg.pdf)

Learning Commentary – assigned February 24, due March 23 (tentative dates).

The Learning Commentary is designed to help you become more aware of and more in control of your own learning. It will also help you consider what constitutes an effective science lesson.

This paper will be done at the end of Chapter 2 and will be based on ideas about force and motion. A detailed description will be handed out later. The evaluation of these commentaries will be based both on the quality and quantity of your comments, and the degree to which you provide evidence to support your comments. In particular, we will be looking for a description of two initial ideas (with supporting evidence), a substantive discussion of how various classroom activities promoted a change in these ideas (with supporting evidence), and a brief description of the final, class consensus ideas. Most credit will be assigned to the middle part (how the ideas changed). Opportunities will be given for peer review and revision.

Physics Ideas – assigned March 28, due April 20 (tentative dates).

For this assignment you will be asked to put together a portfolio for a lesson you might teach. You will select a State benchmark, investigate the science behind that benchmark, select a lesson to teach the topic, and talk about its implementation. A peer review will be done approximately one week before the final paper is due, giving you an opportunity to revise and improve your paper. A more detailed description will be handed out later.

ATTENDANCE:

This is a cooperative learning environment involving small group activities as well as full class discussions. Your active participation is essential to the success of the class for everyone. Because you will play such an important role in your own learning and the learning of your classmates, your attendance is essential, and hence we have a rather strict attendance policy. At a minimum, you are expected to be in class and working for the full three hours (we will have a short, 10-15 minute break in the middle of class).

- Each unexcused absence will result in loss of credit for that day’s assignment.
- Absence is not excused without proper documentation (doctor’s statement for illness; obituary or program of memorial, etc. for death in the family; and garage statement for a car break-down), or in the case of certain University-sanctioned activities, which are officially exempted from this policy. Note that a family vacation is NOT an acceptable excuse – even if your whole family is going and it has been planned for a year.

It is your responsibility to understand the material discussed in class. If you are absent, talk to your group members or your TA to clarify concepts you missed and to help complete the workbook assignment done in class that day.

Makeup Work for Legitimate Absences - Students will not be penalized for absence during the semester due to unavoidable or legitimate circumstances. Such circumstances include verified illness, participation in intercollegiate athletic events, subpoenas, jury duty, military service, bereavement, and religious observances. Such circumstances do not include voting in
local, state, or national elections. For complete information, please see:
http://policy.umn.edu/Policies/Education/Education/MAKEUPWORK.html.

PARTICIPATION AND BEHAVIOR EXPECTATIONS:

You will be primarily responsible for your own learning in this class. The instructors will seldom, if ever, “lecture” in the traditional sense of the word. Instead, you will do science and learn science through engagement in meaningful discussions with your lab partners, through active participation in class and group discussions and through performing experiments and simulations. Similar to the way in which scientists develop ideas, your ideas will be based on evidence gathered from the experiments done by you. At appropriate times, you will be able to compare your ideas with those developed by scientists. It is expected that except for some special scientific terminology, the ideas you develop with the class should be quite similar to the scientists’ ideas. You will develop and deepen your own understanding of some powerful ideas in physics. You will come to realize that these ideas can be used to explain a wide range of interesting scientific phenomena.

The University of Minnesota assumes that all students enroll in its programs with a serious learning purpose and expects them to be responsible individuals who demand of themselves high standards of honesty and personal conduct. All students are expected to behave at all times with the utmost respect and courtesy toward all of their fellow students and their instructors. Much of the class time is spent in discussions and we expect that students will challenge each other’s ideas. This is an important part of the learning process. Respectful language should always be used during questions and discussions, and students should pay full attention to those who are speaking.

It is expected that students will not engage in any behavior that disrupts the classroom learning environment. This includes, but is not limited to, use of cell phones and use of the computers for non-class activities except during the mid-class break.

Lab groups will often finish activities before the entire class is ready to move on to the next activity. When that is the case with your lab group, you are expected to postpone moving on until the entire class is ready. Sometimes you will have a homework assignment that you can begin working on (on your own). Otherwise it would be good for you to have other material with you that you might work quietly on until the remainder of the class catches up. Once again, you should not engage in activity that disrupts the classroom learning environment.

Student conduct code - The University seeks an environment that promotes academic achievement and integrity, that is protective of free inquiry, and that serves the educational mission of the University. Similarly, the University seeks a community that is free from violence, threats, and intimidation; that is respectful of the rights, opportunities, and welfare of students, faculty, staff, and guests of the University; and that does not threaten the physical or mental health or safety of members of the University community. As a student at the University you are expected adhere to Board of Regents Policy: Student Conduct Code. To review the Student Conduct Code, please see:
Note that the conduct code specifically addresses disruptive classroom conduct, which means "engaging in behavior that substantially or repeatedly interrupts either the instructor's ability to teach or student learning". The classroom extends to any setting where a student is engaged in work toward academic credit or satisfaction of program-based requirements or related activities.

**Scholastic dishonesty** - You are expected to do your own academic work and cite sources as necessary. Failing to do so is scholastic dishonesty. Scholastic dishonesty means plagiarizing; cheating on assignments or examinations; engaging in unauthorized collaboration on academic work; taking, acquiring, or using test materials without faculty permission; submitting false or incomplete records of academic achievement; acting alone or in cooperation with another to falsify records or to obtain dishonestly grades, honors, awards, or professional endorsement; altering, forging, or misusing a University academic record; or fabricating or falsifying data, research procedures, or data analysis. (Student Conduct Code: [http://regents.umn.edu/sites/default/files/policies/Student_Conduct_Code.pdf](http://regents.umn.edu/sites/default/files/policies/Student_Conduct_Code.pdf)) If it is determined that a student has cheated, he or she may be given an "F" or an "N" for the course, and may face additional sanctions from the University. For additional information, please see: [http://policy.umn.edu/Policies/Education/Education/INSTRUCTORRESP.html](http://policy.umn.edu/Policies/Education/Education/INSTRUCTORRESP.html).

The Office for Student Conduct and Academic Integrity has compiled a useful list of Frequently Asked Questions pertaining to scholastic dishonesty: [http://www1.umn.edu/oscai/integrity/student/index.html](http://www1.umn.edu/oscai/integrity/student/index.html). If you have additional questions, please clarify with your instructor for the course. Your instructor can respond to your specific questions regarding what would constitute scholastic dishonesty in the context of a particular class-e.g., whether collaboration on assignments is permitted, requirements and methods for citing sources, if electronic aids are permitted or prohibited during an exam.

**Respecting intellectual property.** - Students may not distribute instructor-provided notes or other course materials, except to other members of the same class or with the express (written) consent of the instructor. Instructors have the right to impose additional restrictions on course materials in accordance with copyright and intellectual property law and policy. Students may not engage in the widespread distribution or sale of transcript-like notes or notes that are close to verbatim records of a lecture or presentation. See: [http://www.policy.umn.edu/Policies/Education/Education/STUDENTRESP.html](http://www.policy.umn.edu/Policies/Education/Education/STUDENTRESP.html)

**Use of personal electronic devices in the classroom** - Using personal electronic devices in the classroom setting can hinder instruction and learning, not only for the student using the device but also for other students in the class. To this end, the University establishes the right of each faculty member to determine if and how personal electronic devices are allowed to be used in the classroom. For complete information, please reference: [http://www.policy.umn.edu/Policies/Education/Education/STUDENTRESP.html](http://www.policy.umn.edu/Policies/Education/Education/STUDENTRESP.html)

**DISABILITY ACCOMMODATIONS:**

The University is committed to providing quality education to all students regardless of ability. Determining appropriate disability accommodations is a collaborative process. You as a student must register with Disability Services and provide documentation of your disability. The course
instructor must provide information regarding a course's content, methods, and essential components. The combination of this information will be used by Disability Services to determine appropriate accommodations for a particular student in a particular course. For more information, please reference Disability Services: https://diversity.umn.edu/disability/

SEXUAL HARASSMENT:

"Sexual harassment" means unwelcome sexual advances, requests for sexual favors, and/or other verbal or physical conduct of a sexual nature. Such conduct has the purpose or effect of unreasonably interfering with an individual's work or academic performance or creating an intimidating, hostile, or offensive working or academic environment in any University activity or program. Such behavior is not acceptable in the University setting. For additional information, please consult Board of Regents Policy: http://regents.umn.edu/sites/default/files/policies/SexHarassment.pdf

EQUITY, DIVERSITY, EQUAL OPPORTUNITY, and AFFIRMATIVE ACTION:

The University will provide equal access to and opportunity in its programs and facilities, without regard to race, color, creed, religion, national origin, gender, age, marital status, disability, public assistance status, veteran status, sexual orientation, gender identity, or gender expression. For more information, please consult Board of Regents Policy: http://regents.umn.edu/sites/default/files/policies/Equity_Diversity_EO_AA.pdf

MENTAL HEALTH and STRESS MANAGEMENT:

As a student you may experience a range of issues that can cause barriers to learning, such as strained relationships, increased anxiety, alcohol/drug problems, feeling down, difficulty concentrating and/or lack of motivation. These mental health concerns or stressful events may lead to diminished academic performance and may reduce your ability to participate in daily activities. University of Minnesota services are available to assist you. You can learn more about the broad range of confidential mental health services available on campus via the Student Mental Health Website: http://www.mentalhealth.umn.edu.