

# Physics 3071W Laboratory-Based Physics for Teachers

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Few people think more than two or three times a year; I have made an international reputation for myself by thinking once or twice a week. - George Bernard Shaw

## Instructors

Yuichi Kubota

## **Five goals: This class will help you to**

1. Construct a set of physics ideas that you can apply to explain phenomena that are both intrinsically interesting and typically included in an elementary school science curriculum.
2. Feel more comfortable with science.
3. Learn the nature of science, so you will have more confidence in your ability to do science.
4. Become more aware of, and more in control of, your own learning.
5. Become a teacher who is good and comfortable with science.

## **Style of class:**

- Hands-on experience, activity-based.
- Discussion-oriented (as opposed to lecture-oriented)
- No lectures

Materials to be learned: Elementary physics material suited for potential elementary teachers

- Light and Color
- Static Electricity
- Current Electricity

## **You will do in class:**

- Reading instructions and entering “journals.”
- Making predictions, based on your current physics ideas, on what would happen in the next experiment you will do.
- Performing experiments (both real and simulation on computer).
- Discussing ideas with your classmates.
- Designing a science lesson(s)

### **Required materials:**

- Bring in one ream of paper during the first or second week of school. Write your name on it, and give it to one of the TA's. Throughout the semester we will use these papers to print your "textbook," "notebook" and simulation results, which are all in your computers.
- A 3-ring loose-leaf notebook to keep all of your records – hand-outs, print-outs, hand-written notes. Include a package of lined paper.

### **Computers are used:**

- They contain your textbook and lab manual, which tells you what to do next.
- They contain your notebook in which you write what you observed and thought.
- They let you run simulation experiments.

### **Additional activities:**

- Design a short lesson(s) and present it in a small group.
- Optionally, arrange a trip to a school to present the lesson(s).

*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.*

### **What do you have to do? (what's graded):**

1. Attendance (promptness, too)
2. Homework (HW)
3. In-class assignments (Daily Journals, Idea Journals, etc.)
4. Quizzes (4 of them), Final exam
5. Learning Commentary (2 of them)
6. Science lesson plans (2)
7. While much of the work of the course will be accomplished during the class periods, if you get behind in class activities, you will be expected to catch up in non-class time. You may use the lab at non-class times by arranging with the TAs or the instructors.

### **Grading criteria**

- Your effort in learning and careful observation of your own learning – 50%
  - Learning Commentaries 18%
  - Daily Journals – ~ 4 % together 32%
  - Peer and self evaluations – ~ 3 %
  - Idea Journals – ~ 4 %
  - Our observation of your participation in class – ~ 3 %

- Lesson Plan – ~ 18 %
- How well you learn physics – 50% for “6 parts”
  - HW 1 part (8.33%) 1 part
  - Tests 3 parts (best 3/4) or 4 parts
  - Final 2 parts 1 part (better half)

A A- B+ B B- C+ C C- D+ D

Your course grade: 90 85 80 75 70 65 60 55 50 45

**More details on the requirements above.**

1. **Attendance** – You are expected to be in class and working for the full three hours, i.e., arriving late and leaving early will not be allowed (we will have a short 10-15 minute break in the middle of class). Roll will be taken five minutes after the start of class and five minutes prior to the end of class. If you are not present at either time, you will be counted “late” for the entire class period.

- After two “lates” or absences, you will receive a warning.
- Three or four “lates” will result in a 5% grade reduction (A to A- or B+, for example);
- five (six) “lates” will result in an 8% (10%) reduction of your total final score for the course (A to B, for example).
- Three (five) unexcused absences or excused absences that are not made up in a timely manner will result in a 10% (20%) reduction of your total final score for the course.
- More than 6 “lates” or five unexcused absences will result in “F” for the course.
- 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 broken car). Note that a family vacation is NOT an acceptable excuse – even if your whole family is going and has been planned for a year.

**Why do we care about attendance so much?**

Because you will play such an important role in your own learning and the learning of your classmates, your attendance is essential, and hence our rather strict attendance policy.

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 partner(s), through active participation in class and group discussions and through performing experiments. 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.

2. **Homework** altogether counts as one quiz. Homework assigned must be turned in at the beginning of the next class. Late written assignments (any assignment turned in five minutes or more after the start of class is late) will not be accepted unless special arrangements are made in advance.

You can correct errors on your returned homework and have it re-graded.

You must turn in your re-written HW for re-grading during the first 5 minutes of the following class period.

3. **Idea Journal** (“IJ”) is a WORD file in the computer, and initially contains only questions, which will help you form “Physics Ideas.” At the beginning of each unit, you will record your initial Physics Ideas (that you bring in to class) by answering these questions. Every time you complete a set of activities, you will go back to these questions, and refine (revise or change) your Physics Ideas and their justifications based on how successful your predictions were and what you had to do to explain the experiments in the unit successfully.

The main thing we will be looking for in IJ is NOT if your initial Ideas (or even intermediate Ideas) were “correct” (i.e. agreed with widely accepted ideas in the science community,) but how well you could explain that the Ideas were reasonable to you based on the observations you describe as the justifications. As you do more and more experiments, your Ideas or at least justifications should get more and more solid, elaborated and well articulated.

We will NOT grade IJ for the first unit (Light unit 1) but instead will give you feedback on what can be improved. If, however, the class’ progress towards writing good IJ is not satisfactory, we will keep the option of grading IJ any time after the 1st unit.

You write **Daily Journal** (“DJ”: reflections on your learning) at least once every week to remember how you feel about various aspects of the learning experience, both positive and negative, in this class. Turn it in as you write it so that we can learn from it. In addition, in the last 10 minutes of some classes, we ask some physics questions as DJ to get a quick measure of class progress in “doing physics,” or survey questions about various aspects of our class to get your feedback. Turn in these DJ’s before you leave unless you are told otherwise.

#### **Suggested DJ topics:**

- Reflect on your homework or on discussions with other classmates.
- Discuss how you came to understand a particular idea(s) that emerged during the class.
- Relate something learned that day to a prior experience or to your future role as a teacher.
- Discuss how you felt about particular activities, experiments or discussions.
- Raise concerns about the class or ask questions.

You will receive one point of credit for each daily journal entry, but only if it includes comments of substance. Writing “no comments today” or making only a few superficial remarks is not an appropriate DJ reflection. To get the maximum semester points for DJ, you need to get 14 DJ points for weekly free-format DJ + in-class DJ points.

Daily Journals will be returned at the beginning of the following period. You should keep all your Daily Journals together. They will be useful when you write your Learning Commentary (see below).

### **Why DJ?**

Because many of you are prospective teachers, we believe it is particularly useful for you to monitor your own learning process. You should be conscious of what makes your learning easier or more difficult.

- Which class activities help you learn or prevent you from learning?
- Observe what instructors do that helps you learn or makes your learning more difficult.
- Observe what classmates do.

We believe that monitoring your own learning process will help you become more aware of the learning of your future students, and should therefore make you a more effective teacher.

4. There will be **four quizzes** during the semester. The quizzes will be one hour long and given at the beginning of class on 2/12, 3/12, 4/14, and 5/7.

The final exam counts as two quizzes. Our final is scheduled at Tuesday 5/13 from 8:30-11:30am. If you have any conflicts with this time, we must know by 1/31. After that date there will be no consideration given.

5. **Learning Commentaries (LC)** due on 2/19 and 4/2. These must be 3-4 pages, typed double-spaced. The LC must be turned in during the first five minutes of the period in which they are due.

You are given an opportunity to improve your LC and have it re-graded. However, even if your re-written LC is perfect, the maximum score you receive is 90%. You must turn in your re-written LC for re-grading by the first 5 minutes of the second class-period after your original LC is returned to you.

The details of how we want you to write LC will be distributed as a hand-out soon.

### **6. Science lesson design and presentation**

Twice during the semester, you will be asked to design and write up a science lesson. The

written part is due on 2/26 and 4/16, and shortly afterward you will present a part of the science lesson, which is most interesting to demonstrate, (lasting up to 10 minutes) in a small-group setting. Details of the requirements for the lesson will be handed out in class.

The lesson should address at least one of the Science Education Standards (Minnesota or National), which will be distributed as a hand-out soon. In particular, it should address conceptual understanding of science as opposed acquiring science facts.

Knowing that an atom is made of a nucleus and electrons that go around the nucleus is to know a science fact. Knowing that the solar system consists of the Sun and planets going around it, and that the planets are Mercury, Venus, Earth, Mars, Jupiter, Saturn, Uranus, Neptune, Pluto are knowing science facts. Realizing that because this motion of the planets would lead to their seeming to “wander” motion in the sky relative to other stars (hence their name which means wanderers) is a good example of science.

Part of the 10 minutes will be an emulation of a real class you may give to children in the future, and part of the time will be spent explaining the background of the lesson such as goals of the lesson, what aspect(s) of science education goals at what age group it is meant for. A list of resources, which may be useful to help you design such lesson, will be given on our web page shortly.

Kubota, Yuichi. Physics 3071W: Laboratory-Based Physics for Teachers . University of Minnesota. 30 June 2003.