Physics for the Curious.– SCI 130
Westminster College

1 Pertinent Information

Instructor: Douglas Armstead
Office: 124 Hoyt (724) 946-7201
Office Hours: MWF 2-3pm. These are just the times I guarantee. I am available other times so feel free to drop by or to contact me for an appointment.
Email: armstedn@westminster.edu
Course website: www.westminster.edu/staff/armstedn/sci130.html.
Lecture meets: MWF 12:50-1:50am in Hoyt 206.
Laboratory meets: Thu. 2-5pm in Hoyt 206.
Books:

Nine Crazy Ideas by Robert Ehrlich;
How Things Work, The Physics of Everyday Life by Louis Bloomfield;
QED, The Strange Theory of Light and Matter by Richard P. Feynman.

2 The Point of this Class

Physics is an exciting and demanding subject. Physicists make predictive models of reality based on assumptions about the nature of our world. If a model's predictions are borne out experimentally then the elements of the model tell us about the physical laws that govern our world. Science 130 will be comprised of three distinct but related segments which will help us understand how physics has changed our understanding of the world.

In the first part of this class we will explore what it means to do science by: discussing the scientific method, looking at the history of astronomy to get an appreciation for the way in which a science evolves based on our changing understanding our world, and reading Ehrlich's Nine Crazy ideas in Science with the aim of learning how to evaluate a scientific claim.

The second part of this course revolves around the experimental side of physics. As a case study we will look at the area of applied physics that relates to flight. We will examine some simple models that explain what makes an airplane fly and then apply the understanding we have gained from our physical models construct and test model airplanes in small wind tunnels. We will also touch on how this piece of technology has altered how we interact with our world.

In the final portion of the course we will explore theoretical physics with a case study in the best tested theory in physics, quantum electrodynamics (QED). QED describes how light and matter interact at the most fundamental level. Our aim will be to understand it conceptually in the way that a physicist does, without all of the math that a physicist would use.

3 Expectations

What you should expect from me:

- Explanations of physical concepts that include concrete examples and where reasonable demonstrations.
- In-class examples that help you to understand the kind of reasoning that is necessary to excel in this class.
- Careful and respectful consideration of your questions.
- An open door policy–if my office door is open you should feel free to come in and talk about physics. This is in addition to my regularly scheduled office hours listed above.

What I expect of you:

- Your presence both physically and mentally in class for the entire class period.
- To prepare for class. This includes doing the reading at a level that you arrive with questions in hand about the material.
- If you have a question, ask it. I strongly encourage you to do this during class since one topic builds on the last. Your fellow classmates will thank you–if you are unclear on something, chances are the person next to you is, too.
- Be considerate of your fellow classmates by turning off your cell phones during class and not eating in class.
- Submit work for grading that is your own. If you copy from another student or source and submit it for a grade, then you risk receiving an F in the course. The actual penalty would depend on the severity of the transgression.

4 Grades

You start this class out with an A. Over the course of this semester your grade will be adjusted based on the degree of mastery of the material you show through your homework, in papers, on projects, and on exams.

The final score distribution for the class:

20%	Homework and class work
25%	Midterm Exam #1
25%	Airplane Project
5%	URAC paper
25%	Final Exam

4.1 Graded Elements [1]

Homework/Classwork: The three sections of this course operate in rather divergent ways. They all include laboratory investigations that are designed to deepen your understanding of the ideas discussed in class.

> Section 1: assignments include written position papers where you will be expected to show that you understand how to evaluate a fringe-idea's testablity and argue whether it is likely to be true or not. Experiments revolve around astronomical observations and dating techniques.
>
> Section 2: assignments include problem sets that require the application of fluid static and dynamic principles (e.g., pressure, density, Bernoulli's equation, turbulence). Experiments revolve around the static and dynamic properites of fluids including laminar flow and turbulence.
>
> Section 3: assignments include homework problem sets as well as in-class group problem solving sessions. Being able to do this pivots on an understanding of why light behaves the way it does and how it interacts with charged particles. Labs revolve the behavior of light.

Midterm: This is intended to check your understanding of the material in the first section. The format is short answer and essay. It will require an understanding of how and why astronomy (a science that lead to physics and remains intimately connected with it) has changed with time as well as an understanding of the techniques that we used to judge crazy-ideas.

Project: The second section of the course culminates with your design and testing of a model airplane in a wind tunnel. Your airplane must create lift and your project will in part be judged by how much weight it can lift. It will also be judged by a paper in which you discuss why you designed the plane the way you did (rooting your explanation in the principles of fluid dynamics you learned in class) and how your experimentation influenced your design.

URAC paper: On Wednesday April 27, 2011 the college will hold the first annual Undergraduate Research and Arts Celebration, URAC, an all day event shared by all Westminster students regardless of their course of study. Class that day will be held at the event and you will be expected to write a short paper (3 pages) discussing one of the talks that you attend.

Final Exam: The final tests your understanding of quantum electrodynamics (which predicts how light behaves and how it interacts with charged particles), the third section of the course. The format is problems, short answer, and essay.

[1] If you are looking for the outcomes of this course and the evaluation of these outcomes, they both appear

Final %	Grade
90-100	A- to A
80-89	B- to B+
70-79	C- to C+
60-69	D- to D+
0-59	F

4.2 Academic Integrity

You are expected to observe the College's statements and procedures on Academic Integrity in the 2010-2011 Undergraduate Catalog, pages 71-75. Ask the instructor if you have any uncertainty about what is proper collaboration and what is not.

5 Class Schedule

A rough schedule follows

	Topic	Reading
Section 1 (4 weeks)	History of Science and Assessing Scientific Theories	Reading from Ehrlich
Lab 1	Observing the night sky.	
Lab 2	How the sky changes over the year (planetarium)	
Lab 3	Radioactive decay and half life.	
Midterm		
Section 2 (5 weeks)	Airplanes – Theory, effect, practice	Reading from Bloomfield
Lab 4	Fluids at rest, compressability, temperature, density and pressure	
Lab 5	Fluids in motion	
Lab 6	Building paper airplanes	
Project paper due		
Section 3 (5 weeks)	QED	Reading from Feynman
Lab 7	Reflection and refraction of light	
Lab 8	Lenses	
Lab 9	Laser light diffraction	
Final Exam		

here. It is formated so that the key assesments for each section of the class is stated and what that assessment instrument is looking to measure an understanding of.