SYLLABUS
PHYSICS 210-PHENOMINAL SCIENCE

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(Recommended and some on reserve in library): Kirkpatrick and Francis: “Physics-A World View”

COURSE DESCRIPTION: This is an introduction to basic physics and science methodology that utilizes a hands-on, guided inquiry approach to learning. The text was authored by myself to fit this particular learning style. It has been tested with college and elementary students and revised twice based on classroom experiences. Class sizes are limited to facilitate active and collaborative learning. Students will learn about such core concepts as motion, forces, Newton’s Laws, rotational motion and dynamics, pressure and buoyancy, oscillations and waves, resonance, sound, light, temperature and heat, electricity and magnetism, and atomic physics. A set of in-class and outside exercises will permit the student to establish a strong conceptual understanding by making predictions followed by experimentation and drawing conclusions based on observations. Some quantitative reasoning will be employed in making sense of natural phenomena and performing some, simple problem-solving. Interpreting graphical results is a key element. The student should have a working knowledge of high-school algebra, including the ability to calculate areas and volumes and determine the slope of a graph. Instrumentation will include rudimentary tools such as rulers, balances, sticky tape, soda straws, and timers through more sophisticated technology, including graphing programs and simulations using computers and computer interfaces. Most of the apparatus consists of “off-the-shelf” items found in toy, hardware, and grocery stores with the exception of some physics lab equipment. This course is required of General Science Education majors who will also be taking the Web of Science course at KSC and emphasis will be placed on instilling in them mastery of required knowledge and skills outlined in NH state education standards and the confidence and sense of excitement which will help prepare them to be effective teachers of science in grades K-8. Much of the preparation of this course and the purchase of kit-based instructional materials have been assisted by the Project Inspire Grant funded by the National Science Foundation.

Students will work in pairs. Each pair can interact with the pair across or next to them (four at each table) but, unless specified otherwise, there are no groups of four-each pair produces its own results. In case of an absence, the “odd person out” may join another pair for the day. There are too many exercises in the text to perform in one semester. I will choose those most appropriate to covering as wide a range of topics as possible without rushing. IN some cases, we may only perform certain portions of exercises. I will announce this at the start of class.

Students MUST read the Commentary section at the beginning of each exercise prior to coming to class in order to achieve maximum benefit from this style of learning and use time effectively.

OBJECTIVES: The class shall
• Use methods of inquiry, dialog, computer simulations, and interactive demonstrations to heighten the level of curiosity about and understanding of natural phenomena
• Use observation, experimentation, and the tools of science to reach a deep conceptual understanding of interactions, models, and predictive abilities and limitations of physical science
• Use investigative methods to explore the concepts of forces, motion, momentum, energy and related topics in everyday situations
• Establish a basic understanding of the several key laws and concepts which can be used to explain phenomena observed in the physical world including but not limited to how and why things move, forms of energy, light, sound, heat, electricity, and magnetism

GOALS (outcomes): As a result of completing this course, the student shall
• Possess and demonstrate a basic understanding of the laws and key concepts which govern natural phenomena
• Be able to duplicate basic processes which scientists use to obtain and revise knowledge about the natural world
• Develop a wide variety of problem-solving strategies
• Use oral and written communication, mathematical representation, and physical and conceptual models to describe and explain scientific concepts and ideas
• Be able to apply rational, creative thinking, and investigative skills to situations encountered in an increasingly technological society
• Instill a sense of curiosity and wonder about the natural world
• Construct and revise scientific explanations and models using logic and evidence
• Communicate and defend a scientific argument

Emphasis shall be placed upon:
1. A conceptual framework
2. Laboratory techniques involving hypothesizing, experiment design, modeling, prediction, observation and recording, interpretation, and explanation
3. Ability to make measurements and use computational tools and graphs to explore relationships
4. Properties of matter at all levels
5. The role of science and technology in society and daily life

Topics to be explored include:
1. motion (distance, time, speed, and acceleration)
2. forces (mass, gravity, inertia, equilibrium, groups of forces, torque, friction, Newton’s Laws, circular motion, linear and angular momentum)
3. simple harmonic motion (vibrations), waves, sound, pitch
4. energy (potential and kinetic, thermal, electromagnetic, conservation laws, and transformations)
5. properties of matter (density, elasticity, solids, liquids, and gases, pressure, buoyancy, surface tension, adhesion, Boyle’s and Charles’ Laws)
6. temperature and heat (heating and cooling, transfer mechanisms, specific heat, changes of state, evaporative cooling)
7. electricity (circuits and static electricity, charge, fields, conductors and insulators, Ohm’s Law, series and parallel)
8. magnetism (fields, sources, interactions between magnets and between magnets and currents, motors and generators)
9. light (nature, sources, production, fluorescence, LED’s, lasers, atomic models, spectra, reflection, refraction, mirrors and lenses, polarization, interference)

Methods of Evaluation:
1. Student Portfolio: 75% A detailed description of portfolio expectations will be presented at the start of the course. The portfolio will be checked approximately one month into the semester and suggestions for improvement made. A completed portfolio will be due at the last class meeting. Please purchase a 3-ring binder or a “Trapper Keeper” for this portfolio. You will also want to have a 3-hole punch so you can insert handouts, graphs, etc. Also purchase some ordinary (Cartesian) graph paper and a ruler. The portfolio will include such items as completed exercises with tables and answers, graphs related to exercises, and homework assignments. A semester project to be presented to the class may also be assigned. If so, the completed assignment would also be contained in the portfolio. Get used to keeping a diary. This is the format in which we will complete exercises, complete with all observations and comments as to how your own experiment might be improved and any surprises you encounter. In physics and many other sciences, students usually complete laboratory exercises and hand them in every week. In this course, we complete all exercises in class or immediately after and keep them with the running commentary in the portfolio. NEVER PROCRASTINATE! The portfolio system requires daily attention and simply cannot be completed at the last minute before it is to be checked. Your ability to learn hinges on your attention to this important fact.

A note about the discovery/portfolio system. You may find the approach to learning somewhat unfamiliar and even uncomfortable at first, particularly if you are used to following a text closely, being lectured to, and regurgitating material. Discovery takes time, determination, and patience. We will not cover as much content as I might like, but the depth of knowledge at the conceptual level should be enhanced. Sometimes you may wonder “Why aren’t I being provided with more guidance?” This is natural, and the “loose ends” are intentional. You may, of course, as for assistance at any time. Most of the time I will be more than happy to help. There will be occasions, however, when I will ask you to figure things out on your own. This should not be taken as a sign of indifference - it is simply part of the learning strategy we are employing. I already know many of the answers - I want you to find many of them for yourselves.

2. Midterm and final exams: 25%

3. Class attendance and participation is mandatory! One must be present to inquire. A portfolio cannot be complete unless all observations are recorded. Oral communication is required in class-much of the work carried out involves teamwork and collaborative learning. Don’t put your partner in a bad position by missing class.

4. A snap quiz may be given at any time to assess progress and efficacy of instruction. Any extra credit which might be awarded for such quizzes will be added in to the midterm and final exam grades.

5. Assigned homework and “do at home” exercises must be completed and included in the portfolio.
A list of exercises to be performed, reading, and homework will be handed out separately.