Curriculum Outline

Campbell High School
Character – Courage – Respect – Responsibility

Course & Level: **Conceptual Physics**

Department: **Science**

Teacher: **Dr. Doherty**

Grade level: **11 and 12**

Description of Course:

The conceptual physics course is designed to investigate everyday phenomena of the physical world with a primary emphasis on comprehension rather than computation. Students will be expected to use algebraic skills for some mathematical analysis; however there will not be a heavy reliance on formula usage. Topics in the first semester focus primarily on Mechanics – which includes the study of kinematics (one and two dimensional motion), dynamics (the study of forces), and concepts in gravitational interactions, work, energy, impulse, rotational mechanics, and momentum. In the second semester, students will investigate topics in waves (propagation, reflection, and refraction phenomena) as applied to sound and light, as well as electrostatics, electricity, magnetism, and AC and DC circuit theory. Students will perform frequent laboratory experiments that reinforce concepts and develop skills in collecting, organizing, and analyzing data. Students will be expected to demonstrate problem-solving strategies involving self-designed activities and demonstrations using both common materials and computer-based labware.

School – Wide Expectations:

The school-wide expectations are incorporated into all courses at Campbell High School. Underlined words in the following text illustrate this alignment between the school-wide expectations and the course curriculum.

Academic:

1. Read, write and speak effectively
2. Exhibit critical thinking and problem solving skills
3. Use resources to obtain information and facilitate learning

Civic/Social:

1. Exhibit personal responsibility
2. Work cooperatively in an atmosphere of mutual respect

Core Competencies and State Standards:

1. **Scientific Technique** - Students will develop an understanding in order to evaluate, solve, and explain solutions to problems via the scientific process.

2. **Scientific Investigation** - Students will use microprocessor-based data collection labware (and other lab equipment). Students will work both in an individual setting and cooperatively in groups.

3. **Scientific Research** - Students will research, review and interpret significant scientific developments and produce tangible, project-based applications. Students will demonstrate their understanding via both oral and written communication.

State Standards in all Competencies.

PS 1 *All living and nonliving things are composed of matter having characteristics properties that distinguish one substance from another.*
PS 2 *Energy is necessary for change to occur in matter. Energy can be stored, transferred and transformed, but cannot be destroyed.*
PS 3 *The motion of an object is affected by forces.*
PS4 *The growth of scientific knowledge in Physical Science has been advanced through the development of technology and is used (alone or in combination with other sciences) to identify, understand and solve local and global issues.*

SPS1 *– Scientific Inquiry and Critical Thinking Skills (INQ)* ***SPS2*** *– Unifying Concepts of Science* ***SPS3*** *– Personal, Social, and Technological Perspectives* ***SPS4*** *– Science Skills for Information, Communication and Media Literacy*

Suggested Instructional Strategies:

1. Lecture and Demonstration – Use of demonstration apparatus to guide student inquiry. For example, the "Discrepant Event" – students make predictions on what will happen when Event A occurs and are then required to explain it. The same rationale is applied to Event B in which the predicted outcome does not occur. In order to understand why, students must deconstruct some previously held understanding. This mode of lecture is effective at both including students and exposing misconceptions. Examples of Discrepant Event Demonstrations might be a copper tube drop (penny versus magnet) to investigate Lenz's Law, rolling a disc and a ring down an inclined plane to introduce moments of inertia, or variations of descent path to examine conservation of energy. Physically large demonstration devices also work well to impress new concepts such as using a sonotube with Meker burners (to drive convection currents) as an open tube resonator, a Rueben's Tube (using compressed gas and flame to illustrate standing waves), or freezing drops of falling water by matching frequencies with a stroboscope to examine the kinematics of freely falling bodies.

2. Lab, Investigation – Exploratory or investigation labs allow students to ask their own questions about a particular concept. These labs have limited formal outcomes and are instead designed to elicit ideas from students. One example includes an Electromagnetic Spectrum Lab in which students predict and then perform qualifying tests to determine whether various frequency emissions within the E/M spectrum will penetrate through various materials (will radio frequencies pass through aluminum screen / UV through cotton / gamma through wood, etc.) Another example would be determining which factors effect the period of oscillation in a harmonic oscillator (such as a pendulum or a spring/mass system). Again, students are simply using labware to investigate and evaluate, not quantify or predict.

3. Lab, Evaluation – From the midpoint to the end of a particular unit of study, students are ready to evaluate the relationships that have been presented to them. Oftentimes the goal is to develop a mathematical relationship, or predict the results based on an application of theory. Examples include the ballistic pendulum lab in which a pendulum bob is cut in mid "swing" and students are expected to predict where on the floor the projectile will land or the standing waves lab in which students use the wave speed equation to predict the frequency of oscillation in an elastic string.

4. Construction Project – The physics program is anchored by large projects which run parallel to the course. Students are expected to apply concepts from the course in the design and construction of these projects. In the Mousetrap Car project, students are required to build a wheeled vehicle that moves under the power of a common mousetrap. The understated goal of these projects is to require students to successfully consider and apply concepts from the course (rotational mechanics: moments of torque and inertia, angular kinematics, etc.) without the constraints of vocabulary, formal mathematics, or formulas.

5. Biography Research Project – Students will gain a broader understanding of the essence of scientific inquiry by gaining a historical perspective of the individuals who have shaped the collective understanding. Students not only conduct research and write a five to six page essay on an individual physicist, but are also required to provide a short presentation to the class which includes a demonstrative component (experimental recreation, model, or related demonstration).

Suggested Texts and Media (Software, A/V, etc.):

1. Textbook and ancillary materials (concept development sheets, labs, etc.): *Conceptual Physics*, Paul Hewitt

2. PASCO *Datastudio* software

3. NOVA DVD's**:** *Newton's Dark Secrets* (biography project), *Medieval Siege* (trebuchet project), *Speed of Sound* (bow waves, Doppler Effect, wave speed), *Einstein's Big Idea* (biography, relativity) *Mechanical Universe* (mechanics, E&M, oscillations and waves), *Mythbuster's Episodes*: "Breakstep Bridge" (resonance), "Penny Drop" (terminal velocity, kinematics), "Barrel of Bricks" (dynamics, simple machines).

4. Prentice Hall Test Bank and Generator software

The science curriculum at Campbell High School is a dynamic document, reflecting the nature of the subject. It addresses ever-changing areas of study, such as genetics and quantum physics, as well as the fundamentals, such as the Periodic table and Newton's Laws of Motion. Scientific Research is an important component for each course at Campbell. The analysis and interpretation of recent scientific information and articles will vary appropriately with grade level and course difficulty.
We utilize a variety of instructional resources beyond the identified textbooks and materials throughout the school year to enhance your student's educational experience. Parents/Guardians are welcome to review the available resources throughout the school year by contacting their student's teacher. Due to religious or moral objections, alternative assignments may be available upon request. Please contact the classroom teacher for further details.

Suggested Assessment Strategies:

1. Quiz / Test – Conceptual Physics Test Generator Software. Typically 50% multiple choice, true/false, or matching and 50% open response (a mixture of problem solving, essay, and graphical analysis).

2. Lab Report Rubric – In order to demonstrate competency in the Scientific Investigation requirement, students communicate lab outcomes that comply with a standard lab reporting framework.

3. Project Rubric – Construction projects contain both performance criteria and journaling criteria in the form of rubrics.

4. Informal Groupwork – Various modes of formative assessment in which students work on a particular problem in groups of two to four. Groupwork encourages peer learning, strengthens topical skill sets through teaching, and promotes collaboration and community. Examples of groupwork include whiteboarding / presentation and written problem sets.