# Blackhawk School District

## CURRICULUM

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| **Course Title:** | **Lab Physics** |
| **Grade Level(s):** | **Eleventh-Twelfth** |
| **Length of Course:** | **Daily (42 minutes or 84 minutes – alternates each day)** |
| **Faculty Author(s):** | **Russell Couch** |
| **Date:** | **Fall 2008/ Revised May 2009 / Review October 2012** |

**MISSION STATEMENT:**
The goal of science education is to develop within students an understanding of the world around us by fostering curiosity, developing inquiry skills, and creating an excitement for learning science.

**COURSE DESCRIPTION:**
This is a rigorous academic course requiring an excellent mathematics background. The course includes much laboratory work. Physics is the study of the relationship between matter and energy. This course is concerned with the study of classical mechanics, waves, sound and light. This course is a prerequisite for AP Physics. If the last chapters are not completed in the time allotted, they may be pushed to the following year in AP Physics. If this outline takes less time than allotted, then chapters 8 and 9 of the main text can be completed in this course.

**TEXTBOOK**
*Holt Physics*, Serway and Faughn, Holt, Rinehart and Winston, Inc 2006

**SUPPLIMENTARY MATERIALS**
*Center for Nanoscale Systems Institute for Physics Teachers* www.cns.cornell.edu/cipt/
*Modern Physics Laboratory Experiments*, Holt, Rinehart and Winston, Inc 1990
*Practical Physics Labs*, J. Weston Walch, 1990
*Physics Labs with Computers*, PASCO scientific 1999
*Vector Basics*, Joan C. Obermiller, J. Weston Walch, 1993

**Equipment:** basic physics lab equipment including but not limited to: Pasco Interface equipment, Vernier dynamics cart system, meter sticks, stopwatches, spark timers, masses, triple beam balances etc.

**PA Common Core Standards for Reading and Writing in Science and Technical Subjects:**

Pennsylvania Department of Education has released standards that describe what students in the science and technical subjects' classrooms should know and be able to do with the English language in reading and writing, grade 6 through 12. The standards provide the targets for instruction and student learning essentials for success in all academic areas, not just language arts classrooms. Although the standards are not a curriculum or a prescribed series of activities, Blackhawk School District has used them to develop this science curriculum.

The standards for Reading are available at:

http://static.pdesas.org/content/documents/PA_Common_Core_Standards_for_Reading_in_Science_And_Technical_Subjects_8-7-12.pdf

The standards for Writing are available at:

http://static.pdesas.org/content/documents/PA_Common_Core_Standards_for_Writing_in_Science_and_Technical_Subjects_8-7-12_rev_2.pdf

**ESSENTIAL QUESTIONS:**

Essential questions are the heart of the curriculum. Essential questions are conceptual commitments that teachers will use to guide instructional decision-making. In addition, they are kid friendly so that students can easily understand them. Essential questions are meant to be shared with students in either discussion or posting in the classroom. Essential questions provide the focus for teaching and learning. The following are the Essential Questions for this class:

1. **How can the scientific method be used to help me solve problems that I encounter in my own life?**
2. **How do the rules about the metric system enable scientists to communicate effectively across the world?**
3. **How do you solve word problems in physics?**
4. **What is the best way to get to a destination?**
5. **What kinds of forces do you encounter in your own life and what effect (if any) do these forces have on you?**
6. **In what type of situation does each of Newton's Laws of Motion apply and how can each be used to describe how the motion happens or be able to predict what will happen?**
7. **How do can I use the terms work and energy to describe motion that I see?**
8. **How do CSI people reconstruct an accident using momentum and conservation of momentum?**
9. **When does an object exhibit circular motion? What are some examples?**
10. **What is gravity and how does it relate to Kepler's Laws of Planetary Motion?**
11. **When does an object exhibit Simple Harmonic Motion? What are some examples?**
12. **When is it better to use conservation of energy to predict the outcome of an event, when is it between to use conservation of momentum or does it matter?**
13. **What types of phenomena exhibit wave properties?**
14. **How do corrective lenses enable people to see well?**
15. **In what types of situations do refraction, diffraction and interference occur?**
16. **In what ways are waves and simple harmonic motion similar? Different?**

Assessing Essential questions is key to a robust curriculum. If Essential Questions are the focal point of learning, how then do we assess students? The following is an overview of recommended assessments to the Essential Questions. In addition, Differentiated learning opportunities are embedded as well (noted by DI).

1. How can the scientific method be used to help me solve problems that I encounter in my own life?
    a. Assessment: Essay question on chapter test or midterm or final
2. How do the rules about the metric system enable scientists to communicate effectively across the world?
    a. Assessment: Essay question on Midterm
3. How do you solve word problems in physics?
    a. DI: following the day an assignment that involves word problems, individual help is given to those students that need it during class. Also, every test has word problems
4. What is the best way to get to a destination?

    a. DI: Students will create a project in which they will use the terms displacement, velocity and acceleration to describe directions to get to a destination in at least two different ways and describe which is the best way, the mode of output for the project is up to the student
5. What kinds of forces do you encounter in your own life and what effect (if any) do these forces have on you?
    a. DI: Students will be asked to convey this information but the mode of communication will be up to them, it could be a concept map, an essay, a PowerPoint etc
6. In what type of situation does each of Newton's Laws of Motion apply and how can each be used to describe how the motion happens or be able to predict what will happen?
    a. Assessment: Base group activity in which each group uses their own members' homework to create a poster of the group's best responses to this question.
7. How do can I use the terms work and energy to describe motion that I see?
    a. Assessment: Essay question on chapter test
8. How do CSI people reconstruct an accident using momentum and conservation of momentum?
    a. DI: Base group activity involving different situations that are tailored to the interests of the students.
9. When does an object exhibit circular motion? What are some examples?
    a. Assessment: Essay question on chapter test.
10. What is gravity and how does it relate to Kepler's Laws of Planetary Motion?
    a. Assessment: Classroom discussion.
11. When does an object exhibit Simple Harmonic Motion? What are some examples?
    a. Assessment: Essay question on test
12. When is it better to use conservation of energy to predict the outcome of an event, when is it between to use conservation of momentum or does it matter?
    a. Assessment: Base group activity in which each group uses their own members' homework to create a poster of the group's best responses to this question.
13. What types of phenomena exhibit wave properties?
    a. Assessment: Class discussion/ demonstration of wave properties.
14. How do corrective lenses enable people to see well?
    a. Assessment: Base group activity in which each group uses their own members' homework to create a poster of the group's best responses to this question.
15. In what types of situations do refraction, diffraction and interference occur?
    a. Assessment: Essay question on Midterm.
16. In what ways are waves and simple harmonic motion similar? Different?
    a. Assessment: Classroom discussion.

**ROBUST VOCABULARY:**
Robust vocabulary words are Tier 2 words, meaning that they are complex, powerful, and generalizable. Robust vocabulary words support language development of both lower and high level learners. In addition, robust vocabulary instruction helps prepare students for SATs, upper level high school classes, and college. "Studies showed that robust instruction was quite effective not only for learning the meanings of words but also for affecting reading comprehension." (p. 2 *Bringing Words to Life*)

Teachers are asked to commit to teaching and students USING these words throughout the entire year. Using a variety of instructional strategies, students will learn the meaning of these words in a deep and meaningful way in this content and across other content areas.

The Robust Vocabulary for this class are: **Analyze, Data, Demonstrate, Energy, Estimate, Evaluate, Formula, Hypothesis, Principle, Proportion**

*The following outline provides a general overview of the course content and is a suggested chronological timetable. The days denoted for each area provide an idea for the overall time spent working with a given topic throughout the school year.*

| **COURSE OUTLINE** | **OBJECTIVES** (PA Anchors) | **PROPOSED TIME** | **SUGGESTED LAB ACTIVITES** | **LESSON REFLECTION (for future revisions)** |
|---|---|---|---|---|
| I. Content<br>a. Chapter 1 The Science of Physics<br>i. What is Physics?<br>ii. Measurements in Experiments<br>iii. The Language of Physics | S11.A.1.1.1 Compare and contrast scientific theories, scientific laws, and beliefs.<br>S11.A.2.1.1 Critique the elements of an experimental design (e.g. raising questions, formulating hypotheses, developing procedures, identifying variables, manipulating variables, interpreting data and drawing conclusions) applicable to a specific experimental design.<br>S11.A.2.1.2 Critique the elements of the design process (e.g. identify the problem, understand criteria, create solutions, select solution, test/evaluate, communicate results) applicable to a specific technological design.<br>S11.A.2.1.5 Communicate results of investigations using multiple representations.<br>S11.A.2.2.1 Evaluate appropriate methods, instruments, and scales for precise quantitative and qualitative observations (e.g. to compare properties of materials, water quality). | 12 - 15 days | **Preferred Labs:**<br>CIPT – Atomic Force Microscopy – equipment is here<br>Holt 1 In-Text Lab – Physics and Measurement<br>Holt 1 Discovery – The Circumference-Diameter Ratio of a Circle<br>PPL 16 – Inertial Pendulum<br>**Alternate Labs:**<br>My Home – Made Measurements Lab<br>PPL 1 – The Mass of the Air in the Room<br>MP 1 – Measuring Length<br>MP 2 – Measuring Mass | |
| b. Chapter 2 Motion in One Dimension<br>i. Displacement and Velocity<br>ii. Acceleration – (no Bible Equations except as enrichment or differentiated instruction)<br>iii. Falling Objects | S11.A.2.2.2 Explain how technology (e.g. GPS, spectroscope, scanning electron microscope, pH meter, probe, interface, imaging technology, telescope) is used to extend human abilities and precision.<br>S11.A.3.3.3 Analyze physical patterns of motion to make predictions or draw conclusions (e.g. solar system, tectonic plates, weather systems, atomic motion, waves). | 22 - 25 days | **Preferred Labs:**<br>CLP01 – Position and time<br>CLP02 – Velocity and Time<br>MP3 – Measuring Time – Spark Timer<br>CLP05 – Acceleration of a Freely Falling Picket Fence | |

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| | S11.C.3.1.3 Describe the motion of an object using variables (I.e. acceleration, velocity, displacement). | | **Alternate Labs:**<br><br>Discovery 2, PPL2 – Acceleration of Gravity, CLP04 – Fan Cart, CLP06 – Acceleration of Gravity | |
| c. Vector Ideas lesson<br>i. Naming, Measuring and Drawing Vectors<br>ii. Algebraic Addition of Collinear Vectors<br>iii. Vector Addition with Perpendicular Vectors | | 5 – 7 days | Vector Ideas Worksheets Pages 1 through 20 | |
| d. Chapter 4 Forces and the Laws of Motion<br>i. Changes in Motion<br>ii. Newton's First Law<br>iii. Newton's Second and Third Law<br>iv. Everyday Forces | S11.A.1.3.2 Describe or interpret dynamic changes to stable systems (e.g. chemical reactions, human body, food webs, tectonics, homeostasis). | 22 - 25 days | **Preferred Labs:**<br><br>Holt 4 Discovery – Discovering Newton's Laws<br><br>MP 4 Acceleration with spark timers<br><br>CL P08 – Newton's Second Law – Constant Force<br><br>CL P09 – Newton's Second Law – The Push and Pull of a Cart<br><br>MP 7 – Coefficient of Sliding Friction<br><br>**Alternate Labs:**<br>CL P12, Holt 4 Inv, PPL 19, CL P10, CL P21 | |
| e. Chapter 5 Work and Energy<br>i. Work<br>ii. Energy<br>iii. Conservation of Energy | S11.A.3.1.4 Apply the universal systems model of inputs, processes, outputs, and feedback to a working system (e.g. heating, motor, food production) and identify the resources necessary for operation of the | 15 days | **Preferred Labs:**<br>Holt 5 Discovery – Exploring Work and Energy<br><br>PPL 7 – Conservation of Energy Potential into Kinetic | |

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| iv. Power | system.<br>S11.C.2.1.3 Apply the knowledge of conservation of energy to explain common systems (e.g. refrigeration, rocket propulsion, heat pump). | | MP13 – Elastic Potential Energy<br><br>MP12 - Power<br><br>**Alternate Labs:**<br>CLP19, PPL8, PPL6 | |
| f. Chapter 6 Momentum and Collisions<br>i. Momentum and Impulse<br>ii. Conservation of Momentum<br>iii. Elastic and Inelastic Collisions | S11.A.1.1.4 Explain how specific scientific knowledge or technological design concepts solve practical problems (e.g. momentum, Newton's universal law of gravitation, tectonics, conservation of mass and energy, cell theory, theory of evolution, atomic theory, theory of relativity, Pasteur's germ theory, relativity, heliocentric theory, ideal gas laws).<br>S11.C.3.1.1 Explain common phenomena (e.g. a rock in a landslide, an astronaut during a space walk, a car hitting a patch of ice on the road) using an understanding of conservation of momentum. | 15 days | **Preferred Labs:**<br>CLP11 – Impulse and Momentum<br><br>Enrichment 9 - conservation of momentum - HO train cars – modified to be used with dynamics carts with plungers | |
| g. Chapter 7 Circular Motion and Gravitation<br>i. Circular Motion<br>ii. Newton's Law of Universal Gravitation<br>iii. Motion in Space<br>iv. Torque and Simple Machines | S11.A.1.1.4 Explain how specific scientific knowledge or technological design concepts solve practical problems (e.g. momentum, Newton's universal law of gravitation, tectonics, conservation of mass and energy, cell theory, theory of evolution, atomic theory, theory of relativity, Pasteur's germ theory, relativity, heliocentric theory, ideal gas laws).<br>S11.C.3.1.5 Calculate the mechanical advantage for moving an object by using a simple machine.<br>S11.D.3.1.1 Describe planetary motion and the physical laws that explain planetary motion.<br>S11.D.3.1.3 Explain the current scientific theories of the origin of the solar system and universe (e.g. big bang theory, solar nebular theory, stellar evolution) | 15 days | **Preferred Labs:**<br><br>MP 9 – Centripetal Force<br><br>Holt 7 In-Text – Machines and Efficiency<br><br>MP8 – Center of Gravity<br><br>**Alternate Labs:**<br><br>PPL17, CLP26, PPL20, MP11 | |

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| h. Chapter 11 Vibrations and Waves<br>i. Simple Harmonic Motion<br>ii. Measuring Simple Harmonic<br>iii. Motion<br>iv. Properties of Waves<br>v. Wave Interactions | | 14 - 15 days | **Preferred Labs:**<br><br>Holt 11 In-Text – Inquiry Lab – Simple Harmonic Motion of a Pendulum<br><br>PPL15 – Springs and Masses<br><br>**Alternate Labs:**<br>PPL5, MP10, CLP14, CLP15 | |
| i. Chapter 12 Sound<br>i. Sound Waves<br>ii. Sound Intensity and Resonance<br>iii. Harmonics | | 8 - 10 days | **Preferred Labs:**<br>PPL 35 – Using an Echo to Find the Speed of Sound<br><br>MP 25 – Resonance: The Speed of Sound<br><br>PPL 36 – Waves in Strings or CIPT borrowed lab on resonance – Resonance in Transverse Waves – equipment needs to be borrowed and procedure needs to be modified for use with Pasco photogates, but CIPT is a better version<br><br>**Alternate Labs:**<br>CLP 27, Holt12 Inv, PPL 37 | |
| j. Chapter 13 Light and Reflection<br>i. Characteristics of Light<br>ii. Flat Mirrors<br>iii. Curved Mirrors<br>iv. Color and Polarization | S11.C.2.1.1 Compare or analyze waves in the electromagnetic spectrum (e.g. ultraviolet, infrared, visible light, X-rays, microwaves) as well as their properties, energy levels, and motions). | 14 - 15 days | **Preferred Labs:**<br><br>MP 26 Photometry<br><br>MP 27 Plane Mirrors<br><br>CIPT – Communicating with Light: From Telephony to Cell Phones<br><br>**Alternate Labs:**<br>CIPT – Photovoltaic Cells – equipment needs to be borrowed | |

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| k. Chapter 14 Refraction<br>i. Refraction<br>ii. Thin Lenses<br>iii. Optical Phenomena | | 10 days | MP 29 – Index of Refraction of Glass<br><br>MP 30 – Converging Lenses | |
| l. Chapter 15 Interference and Diffraction<br>i. Interference<br>ii. Diffraction<br>iii. Lasers | | 8 - 10 days | **Preferred Labs:**<br><br>CIPT labs on Diffraction and DNA Diffraction – Equipment is here<br><br>CIPT lab on Thin Film Interference – Equipment needs to be borrowed | |
| Covered in AP Physics | *S11.C.3.1.4 Explain how electricity induces magnetism and how magnetism induces electricity as two aspects of a single electromagnetic force.*<br>*s11.C.2.1.4 Use Ohm's Law to explain relative resistances, currents, and voltage.* | | | |
| Not Covered | *S11.D.3.1.2 Describe the structure, formation, and life cycle of stars.*<br>*S11.B.2.2.1 Describe how genetic information is expressed (I.e. DNA, genes, chromosomes, transcription, translation, and replication).* | | | |
| Covered in doing lab exercises and lab reports | S11.A.1.1.3 Evaluate the appropriateness of research questions (i.e. testable vs. non-testable).<br>S11.A.1.1.5 Analyze or compare the use of both direct and indirect observation as means to study the world and the universe (e.g. behavior of atoms, functions of cells, birth of stars).<br>S11.A.1.3.1 Use appropriate quantitative data to describe or interpret change in systems (e.g. biological indices, electrical | | **Supplementary Lab Manuals**<br>Modern Physics – Exercises and Laboratory Experiments; Frederick E. Trinklein; Holt, Rinehart and Winston, Inc.<br><br>Practical Physics Labs; Peter Goodwin; J. Weston Walsh, Publisher<br><br>Computer Lab Manual from | |

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| | circuit data, automobile diagnostic systems data).<br>S11.A.2.1.3 Use data to make inferences and predictions, or to draw conclusions, demonstrating understand of experimental limits.<br>S11.A.2.1.4 Critique the results and conclusions of scientific inquiry for consistency and logic.<br>S11.A.3.1.2 Analyze and predict the effect of making a change in one part of a system on the system as a whole.<br>S11.A.3.1.3 Use appropriate quantitative data to describe or interpret a system (e.g. biological indices, electrical circuit data, automobile diagnostic systems data).<br>S11.A.3.2.1 Compare the accuracy of predictions represented in a model to actual observations and behavior. | | Pasco Scientific<br><br>Center for Nanoscale Systems Institute for Physics Teachers<br>www.cns.cornell.edu/cipt/ | |
| Covered throughout the course | S11.A.1.1.2 Analyze and explain the accuracy of scientific facts, principles, theories, and laws.<br>S11.A.3.1.1 Apply systems analysis, showing relationships (e.g. flowcharts, concept maps), input and output, and measurements to explain a system and its parts.<br>S11.A.3.2.2 Describe advantages and disadvantages of using models to simulate processes and outcomes.<br>S11.A.3.2.3 Describe how relationships represented in models are used to explain scientific or technological concepts (e.g. dimensions of objects within the solar system, life spans, size of atomic particles, topographic maps). | | | |