Course of Study

PHYSICS

Warren County Career Center

3525 North State Route 48
Lebanon, Ohio 45036

Adopted 6-15-06

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Acknowledgements

Physics
Warren County Career Center

We would like to take this opportunity to express our gratitude to the following people for their guidance and support in the preparation of this course of study:

Warren County Career Center Administrative Team
Warren County Educational Service Center
Mr. Karl Flem
Mr. Jeff Little
Mrs. Adrienne Schmidt
Ms. Toni Welles
Mrs. Charla Cornwell
Mrs. Sandra Monti

Warren County Career Center
Resolution Of School Board Approval

WHEREAS, representatives of the Science Department of the Warren County Career Center have reviewed the Course of Study; and

WHEREAS, this Course of Study is based upon Academic Content Standards adopted by the State of Ohio for the Physics program; and

WHEREAS, the Science Department have reviewed and added competencies as needed to address local labor market needs and trends in the industry;

NOW, THEREFORE, BE IT RESOLVED, in accordance with the Superintendent's recommendation, that the Warren County Career Center adopt the Physics Course of Study.

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District Superintendent Date

_____

President, Board of Education Date

Statement of Recommendation

The Science Department at Warren County Career Center has reviewed this course of study and recommends it for use as the foundation for instruction in the Physics class.

The developers of this course of study have considered local labor market needs and the school's ability to offer specialized programs. The competencies have been reviewed and accepted as being congruent with our school's vision, mission, and strategic goals. When appropriate, additional competencies related to the program area have been incorporated into this course of study.

Achievement of technical competencies, utilizing proper attitudes, and demonstrating appropriate values are critical for successful employment and for furthering educational opportunities within a student's chosen field. We believe that this course of study adequately and correctly focuses upon student development.

This course of study is recommended on: 6-15-06

Warren County Career Center Vision Statement

WCCC is the valued partner of choice within the educational and economic systems of our communities, by providing quality academic and career technical education.

We pave the way for a future of opportunities unique to each of our learners.

Warren County Career Center Mission Statement

To prepare youths and adults to make informed career choices and to successfully enter, compete, and advance in a changing work world.

Warren County Career Values

- Communicating openly and honestly
- Taking ownership of personal actions and being held accountable for results
- Upholding and demonstrating high ethical, educational and fiscal standards
- Exhibiting high levels of professionalism
- Providing high quality instruction and highly qualified staff to ensure success for all learners
- Making quality customer service a high priority
- Promoting partnerships and a team environment
- Celebrating team and individual achievements
- Using data to drive planning, decision making and actions

Course Design

Courses are designed to reflect career-focused education, which combines high-level academics with real-life technical skills. The intent is to maximize a student's present and future academic and career success.

Career-focused education enhances the integration of academic and technical skills, designs programs that prepare students with transferable skills and promotes each student's career opportunities.

Course Philosophy

We believe that the philosophy for our science courses to be:

- Prepare students to use appropriate scientific processes and principles to make personal decisions;
- Enable students to engage in intelligent public discourse about matters of scientific and technological concern;
- Help students develop an understanding of themselves and the world in which they live;
- Foster an understanding of the nature of science, the development of science processes, the principles of science, and the connections between all the sciences;
- Increase their future economic productivity through the use of scientific knowledge, understanding, and skills in their careers.

Course Goals

The course goals for Physics are to:

- Acquire an understanding of the concepts of matter and energy;
- Learn how concepts have developed from earlier ideas and thus to become aware of the methods by which scientific understandings evolve;
- Master some of the quantitative relationships that express these understandings and to acquire skill in using them;
- Develop the ability to recognize, define, and solve problems;
- Understand Physics concepts and how their interactions are involved with technology and career pathways.

Course Description

This course gives the student a comprehensive study of general Physics concepts and their application in career pathways.

This study will help students develop the skills necessary for development of critical thinking in the work force and real life situations.

Concepts taught in this course will prepare students for success in college level coursework in the physical sciences.

Students should have successfully completed Algebra I, and it is highly recommended that the student has successfully completed or is concurrently taking Geometry or Algebra II.

Academic and Technical Integration

Expectations of curriculum must be aligned with what is written, taught, assessed, and reported. Student expectations focus on active, project-centered learning—an approach to learning that emphasizes a connection between ideas in a discipline and the outside world. Educational programming and course content will clearly connect career and post-secondary opportunities. At the Warren County Career Center, the main goal is to design courses and projects that use strategies for authentic instruction. These characteristics of instruction focus on deep understanding, established opportunities for concept connections, provide anticipatory and abstract thinking, and emphasize genuine application.

The academic courses at the WCCC follow the state model curricula. They are designed to meet both associate school and state requirements. These standards respond to the need to improve student achievement, quality of curriculum and instruction, and strengthen school and community relationships.

Technology

The Warren County Career Center board and staff believe that technology skills are essential for all students to achieve in the 21st century. It is the goal of this district to infuse technology into all facets of education:

- Instruction
- Assessment
- Administration
- Career planning
- Course design
- Professional development

Strategies to incorporate technology into all facets of education are a priority of the district and there is commitment to a continual process to provide updated hardware, software, and professional development for staff members for the purpose of providing a high quality education, with the integration of technology, for all students.

Students Served

The population served by this program are juniors and seniors at the Warren County Career Center.

Scope and Sequence

Physics

Competency 1 *Methods of Science and Measurement*

- Introduce the concepts of matter and energy
- Understand some of the methods and activities by which scientists study matter and energy
- Understand the role of measurement in obtaining precise information about matter and energy
- Learn how to measure length and time
- Learn how to express measured quantities and how to deal mathematically with them
- Identify mass and weight as properties of all matter and learn how to measure them
- Learn the difference between mass and weight

Competency 2 *Force, Motion, and Energy*

- Explain that energy is often associated with matter in motion and that motion is controlled by forces
- Learn how to represent forces and motion by vectors
- Learn how to obtain the combined effect of two or more vectors acting upon the same point of a body
- Understand how a vector can act in directions other than its own
- Understand that the motion of a body is relative and can only be described with respect to some other body
- Learn how to describe and analyze the motion of a body moving in a straight line
- Learn how to describe and analyze the motion of bodies that are confined to a plane
- Apply that knowledge to projectiles, planets, and pendulums
- Learn Newton's three laws of motion, which describe how forces control motion
- Understand the limitations of Newton's laws and the role of Einstein's theory of relativity in dealing with them
- Understand the nature of friction and its role in opposing the motion of bodies
- Understand and apply the concepts of momentum and the law of conservation of momentum
- Discuss how the application of Newton's laws of motion led to the law of gravitation
- Understand that the law of gravitation applies to all matter in the universe
- Apply the law of gravitation in explaining the motion of planets, satellites, and falling bodies
- Learn how forces do work
- Learn the role of friction in resisting forces
- Compare the relationship between the work input and the work output in a frictionless machine
- Compare the relationship between the work input and the work output in a practical machine
- Learn how to compute and measure power
- Understand how energy is measured
- Identify the various forms of energy and to note that mass is one of them

- Explain that mass and energy may be transformed into other forms of mass and energy but that in all such transformations, the sum total of mass and energy remains the same
- Understand the meaning and importance of the law of conservation of mass and energy

Competency 3 *Heat and the Structure of Matter*

- Learn the difference between temperature and heat
- Find out how to measure temperature
- Find out how to measure heat
- Learn that when heat is added to a substance the temperature of the substance rises or the substance changes state
- Find that the law of conservation applies to heat and in any transfer of heat from one body to another, heat is neither created nor destroyed
- Show that heat can do work and is a form of energy
- Understand that the three laws of thermodynamics describe the behavior of physical processes involving work and heat
- Examine the evidence that suggests the molecular structure of matter and the existence of attractive and repulsive forces among molecules
- Study the nature of the forces and molecular motions in solids, liquids, and gases
- Understand that heating a body of matter to a higher temperature increases the motion of its molecules, while cooling the body slows down its molecular motion
- Examine the evidence that led to the identification of the particles of which matter is composed as molecules and atoms
- Investigate the general gas laws and to learn how to apply them
- Develop a theory of molecular motion that explain the behavior of gases both qualitatively and quantitatively
- Apply this theory to understanding the varying conditions of a gas such as its temperature and pressure
- Evaluate the theory in terms of its successes and limitations

Competency 4 *Wave Motion, Sound, and Light*

- Study the nature of wave motion as means of transferring energy
- Study some of the phenomena characteristic of wave motion such as reflection, refraction, interference, and diffraction
- Understand the nature and transmission of sound as an example of wave motion
- Identify light as a form of energy
- Study the properties and behavior of light
- Investigate and evaluate the different theories that have been advanced to explain the properties and behavior of light
- Observe and study how light is reflected and refracted
- Investigate how the wave theory of light accounts for its reflection and refraction
- Learn how the refraction of light through a prism can be used to separate white light into its component colors
- Learn how mirrors and lenses form images
- Learn how mirrors and lenses are used in optical instruments to increase the range and the accuracy of human vision
- Study the interference and diffraction of light as further evidence of its wave nature
- Learn how to make a direct measurement of the wavelengths of light of different colors

Competency 5 *Electricity*

- Study the evidence that all bodies of matter contain positive and negative electric charges

- Learn how bodies acquire electric charges and how to detect and identify those charges
- Propose a theory to explain how bodies gain or lose electric charge and to test the theory
- Learn how to control the movement of electrons in charging and discharging bodies and in setting up a continuous electric current
- Investigate how electricity is conducted through liquids and gases
- Examine the evidence leading to the discovery that there is a natural unit of electric charge equal to the quantity of charge on the electron
- Study the evidence that supports the law of conservation of electric charge and learn to apply that law
- Study quantitatively the nature of the forces between electric charges
- Develop the concept of the electric field as a transmitter of electric force
- Learn how work is done and potential energy is stored in an electric field
- Learn how to use electric fields to control and direct the motion of electric charges
- Learn how a steady direct current may be set up and maintained in an electric circuit
- Study the factors that control the flow of current in an electric circuit
- Study the role of energy in the electric circuit; how it is received, transferred, and transformed
- Learn how to connect electrical devices for most effective use of electrical energy
- Learn the characteristics of series connections in circuits
- Learn the characteristics of parallel connections in circuits

Competency 6 *Electromagnetism*

- Become familiar with the properties of magnets and their magnetic fields
- Understand the interrelationships between electric currents and magnetic fields
- Develop a theory of magnetism and study the evidence supporting that theory
- Recognize magnetism as a property of all matter
- Investigate the nature of the force exerted by a magnetic field on electric currents and moving charges
- Learn how magnetic forces are used in meters to measure electric currents
- Understand how magnetic forces enable us to convert electrical to mechanical energy in such devices as the motor
- Learn how electric and magnetic fields can be used to measure the velocities and masses of charged atomic and subatomic particles
- Learn how magnetic fields can produce currents in conductors
- Understand how this effect is applied in the electric generator to convert mechanical energy into electrical energy
- Learn how a changing current in one circuit induces an electromotive force in a nearby circuit
- Understand how the above effect is used in the transformer to increase or decrease the EMF applied to the transformer
- Learn how electromagnetic waves are generated and transmit energy
- Learn how electromagnetic waves are used in radio reception and transmission
- Evaluate the successes and failures of Maxwell's theory of the origin, nature, and behavior of electromagnetic waves

Competency 7 *Quantum Theory and Nuclear Physics*

- Examine the evidence that light has particle-like properties
- Study the evidence that matter has wavelike properties
- Learn how the quantum theory provides an explanation for both particle-like and wavelike properties of electromagnetic radiation as well as of matter
- Examine the experimental evidence that revealed the nature of the atomic nucleus
- Learn how this evidence led to the Rutherford model of the atom
- Evaluate the successes and failures of the Rutherford atomic model
- Learn how by applying the quantum idea to the Rutherford model of the atom, Bohr developed a model of the hydrogen atom that fully explained its emission and absorption of light
- Evaluate the successes and failures of the Bohr atomic model
- Learn how the Bohr model was modified to eliminate its weaknesses
- Examine the experimental evidence supporting the current model of the atom
- Learn how quantum principles explain the structure of atoms and some of their chemical properties
- Understand the mechanism of conduction in solids that explains the differences in conductivity between conductors, semiconductors, and insulators
- Learn how semiconductor diodes may be used to rectify alternating currents and how semiconductor transistors may be used to amplify currents and voltages
- Understand the principle of the laser that enables it to produce concentrated, coherent, single-frequency beams of light
- Gain an insight into the structure of the atomic nucleus and the forces that act on its constituent parts
- Learn how to compute the binding energy that holds the nucleus together
- Understand from the structure of the nucleus how some nuclei can be transmuted into others
- Learn the principles underlying nuclear reactions
- Study the methods whereby large quantities of nuclear energy may be released to become sources of useful power
- Become familiar with the instruments used to detect nuclear and subnuclear particles
- Understand the principles underlying the machines used to accelerate high speed projectiles for probing atomic nuclei and subnuclear particles
- Classify the subnuclear particles that emerge from nuclear disruptions according to their similarities and differenes
- Study the four forces that account for all the properties and changes in matter

TECHNOLOGY STANDARDS

Standard 1: Nature of Technology

Students develop an understanding of technology, its characteristics, scope, core concepts* and relationships between technologies and other fields.

Benchmark A: Synthesize information, evaluate and make decisions about technologies.

Benchmark B: Apply technological knowledge in decision-making.

Benchmark C: Examine the synergy between and among technologies and other fields of study when solving technological problems.

Standard 2: Technology and Society Interaction

Students recognize interactions among society, the environment and technology, and understand technology's relationship with history. Consideration of these concepts forms a foundation for engaging in responsible and ethical use of technology.

Benchmark A: Interpret and practice responsible citizenship relative to technology.

Benchmark B: Demonstrate the relationship among people, technology and the environment.

Benchmark C: Interpret and evaluate the influence of technology throughout history, and predict its impact on the future.

Benchmark D: Analyze ethical and legal technology issues and formulate solutions and strategies that foster responsible technology usage.

Benchmark E: Forecast the impact of technological products and systems.

Standard 3: Technology for Productivity Applications

Students learn the operations of technology through the usage of technology and productivity tools.

Benchmark A: Integrate conceptual knowledge of technology systems in determining practical applications for learning and technical problem-solving.

Benchmark B: Identify, select and apply appropriate technology tools and resources to produce creative works and to construct technology-enhanced models.

Standard 4: Technology and Communication Applications

Students use an array of technologies and apply design concepts to communicate with multiple audiences, acquire and disseminate information and enhance learning.

Benchmark A: Apply appropriate communication design principles in published and presented projects.

Benchmark B: Create, publish and present information, utilizing formats appropriate to the content and audience.

Benchmark C: Identify communication needs, select appropriate communication tools and design collaborative interactive projects and activities to communicate with others, incorporating emerging technologies.

Standard 5: Technology and Information Literacy

Students engage in information literacy strategies, use the Internet, technology tools and resources, and apply information-management skills to answer questions and expand knowledge.

Benchmark A: Determine and apply an evaluative process to all information sources chosen for a project.

Benchmark B: Apply a research process model to conduct research and meet information needs.

Benchmark C: Formulate advanced search strategies, demonstrating an understanding of the strengths and limitations of the Internet, and evaluate the quality and appropriate use of Internet resources.

Benchmark D: Evaluate choices of electronic resources and determine their strengths and limitations.

Standard 6: Design

Students apply a number of problem-solving strategies demonstrating the nature of design, the role of engineering and the role of assessment.

Benchmark A: Identify and produce a product or system using a design process, evaluate the final solution and communicate the findings.

Benchmark B: Recognize the role of teamwork in engineering design and of prototyping in the design process.

Benchmark C: Understand and apply research, development and experimentation to problem-solving.

Standard 7: Designed World

Students understand how the physical, informational and bio-related technological systems of the designed world are brought about by the design process. Critical to this will be students' understanding of their role in the designed world: its processes, products, standards, services, history, future,.issues and career connections.

Benchmark A: Classify, demonstrate, examine, and appraise energy and power technologies.

Benchmark B: Classify, demonstrate, examine and appraise transportation technologies.

Benchmark C: Classify, demonstrate, examine and appraise manufacturing technologies.

Benchmark D: Classify, demonstrate, examine and appraise construction technologies.

Benchmark E: Classify, demonstrate, examine and appraise information and communication technologies

Benchmark F: Classify, demonstrate, examine and appraise medical technologies.

Benchmark G: Classify, demonstrate, examine and appraise agricultural and related biotechnologies.

Performance Measures/Student Assessment/Instructional Strategies

Assessments/Evaluations

- Observations
- Demonstrations
- Portfolios
- Standardized Tests
- Class Assignment
- Quizzes/Tests/Exams

Instructional Strategies

- Teacher-Directed & Student-Centered Activities
- Case Study Problem Solving
- Cooperative Learning
- Project-Based Learning
- Career-Based Learning (Internships/Shadowing/Placement)
- Community-Based Learning (CTSOs and Other)
- Exploratory Learning
- Independent Research
- Team Teaching

Content Specific Strategies