

Science Course Description

Science - 3660 - Physics: Principle of Technology (9-12) [1995]

Course Description

The Core Curriculum for Principles of Technology (POT) is not intended to be a complete outline of all topics to be covered, but a set of essential concepts and processes that every student who has completed the POT I course (units one through seven) should master in order to receive physics credit.

The Core Curriculum for Physics-Principles of Technology focuses on three main topics: matter, motion, and energy. The Core was designed using the Project 2061s Benchmarks For Science Literacy as a guide to determine content and process skills for students to reach scientific literacy in physics. The skills, tools, and processes used by science are emphasized. The nature of science and technology has been infused into the Core. Personal relevance of science is an important part of this Core and should be emphasized.

The goals stated in the Intended Learning Outcomes should guide instruction. Hands-on, student-centered approaches to instruction with the student as scientist should be emphasized. Instruction should extend beyond the Core to meet student needs. Not all possible physics topics are included in this Core, but can be included to meet student needs. The content and processes in this Core articulate with the rest of the science Core Curriculum K-12.

The three topics covered in the physics Core, matter, motion, and energy, are developed around systems and the nature of science. Everything is part of a system, whether it is a book on a table, a cog in a machine, a satellite in orbit, or a complex electrical circuit. Having students do science enables them to construct knowledge.

The hands-on nature of this Core increases the need for teachers to use appropriate safety precautions in the laboratory and field.

For the POT units of instruction, references are made in the standards and objectives to the CORE materials. The references are not comprehensive or exclusive, and instruction should include additional materials.

Core Standards of the Course

TOPIC: Matter

STANDARD: 3660 - 01

Students will analyze properties of matter.

OBJECTIVES:

3660-0101

Collect and report data on the properties of matter.

- Use appropriate measuring tools (e.g., meter stick, micrometer, graduated cylinder, balance) to measure physical properties of matter (e.g., mass, volume, density, weight).
- Express measurements and quantities in appropriate numerical form (e.g., accuracy of numbers, powers of ten) and units.

3660-0102

Explain and predict the behavior of matter in terms of energy changes.

- Compare and contrast the properties of each state of matter. POT: lab 1t1, lab 5t1
- Observe and record phase changes in terms of energy transfer. POT: lab 5t1, lab 5t2

3660-0103

Determine the electrical properties of matter.

POT:*all electrical sub-unit labs*

- Observe and measure resistance, conduction, static charges.
- Collect and record data on an electrical property of matter.
- Modify an electrical circuit to accomplish a specified purpose.
- Research technologies that make use of the electrical properties of matter.

3660-0104

Determine the magnetic properties of matter.

POT:*lab 2e2*

- Observe and measure repulsion, attraction, and electromagnetism.
- Design and conduct an experiment to identify materials that have magnetic properties.
- Research technological applications of magnetic fields.

3660-0105

Determine the thermal properties of matter.

POT:*all thermal sub-unit labs*

- Observe and measure conductivity, specific heat, latent heat.
- Hypothesize the thermal properties of specified materials and provide evidence to support hypotheses.
- Design and conduct an experiment to test a hypothesis about thermal properties of a material.

3660-0106

Determine the optical properties of matter.

POT:*Year II Optics Unit 13*

- Observe and measure reflection, refraction, images by lenses and mirrors, and polarization.
- Collect and report data on an optical property of matter.
- Design a device that uses the optical properties of matter to accomplish a specified purpose.

3660-0107

Compare various models of matter.

POT:*Refer to POT supplement: Matter Development*

- Trace the historical development of models of matter (e.g., Aristotle's model, Dalton's model, Bohr model, wave model).
- Research and report how technological developments have changed models of matter.
- Distinguish between direct evidence and inferences that helped develop models of matter.

TOPIC: Motion

STANDARD: 3660 - 02

Students will investigate the laws of motion.

OBJECTIVES:

3660-0201

Analyze the motion of, and within, a system.

- Measure and analyze an objects motion in terms of frame of reference, speed, velocity, and acceleration.
POT:*labs 2m, labs 3m*
- Compare and contrast linear and non-linear motion.
POT:*all rotational mechanics*
- Use appropriate technology to make observations and measurements of motion.
POT:*all sub-unit labs*
- Describe the motion of a system.
POT:*all sub-unit labs*

3660-0202

Analyze motion using Newtons three laws.

POT:*supplement: Newtons Laws*

- Experimentally infer Newtons laws.
- Research and report the historical and technological changes that led to the development of Newtons Laws of Motion (e.g., Aristotle to Galileo, Galileo to Newton, Newton to Einstein).
- Model an object's or system's motion in terms of Newtons laws.

3660-0203

Relate various forces to their effect on motion.

- Collect, record, analyze data, and report results on forces that use physical contact (e.g., friction, springs, collisions) analyze and report results.
POT:*lab 1m1, unit 4 labs*
- Differentiate gravitational, electric, and magnetic forces.
POT:*lab 2e2*
- Research and report on forces within the nucleus.
- Hypothesize how electric and magnetic forces and fields will interact with each other.
- Design and perform an experiment to test a hypothesis.
POT:*(lab 2e2)*
- Determine various forces in a system and interpret their effects on the system.
POT:*(Units 4, 5, 6, 7 labs)*

3660-0204

Apply principles of momentum to motion.

- Relate momentum to motion.
- Experimentally demonstrate conservation of momentum (e.g., efficiency equations).
POT:*Units 2, 3, 4, 5, 6, 7 labs*
- Predict how conservation of momentum will affect the behavior of a system (e.g., flywheel, gyroscope).
POT:*Units 4, 5, 6, 7*
- Explain the connection between momentum principles and Newtons laws.

TOPIC: Motion

STANDARD: 3660 - 03

Students will investigate periodic motion and waves.

OBJECTIVES:

3660-0301

Compare and contrast periodic motion and waves.

- Observe, analyze, and report the characteristics of periodic motion and waves (e.g., amplitude, frequency, wavelength, wave speed, period).
POT: *lab 3e2*
- Collect and record data on various behaviors of periodic motion and waves (e.g., interference, Doppler effect).
POT: *lab 1m1*
- Determine the relationships between the descriptive properties of periodic motion and waves (e.g., $v = fl$, $f = 1/T$, $T = 1/f$).
POT: *Unit 3 sub-unit 3, Electrical Math lab*

3660-0302

Differentiate wave phenomena in events and systems.

- Observe and record the characteristics of various wave types. (e.g., mechanical, electromagnetic, longitudinal, transverse).
POT: *Unit 3 sub-unit 3, Electrical*
- Classify waves according to type.
- Identify and categorize different wave phenomena in systems (e.g., color patterns in a soap bubble, interference in radio reception, collapse of the Tacoma Narrows Bridge).

TOPIC: Energy

STANDARD: 3660 - 04

Students will analyze forms of energy, and the relationship between work and energy.

OBJECTIVES:

3660-0401

Categorize various forms of energy.

- Gather data to quantitatively describe forms of energy.
POT: *Unit 5 labs*
- Identify characteristics of various forms of energy.
POT: *Unit 5 Energy*
- Observe and describe different uses of energy used in the world (e.g., local power plant, windmill, toy car, stereo).

3660-0402

Compare and contrast potential and kinetic energy.

- Classify examples of energy as potential, kinetic, or a combination.
- Demonstrate the conversion of energy (e.g., potential to kinetic, kinetic to potential) in a student designed project.

3660-0403

Determine and report the relationship between work and energy.

- Based on observed data, calculate the amount of energy needed to do a certain amount of work.
- Research and report the historical and technological development of the concept of work and energy (e.g., Joule, Carnot, Watt).
- Distinguish between the colloquial and scientific usage of the terms work and energy.

TOPIC: Energy

STANDARD: 3660 - 05

Students will differentiate processes involved in energy changes.

OBJECTIVES:**3660-0501**

Determine the characteristics of energy conservation and change.

- Observe and classify energy transformations in systems (e.g., mechanical to heat, kinetic to potential, hot to cold, light to heat, mechanical to electrical).
POT: Unit 7 labs, lab 2f2, 2e1
- Measure and classify energy losses in a system (e.g., vibrations, sound, heat, friction).
- Demonstrate transfer of energy by wave motion.
- Determine experimentally the efficiency of an energy system (e.g., electric motor, heat engine, light bulb, pulley system).

3660-0502

Analyze energy in nuclear processes.

POT: Refer to POT supplement: Nuclear Physics

- Compare and contrast fusion and fission.
- Relate radioactivity to: half-life, types of decay (e.g., alpha, beta, gamma), and uses (e.g., radiocarbon dating and nuclear medicine).
- Compare and contrast electromagnetic radiation (e.g., microwave, television, radio) and radioactivity (e.g., radioactive decay, nuclear reactor, Chernobyl).

3660-0503

Evaluate the economic, social, and environmental impacts of energy transformations, sources, and uses.

- Assess the implications of the use of a particular energy source (e.g., solar, fossil fuels, nuclear, wind).
- Analyze how energy transformations and technology change the nature and quality of life.
- Evaluate the effects on society of nuclear applications (e.g., tracers, irradiation).
- Investigate careers in energy related fields (e.g., Power Plant Engineer, Pipe Fitter, Energy Audit Specialist, Nuclear Engineer, Heating and Refrigeration Technician).

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