Hazelwood School District

High Expectations For All!

Honors Physics

Grades 9-12

<u>Curriculum Committee Members</u>

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Reviewed by High School Science Teachers on February 6, 2018

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Hazelwood School District

Mission Statement

We are a collaborative learning community guided by a relentless focus to ensure each student achieves maximum growth

Vision Statement

HSD will foster lifelong learners, productive citizens, and responsible leaders for an ever-evolving society.

Board of Education on January 5, 2010

Goals

Goal #1: Hazelwood students will meet or exceed state standards in all curricular area with emphasis in reading, writing, mathematics, science and social studies.

Goal #2: Hazelwood staff will acquire and apply skills necessary for improving student achievement.

Goal #3: Hazelwood School District, the community, and all families will support the learning of all children.

Curriculum Overview

According to the American Association of Physics Teachers (AAPT), in order for students to truly gain an understanding of the molecular nature of biology and biochemical processes in cells, as well as the abstract nature of chemistry, it is necessary for students to have a basic understanding of physics, the foundational science.

The curriculum is aligned to the 2016 Missouri Learning Standards for Science published by the Missouri Department of Elementary and Secondary Education (DESE). The curriculum meets all the state and district requirements for 21st century skills, assessment literacy and cultural relevance. The Missouri Learning Standards for Science are based largely on the Next Generation Science Standards. The standards promote the three-dimensional learning approach which includes emphasis on Disciplinary Core Ideas, Crosscutting Concepts, and Science and Engineering Practices to make sense of phenomena and design solutions to problems.

> "Classrooms incorporating three-dimensional learning will have students build models, design investigations, share ideas, develop explanations, and argue using evidence, all of which allow students to develop important 21st century skills such as problem solving, critical thinking, communication, collaboration, and self-management (NRC 2012a). Three-dimensional learning also helps students learn to apply new knowledge to other situations. Every student will benefit from this new instructional approach."
>
> - Joe Krajnik, Professor, Michigan State University, NSTA Collaborator and Author

The curriculum contains performance tasks which include constructed response and selected response items that represent rigorous course content with clearly outlined expectations. The assessments are fluid and will be revised as driven by curriculum implementation. The assessments are required, and the learning activities are suggested but strongly encouraged. The scope and sequence and learning activities are written in support of modeling instruction, an instructional approached developed by Arizona State University specifically for Physics instruction. This method has expanded to all of the core sciences which include biology and chemistry, as well as middle school science.

Krajcik, J. (2015). Three-dimensional instruction. *The Science Teacher*, *82*(8), 50.

National Research Council (NRC). 2012b. A framework for K–12 science education: Practices, crosscutting concepts, and core ideas. Washington, DC: National Academies Press.

COURSE TITLE: Honors Physics

GRADE LEVEL: 9 – 12

CONTENT AREA: High School Science

Course Description:

In Honors Physics, students will learn to analyze the physical world and apply general laws of motion, energy, and matter to mechanical systems. Investigations will include constant and accelerated motion, Newton's Laws, gravitation, conservation of energy, and momentum. This course will provide the students with a foundation of basic principles to allow them to be competitive in today's technological society. Laboratory investigations are included in each unit. During the second semester, students will continue to analyze concepts affecting their physical world including wave motion and electromagnetism. Investigations will include wave characteristics, wave interactions, reflection, refraction, electricity, and magnetism. This course will provide the student an understanding to analyze the benefits and dangers of new technologies. Laboratory investigations are included in each unit.

Course Rationale:

The physics course builds on students' knowledge and skills developed throughout 8th grade algebra and middle school physical science. A knowledge and understanding of physics often provides the unifying link between interdisciplinary studies. The study of physics provides the foundation knowledge and skills required to support participation in a range of careers. It is a discipline that utilizes innovative and creative thinking to address new challenges, such as energy efficiency and the creation of new materials.

Course Scope and Sequence	
First Semester	
Unit 1: Electricity (13 – 90 minute class periods)	Unit 2: Scientific Methods (6 – 90 minute class periods)
Unit 3: Constant Velocity (8 -90 minute class periods)	Unit 4: Constant Acceleration (10 – 90 minute class periods)
Second Semester	
Unit 5: Newton's First and Third Law (12 – 90 minute class periods)	Unit 6: Newton's Second Law (10 – 90 minute class periods)
Unit 7: Energy (11 – 90 minute class periods)	Unit 8: Momentum (7 – 90 minute class periods)
Unit 9: Waves (8 – 90 minute class periods)	

Proposed Course Materials and Resources:

Exploring Physics Curriculum (University of Missouri-Columbia)
Modeling Physics Curriculum (Google Drive or www.modelingteaching.org)

Essential Terminology/Vocabulary

Unit 1:
Amp(ere) (A), battery, circuit, closed circuit, conductor, current, electrodes, electrolytes, equivalent resistance, insulator, Joule (J), kilowatt-hour (kW*hr), multi-meter, ohm (Ω), Ohm's law, open circuit, parallel circuit, resistance, resistor, series circuit, short circuit, switch, volt (V), voltage, and wet-cell battery.

Unit 2:
Control, conversion factor, dependent variable, dimensional analysis, equivalence statement, Graphical Analysis, graphical relationships, independent variable, mathematical representations, metric prefixes, and significant figures (digits).

Unit 3:
Control, Dependent variable, displacement, distance, Frame of reference, Independent variable, kinematics, magnitude, mathematical representations, motion maps (or motion diagrams), scalar, time, Trend line (or line of best fit), and vector.

Unit 4:
Acceleration, acceleration due to gravity, control, dependent variable, displacement, distance, frame of reference, independent variable, kinematics, magnitude, mathematical representations, motion maps (or motion diagrams), scalars, tangent line, trend line (or line of best fit), time, vectors, and velocity.

Unit 5:
Acceleration, acceleration due to gravity, action-reaction (or action force and reaction force), balanced (equilibrium), components, cosine, displacement, distance, force (or free body) diagrams, friction, inertia, mass, mathematical representations, motion maps (or motion diagrams), net force, normal (force), sine, scalars, static(s), tangent, tension, time, vectors, velocity, and weight.

Unit 6:
Acceleration, acceleration due to gravity, action-reaction (or action force and reaction force), balanced (equilibrium), coefficient of friction, components, cosine, displacement, distance, force (or free body) diagrams, friction, inertia, mass, mathematical representations, motion maps (or motion diagrams), net force, normal (force), sine, scalars, static(s), tangent, tension, time, vectors, velocity, and weight.

Unit 7:
Acceleration due to gravity, chemical potential energy, conservation of energy, elastic potential energy, dissipated energy, gravitational potential energy, height, Hooke's law, kinetic energy, mass, spring (force) constant, stretch, time, velocity, and weight.

Unit 8:
Components, conservation of momentum, elastic collision, explosions, force (or free body) diagram, inertia, impulse, inelastic collision, mass, mathematical representations, momentum, net force, normal (force), time, vectors, velocity, and weight.

Unit 9:
Amplitude, antinode, fixed end, free end, frequency, fundamental, hertz (hz), interference, light wave, longitudinal, mechanical wave, medium, node, period, propagation, pulse, pulse length, reflection, sound wave, speed, standing wave, tension, transverse, traveling pulse, and wave.

Unit Objectives:

Unit 1:

1. I can compare and contrast a one-bulb circuit and a two-bulb series circuit.
2. I can define current, voltage and resistance.
3. I can measure the current throughout a series circuit.
4. I can measure the voltage of the battery and across each resistor in a series circuit and describe how they relate.
5. I can show changes in voltage and current in a series circuit with a graph.
6. I can measure the equivalent resistance of a series circuit, and obtain the mathematical relationship.
7. I can calculate the voltage, current and resistance for various series circuits.
8. I can calculate the voltage, current and/or resistance for various parallel circuits.
9. I can predict the behaviors of various mixed series/parallel circuits and short circuits.
10. I can apply Ohm's Law verbally and mathematically.
11. I can relate voltage and current to power.
12. I can calculate the electrical power in watts, using the equation P=VI.
13. I can relate power to energy and time.
14. I can calculate the electrical energy in joules or kilowatt-hours for various circuits.
15. I can create a verbal, schematic, pictorial or mathematical description of a physical electrical circuit.
16. I can construct an electrical circuit from the verbal, schematic, mathematical, or pictorial representation of a circuit.
17. I can describe how electrical devices work.
18. I can use a multimeter to measure current, voltage and resistance.
19. I can design and conduct a quantitative experiment to determine a mathematical relationship among current, voltage, and resistance (Ohm's Law).
20. I can identify the essential components of a wet-cell battery.
21. I can construct batteries using different combinations of electrodes and electrolytes.
22. I can conduct experiments to determine how the length, the diameter, and the resistivity of a wire affect its resistance and develop a formula.

Unit 2:

1. I can understand safety rules for science
2. I can convert metric measurements using the metric prefixes from kilo- to milli-
3. I know how to use dimensional analysis to convert measurements from one unit to another, whether metric to metric, English to metric or metric to English
4. I can graph data on a line graph manually or with Graphical Analysis
5. I can write the equation for a line in slope intercept form
6. I can determine the relationship between radius and circumference and radius and area for a circle.

Unit 3:

1. I can graph the position of a constant velocity vehicle with respect to time
2. I can write the equation for a line in slope intercept form (from unit 2)
3. I can read and interpret a position time graph
4. I can read and interpret a velocity time graph
5. I can determine the location where buggies of different speeds will meet
6. I can produce an x vs t graph, v vs t graph, written description or motion map if I am given any of the four.

Unit 4:

1. I can graph position vs time for an object speeding up in a positive direction.
2. I can derive kinematic equations using the area under a v vs t graph.
3. I can use position vs time data to estimate the acceleration of the object speeding up in a positive direction.
4. I can distinguish between positive and negative acceleration in both positive and negative directions.
5. I can graph x vt t and v vs t graphs for accelerated motion in all directions.
6. I can draw the missing x vs t, v vs t and a vs t graphs when starting with either an x vs t or v vs t graph.
7. I can explain why everything falls at the same rate, neglecting air resistance.
8. I can calculate missing quantities using kinematic equations for objects in free fall.

Unit 5:

1. I can explain Newton's first law (Law of Inertia) and how it applies to a bowling ball moving through an obstacle course.
2. I can draw a force (free body) diagram for various objects.
3. I can describe various types of forces that can act upon an object, such as friction, applied, tension, normal and gravity.
4. I can perform mathematical operations (addition and subtraction) with vectors graphically and mathematically.
5. I can find the horizontal and vertical components of a vector when given its magnitude and direction.
6. I can apply finding vector components to a kinematics problem.
7. I can draw a free body (force) diagram for an object in equilibrium.

Unit 6:

1. I can determine how the acceleration of a system changes as the force is varied when the mass is held constant.
2. I can determine how the acceleration of a system changes as the mass is varied when the force is held constant.
3. I can determine the acceleration of an elevator, using the mass and the net force.
4. I can determine the acceleration of an object moving horizontally, using the mass and the net force.
5. I can draw a free body (force) diagram for an object having a net force.

6. I can determine the net force, and acceleration for objects on inclines, being pushed or pulled at angles, and two body problems.
7. I can apply finding vector components to a kinematics problem.
8. I can measure the frictional force using a spring scale on various surfaces.
9. I can calculate the force of friction knowing the coefficient of friction and the normal force.

Unit 7:

1. I can show energy conversions for objects using a series of pie charts.
2. I can verify Hooke's law for springs.
3. I can develop the formula for elastic potential energy using Hooke's law.
4. I can interpret a force vs stretch graph to calculate the spring constant, or the elastic energy of a spring.
5. I can determine power based upon work, energy and time.
6. I can use the conservation of energy to solve for unknown quantities in energy transfer problems.
7. I can verify the law of conservation of energy in a laboratory setting.

Unit 8:

1. I can determine the relationship among mass, velocity and momentum.
2. I can use the impulse-momentum theorem to solve momentum problems.
3. I can demonstrate the conservation of momentum in both elastic and inelastic collisions.
4. I can demonstrate the conservation of kinetic energy in an elastic collision (optional standard).
5. I can use the conservation of momentum to calculate unknown quantities in collisions and explosions.

Unit 9:

1. I can identify wave characteristics in a variety of media.
2. I can investigate various wave phenomena in different media.
3. I can describe wave propagation and interactions, using multiple representations (i.e., pictorial and/or verbal descriptions, graphs, mathematical models).
4. I can describe wave propagation and interactions, using multiple representations (i.e., pictorial and/or verbal descriptions, graphs, mathematical models).
5. I can design and conduct an experiment to determine the speed of sound.
6. I can investigate the wave nature of light.