Physics

NCAA Approved

Mt. Edgecumbe High School
Science
Grades 11 - 12, Duration 1 Semester, 1 Credit
Elective Course

Description

Physics is the science that uses mathematics and observations to model everything that has happened, is happening, and will happen in the Universe. This class is an introduction to Physics for juniors and seniors planning to attend college. Class includes hands-on laboratory activities, lecture, and field trips. Good note-taking skills and academic responsibility are required. This is a challenging class. It may make you think harder than any other class at MEHS.

Scope and Sequence

Timeframe	Unit	Instructional Topics
Ongoing	UNITS	
5 Day(s)	Measurement	1. Physical Quantities PP 2. Lab One - Measurement 3. Propagation of Error
15 Day(s)	Kinematics 1D	1. X vs. T graphs LAB 2. V vs. T Graphs LAB 3. Problem Solving 4. Gravity Lab
5 Day(s)	2D Kinematics / Parametrics	1. Vectors
10 Day(s)	Forces & Newton's Laws	1. The Four Fundamental Forces 2. Newton's Laws
10 Day(s)	Kepler's Laws and Gravitation	1. Newton's Law of Universal Gravitation 2. Kepler's Laws
15 Day(s)	Work, Energy, Power, Conservation of Energy	1. Work 2. Energy (and Conservation of Energy) 3. Power
5 Day(s)	Electricity	
Ongoing	Wind Turbines	
Ongoing	Bicycle Generator	

Materials and Resources

Vernier LoggerPro. Software
Vernier Lab Kits - Motion Detectors, Photo Gates, Force Sensors, etc.
Class Set of PC's
Class Set of TI-84 Calculators

Prerequisite (What do you need to take before this)

Integrated Science One
Integrated Science Two
Trigonometry - (may be taken simultaneously)

Dual Credit

No

Location

Field House Room 201 Mr. Hunter

Course Details

UNIT: UNITS -- Ongoing

Description
On the first day of class we discuss the SI units, (metric). Throughout the entire class we combine these units to create units for

velocity, acceleration, force, work, energy, power, etc.

Dimensional analysis is used to check calculations to make sure that everything is being used appropriately. Students are encouraged to use dimensional analysis to make sure their answers come out in the units they should.

UNIT: Measurement -- 5 Day(s)

Description
This is the first unit of Physics class. Students are introduced to the SI units, measurement, physical quantities, uncertainty, and propagation of error.

TOPIC: Physical Quantities PP -- 1 Day(s)

Description
Teacher led introduction and modeling of best practices.

Knowledge & Skills

TOPIC: Lab One - Measurement -- 4 Day(s)

Description
Students measure the physical quantities of different objects and then calculate volume, surface area, or other values that cannot be easily measured directly. Students use propagation of errors to make sure that the calculated values are no more precise than the methods used to make measurements allow.

Knowledge & Skills

TOPIC: Propagation of Error [Ongoing]

Description
Propagation of errors is the method used to make sure scientific results are no more accurate than the measurements used to collect the data used in the calculations. Every lab and some quizzes require students to use this method when calculating.

Knowledge & Skills

UNIT: Kinematics 1D -- 15 Day(s)

Description
Students learned about position, time, velocity, acceleration, and gravity. Students use the kinematic equations to solve example problems. Students apply these concepts to a real world situation in the Gravity Lab.

TOPIC: X vs. T graphs LAB -- 3 Day(s)

Description
Lecture introduces concept of position vs. time graphs. Students use lab equipment to make specific shapes on their graphs. Students then write a "journal" to explain a given graph on a handout.

Knowledge & Skills

TOPIC: V vs. T Graphs LAB -- 2 Day(s)

Description
Students are challenged to make specific shaped V vs. T graphs using the lab equipment. We then get together as a class to compare these graphs to the X vs. T graphs. Then teacher lectures about the relationship between the slope of the X vs. T graph and the V vs. T graph, and the area under the curve of a V vs. T graph to an X vs. T graph. We also discuss slope of V vs. T graph.
There are a lot of calculus concepts that are related to Vvs.T graphs. We use calculus to integrate and differentiate the velocity function, creating the position and acceleration functions.

Knowledge & Skills

TOPIC: Problem Solving [Ongoing]

Description
We spend about 5 full days in class working on just solving problems. Beginning with a picture, then listing what is known, then listing what is needed, then identifying an equation, or multiple equations that will allow us to get what we need using only what is known. This is also ongoing throughout the rest of the course.

Knowledge & Skills

TOPIC: Gravity Lab -- 5 Day(s)

Description
Students are given one week in which to calculate the acceleration due to gravity. They required to develop their own methods and make their own measurements. Then they are encouraged to compare their values and the look up the accepted value. Formal lab report required.

Knowledge & Skills

UNIT: 2D Kinematics / Parametrics -- 5 Day(s)

Description
Continuation of concepts from 1D kinematics, but now time ties two axes together. Students learn to use separate equations for each dimension and to use the same time for each. These problems often result in systems of equations, often systems of a linear equation and a quadratic equation, or systems of two quadratic equations.
Typical problems include projectiles and ramps.

TOPIC: Vectors [Ongoing]

Description
Motion in two dimensions often begins with students assigning the x and y axes to a problem. Depending on the problem situation, this may result in velocity, displacement, and/or acceleration not aligning with one of the axes. Students need to use trigonometric functions to calculate the components in the x and y directions.
We use vector addition and subtraction.

Vectors also come up in force diagrams, ramps, projectiles, navigation, etc.

Knowledge & Skills

UNIT: Forces & Newton's Laws -- 10 Day(s)

Description
We discuss the four types of forces: strong nuclear force, weak nuclear interaction, electromagnetic force, and gravity. Newton's three laws, net forces, force diagrams, and free-body diagrams. Newton's law of universal gravitation.

TOPIC: The Four Fundamental Forces -- 2 Day(s)

Description
We discuss the Weak Interaction and Beta Decay (type of radiation), Strong Nuclear Force, Electromagnetic Forces, and Gravity.
The concept of Net Forces is introduced.

Knowledge & Skills

TOPIC: Newton's Laws -- 6 Day(s)

Description
Students recall Newton's three laws from Integrated Science One and from middle school science. We take two days to unpack these laws and to pay particular attention to the details. Net forces, force diagrams, free-body diagrams, etc.
Students get worksheets and use vernier scales to test these laws in real world examples.
Once we get the basics down, we apply the laws to 2 dimensional situations.

Knowledge & Skills

UNIT: Kepler's Laws and Gravitation -- 10 Day(s)

Description
Newton's law of universal gravitation. Kepler's laws of planetary motion.

Assessments
QUIZ

TOPIC: Newton's Law of Universal Gravitation -- 4 Day(s)

Description
Every mass is attracted to every other mass, directly proportional to the masses and inversely proportionally to the square of the distance between the masses.
Gravity is a far weaker force than the other forces. We learn about Newton's hypothesis and methods to calculate the gravitational constant: G.
Students calculate the force (and acceleration) of gravity at different distances from the center of the earth. Students also learn about the Geoid and how gravity varies according to the density of the material in the Earth.

Knowledge & Skills

TOPIC: Kepler's Laws -- 6 Day(s)

Description
Gravity works over great distances, but the force decreases quickly. Johannes Kepler developed three laws to describe the motion of planetary bodies orbiting one another.
Students learn to use the laws to calculate orbital periods and speeds.
YouTube videos

Knowledge & Skills

UNIT: Work, Energy, Power, Conservation of Energy -- 15 Day(s)

Description
This unit introduces the concepts of work and energy. Students learn the units (Joules), and take real work examples to compare energy, work, and power of different systems. Conservation of energy is a major topic in physics.

TOPIC: Work -- 5 Day(s)

Description
What is work? Students love this question. Work in the physics sense is the product of a force applied by the distance over which it is applied. W = f*d
Students calculate work done by different forces.

Knowledge & Skills

TOPIC: Energy (and Conservation of Energy) -- 5 Day(s)

Description
Energy cannot be created or destroyed. This means the beginning energy in a system must equal the ending energy.
We discuss the forms of energy, potential and kinetic. We also categorize these forms into different types:
Potential - Gravitational potential, chemical, thermal, etc.
Kinetic - linear and rotational motions, arguably thermal, etc.

Students can solve many of the kinematics problems from before using conservation of energy. Motion on ramps is a particularly useful application as the conservation of energy method requires fewer calculations (usually). Students like this easier approach.

Knowledge & Skills

TOPIC: Power -- 5 Day(s)

Description
Power is the rate at which work is done. The more one can do in a second, the more power he has. We calculate the power of different systems, electric motors, and Mr. Hunter. We also compare mechanical work and power to electrical work and power.

Knowledge & Skills

UNIT: Electricity -- 5 Day(s)

Description
Students will be introduced to basic series and parallel electric circuits. We will also discuss capacitors, inductors and LRC circuits. LRC circuits are simple harmonic oscillators with a natural frequency.
Much of this is done using the PHET online applets to design these circuits and immediately see the results.

UNIT: Wind Turbines -- Ongoing

Description
This is a class project that we spend about one day a week on. We design and build wind turbines that require students to use the scientific and engineering processes to research, design, test, refine, test, and build turbine blades and a power train gearing system to power a small electric generator. Students also collaborate with the robotics/engineering program to use the 3D printer and SolidWorks modeling program.
Students are required to maintain and engineer's notebook. This group project results in a laboratory grade. Usually a representative from the UAF wind-diesel lab comes to test the turbines and to interview the students.

UNIT: Bicycle Generator -- Ongoing

Description
This is a new unit that has yet to happen. We will design and build a working bicycle powered generator to run a computer in the classroom. One version will use a car alternator or other commercial generator product. The other will require the students to build

an electrical generator from scratch. We will work on this periodically throughout the semester.