Physics in the Universe with Labs

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Edgenuity, Inc

Submission Feedback

APPROVED

Basic Course Information

Title:	Physics in the Universe with Labs
Transcript abbreviations:	
Length of course:	Full Year
Subject area:	Laboratory Science (D) / Physics/Earth & Space Sciences
UC honors designation?	No
Prerequisites:	Algebra I (Required)
Co-requisites:	Pre-Calculus (or prerequisite) (Recommended)
Integrated (Academics / CTE)?	No
Does your course include lab activities in your course description?	Yes
Grade levels:	9th, 10th, 11th, 12th
Course learning environment:	Online

Course Description

Course overview:

This laboratory science course is aligned to the Next Generation Science Standards for California Public Schools, and is designed to introduce students to collegiate-level principles and concepts of Physics. Concepts discussed include motion and forces, gravitation and motion in space, momentum, energy and matter, waves, electricity, magnetism, and nuclear processes. Students also conduct a variety of laboratory activities that develop skills in observation, use of scientific tools and techniques, data collection and analysis, and mathematical applications. The course includes teacher-supervised, hands-on laboratory activities that involve inquiry, observation, analysis and write-up and account for twenty percent of class time, and the content emphasizes the application of scientific thinking to the real world and was specifically designed to meet the Next Generation Science Standards.

Course content:

Forces and Motion: Part 1

In this unit, students investigate various aspects of one- and two-dimensional motion, including analysis of velocity and acceleration graphs. Students apply mathematical concepts such as slope, averages, and appropriate use of significant figures, as well as utilizing vectors in order to determine specific components of an object's displacement and overall object displacement. Students also apply vectors to examine the relationships between velocity and distance in projectile motion, as well as complete a laboratory activity to gain a comprehensive understanding of the relationships between position, velocity, and acceleration of an object. In addition, students further develop scientific literacy skills through the completion of a scientific lab report for the activity. In this unit and throughout the course, students are assessed through formative assessment as embedded assignments and checks for understanding during instruction, formal assessments at the end of each lesson, unit, and semester, and formal written laboratory reports, essays, and projects.

💻 Unit Assignment(s):

Lesson: Projectile Motion

This assignment is designed to assess student understanding of lesson consent and allow students to apply and extend this knowledge in a variety of real world scenarios. Students complete a series of analysis questions and two short writing assignments to examine how projectile motion can be

described, including identifying examples of projectile motion and analyzing motion maps of projectiles. In the questions, students apply mathematics and computational thinking to calculate values related to horizontally launched projectiles and calculate distance traveled and time in flight for projectiles launched at an angle. They also utilize vector quantities to calculate the components of projectile motion velocity. In the writing assignments students analyze two scenarios and construct explanations for how the scenarios would change when certain factors change.

🧪 Unit Lab Activities:

Lab: Motion with Constant Acceleration

Students utilize a dynamics track and cart in order to explore aspects of motion, including the relationship between position, time, velocity, and acceleration. First they formulate an investigation question they will answer by measuring and recording the time it takes to travel certain distances and completing calculations. The teacher helps students review how to calculate acceleration from velocity-time graphs. Then teacher reviews the lab requirements, safety protocol, and lab report expectations with students and students generate a hypothesis about the effect of the angle of the track on the acceleration of the cart. Students investigate how factors impact the overall motion of the cart, and specifically, the cart's acceleration. They also perform mathematical and graphical analysis and interpretation of the data obtained and graph velocity vs. time to determine acceleration. Finally, students reflect on the lab through a series of analysis questions and write a detailed lab report to submit to the teacher that demonstrates strong scientific reasoning and writing and includes an introduction, materials and procedures used, organized data from completing the lab, analysis, and a conclusion.

Forces and Motion: Part 2

In this unit, students investigate how Newton's Laws of Motion relate to forces. Students apply graphical and mathematical analysis to determine the net forces acting on various objects, as well as investigate the relationships between forces and changes in motion. Students also complete a laboratory activity to gain a comprehensive understanding of the overall impact of force and mass on an object's acceleration. In addition, students investigate the dynamics of elastic and inelastic collisions in order to gain an understanding of momentum and its conservation, and apply graphical and mathematical concepts to calculate overall momentum in changing systems. Students then complete a laboratory activity to gain a comprehensive understanding of the relationships between mass, position, and velocity of colliding objects and further develop scientific literacy skills through the completion of a scientific lab report for the activity.

💻 Unit Assignment(s):

Lesson: Impulse and Momentum

The assignment first assesses student understanding of lesson content and then students apply what they have learned to this point in the unit to a project and detailed report in the formal lab report format. First students respond to a series of questions to describe momentum and impulse and their relationship, perform calculations involving these two values, and compare the momentum and impulse of different objects. Then students complete two short writing assignments to apply momentum and impulse to real world scenarios, such as the use of brakes and airbags in automobiles. Finally students complete an egg drop project. The teacher provides them with supplies to design and build build a device that will keep an egg from cracking when it is dropped from a certain height. They must test the device, determine how well it worked, and make recommendations to improve its design. Then they explain their final design and the logic that supports it in the formal lab report and present it to the class.

🧪 Unit Lab Activities:

Lab: Newton's Second Law

Students formulate an investigative questions that they can answer by varying two different variables and determining how each one affects how quickly a cart moves along a track. The teacher guides students to assemble the track with the cart, motion detector, pulley, and all other parts and reviews the lab safety protocol for the experiment, and then students formulate one hypothesis about how the force applied to a cart affects the acceleration of the cart and another one about how the mass of a cart affects the acceleration of the cart. During the lab, students record, organize, and evaluate data and use mathematics and computational thinking to determine the effects of force and mass on the acceleration of a physics cart. They compare how changes in force and changes in mass impact acceleration differently, such as determining the type of relationships shown by the data (i.e., direct vs. inverse). After the lab, students use and apply scientific models to answer questions regarding the relationship between force and acceleration, as well as mass and acceleration. Students also analyze their results through reflection questions and then write and submit a formal lab report.

Lab: Conservation of Linear Momentum

Students use a dynamics track to generate collisions between two carts and begin the lab by formulating an investigative question about the relationship between mass and colliding objects. Teachers guide students in the assembly of the tracks and carts and help them create a hypothesis about the effect of increasing the total mass of the carts on the final velocity after an inelastic collision. Before beginning students review the safety protocol and during the experiment they collect data to compare momentum before and after the collisions. After the lab students apply knowledge from the laboratory activity to analyze conservation of momentum in real-world scenarios and then they further analyze and interpret their data from the lab to write and submit a formal lab report.

Forces at a Distance

In this unit, students utilize mathematical and graphical analysis to determine the impact of various factors such as mass, distance, and inertia on gravitational force, centripetal acceleration, and circular motion. Students also utilize specific mathematical formulas and laws to calculate factors involved in circular motion such as tangential speed, centripetal acceleration, and effects of centripetal forces on motion. Students then investigate factors that impact movement of objects in space, and apply mathematical concepts to determine how gravitation and other forces impact the speed and period of motion in space. Students also analyze the relationships between objects such as planets and satellites in space and how they impact each other's motion.

💻 Unit Assignment(s):

Lesson: Centripetal Acceleration

Students first respond to multiple choice questions to assess their understanding of lesson content and then they complete three short writings that deepen understanding of the concepts of rotation and revolution, tangent speeds, and direction, speed, and acceleration of an object moving with uniform circular motion. Students analyze real world situations tangent speeds on Earth, clearly communicating their reasoning, and they submit their responses to the teacher.

🧪 Unit Lab Activities:

Lab: Circular Motion

Students conduct an investigation to explore the relationship between the centripetal force, mass, radius, and velocity of an object moving with uniform circular motion. Prior to completing the lab students apply the concepts of circular motion to solve problems and write about the interaction between centripetal force and inertia in real world scenarios. Then students write an exploratory question and the teacher introduces the lab and safety protocol and guides students in the formulation of three hypothesis for the experiment, one for each set of variables they will test. The teacher also helps students during the lab to set up the materials, effectively run each trial, run additional trials with further variation, make appropriate calculations, record, analyze, and interpret data, and graph the results. Following the lab students write and submit a formal lab report to evaluate and communicate their findings.

Energy Conversion and Renewable Energy: Part 1

In this unit, students utilize graphical and mathematical analysis to gain a comprehensive understanding of the concepts of work, power, and energy. In this unit, students investigate real-world applications of energy. Students differentiate between potential and kinetic energy and utilize graphical and mathematical analysis to gain a comprehensive understanding of the concepts of work, power, and energy. Students then investigate how energy is transformed and conserved as it changes forms, as well as perform graphical and mathematical analysis of energy transfer diagrams and various energy transfer scenarios to confirm the law of conservation of energy. Students also complete a laboratory activity to evaluate the relationships between mass, speed, and kinetic energy of an object, and further develop scientific literacy skills through the completion of a scientific lab report for the activity.

💻 Unit Assignment(s):

Lesson: Kinetic Energy

Students complete a series of multiple choice and open ended questions to assess their understanding of kinetic energy. They explain the work-energy theorem and its relationship to positive and negative work. Students then utilize work and kinetic energy concepts to mathematically analyze real-world scenarios and determine how factors such as mass and velocity impact the amount of kinetic energy found in an object, as well as work output. In completing the assignment for this lesson, students apply knowledge of significant figures in calculating values. In addition, within this lesson, students use mathematical and graphical models of real-world scenarios to analyze how changes in kinetic energy affect other scientific phenomena such as velocity and work done by an object.

🧪 Unit Lab Activities:

Lab: Conservation of Energy

Students conduct an investigation to explore the relationship between different types of energy to verify that energy is conserved. Prior to completing the lab students apply the law of conservation of energy to solve problems. They analyze real world examples such as children on a swing set and a battery powered drill to apply mathematics and computational thinking. Then students write an exploratory question to further explore how energy is conserved and the teacher introduces the lab and safety protocol and help. Students develop a hypothesis and then complete the lab to test the law of conservation of energy on a marble rolling down ramps made of different materials with varying levels of friction. Students apply the relationship between kinetic energy, gravitational potential energy, and heat due to friction to determine the landing position of the marble after it rolls down each ramp and off a table. Students record their data for each experiment and utilize follow up questions to analyze the data and justify a stand on whether the results from each experiment support the law of conservation of energy. Following the lab students incorporate their findings and justification into a formal lab report that they submit to the teacher.

Energy Conversion and Renewable Energy: Part 2

In this unit, students investigate the relationships between thermal energy, heat, and temperature, as well as how kinetic energy is demonstrated by changes in temperature. In addition, students analyze graphical models to gain a comprehensive understanding of the various methods of heat transfer and complete a laboratory activity to gain a comprehensive understanding of how energy is converted to heat within a mechanical system. Students also examine natural energy resources and the impact of human use and conservation of resources on the environment.

💻 Unit Assignment(s):

Lesson: Human Impact on Resources

Students first complete a series of questions that assess their understanding of lesson content and guide them to apply their understanding to the real world to analyze human impact on resources is a variety of thought provoking scenarios from different environments, including urbanization, desertification, mining, habitat restoration, and dam construction. Students also analyze how factors such as forest fires, volcanic eruptions, farming, industry, construction, and the burning of fossil fuels contribute to pollution, smog, and acid rain. Following the questions students complete a research project in which they develop an argument for or against road construction in rainforests, supporting the position with facts from their research and considering counterclaims, and then they present and defend the position in a class discussion.

🧪 Unit Lab Activities:

Lab: Mechanical Equivalent of Heat

Students conduct an in-depth investigation of the relationship between gravitational potential energy (GPE) and its conversion to thermal energy. First students formulate an investigative question about potential energy's conversion to thermal energy. The teacher reviews calculating gravitational potential energy and heated energy with the class. Students develop a hypothesis and then examine this relationship using a system composed of a falling cylinder attached to a propeller in a water bath. Students adjust either the height or mass of the cylinder during the experiment, and then use quantitative observation and mathematical analysis to determine how these factors impact the movement of the propeller and the change in temperature of the water bath, as well as use graphical analysis to determine the type of relationship that exists between GPE and change in temperature. Upon completion of the lab, students communicate the results of the laboratory investigation in a written lab report that is published.

Energy Conversion and Renewable Energy: Part 3

In this unit, students investigate the relationship between electric charge, electric force, and electric fields, as well as utilize mathematical and graphical analysis and complete a laboratory activity to gain a comprehensive understanding of Coulomb's law and factors that affect static electricity. Students also identify the impact of various factors in electric circuits and use Ohm's Law to differentiate between the role of current, voltage, transistors, and resistance in series and parallel circuits. In addition, students plan and complete a laboratory activity to gain a comprehensive understanding of the structure of series and parallel circuits. Finally, students evaluate the properties of magnets and how they affect magnetic forces and fields, as well as analyze the relationships between electricity and magnetism and how each impacts the other, including completing an investigation of the impact of magnetic polarity on induced current.

💻 Unit Assignment(s):

Lesson: Electromagnetic Induction

After a series of open ended questions that help students explore electromagnetism and draw conclusion while analyzing scenarios, students complete a project in which they plan an investigation to explore the evidence that an electric current produces a magnetic field, and that a changing magnetic field produces an electric current. This project must be completed in person under teacher guidance. The teacher first explains the project and reviews the project guide with students. Since this is an investigation students formulate a question and two hypotheses to test the question. The teacher presents several examples of effective experiments and helps students as they plan. Students must first determine the types of data they will gather and the tools used for gathering the data, design the experiment, and get the teacher's approval before continuing with the assignment. Then students gather the materials, run the experiment, gather and analyze the data, and complete a detailed report to submit to the teacher.

🧪 Unit Lab Activities:

Lab: Circuit Design

In this lab students plan their own investigation. First they formulate an investigative question about constructing basic electric circuits to measure current flow. The teacher reviews some general considerations for setting up circuits with the class and then they identify variables and formulate two hypotheses to guide the investigation. Students plan a scientific inquiry utilizing circuits created with batteries, flashlight bulbs, test leads, an ammeter, and various resistors to examine the impact of changes in voltage and/or resistance on overall current flow. They then use mathematical and graphical analysis to compare the effects of changing voltage or resistance on

the current through a series circuits and a parallel circuit, as well as to examine the relationships between current, resistance, and voltage shown by the data collected. They analyze the data collected through a series of reflection questions and report their findings in a detailed lab report.

Lab: Electromagnetic Induction

Students first create an investigatory question for the experiment and then the teacher reviews the lab procedures, safety protocol, and induction system setup with the class. Then students identify variables and formulate a hypothesis. They conduct a scientific inquiry to test the impact of magnet polarity on the induced current flowing through a wire loop in an electromagnet. Students utilize an electromagnetic induction apparatus to examine current induction both with normal magnet polarity and reversed magnet polarity. They then utilize the data from the experiment to determine what would happen to the current in an electromagnet in other real-world scenarios. Finally, they analyze the data collected through a series of reflection questions and report their findings in a detailed lab report.

Nuclear Processes and Earth History

In this unit, students gain a comprehensive understanding of introductory concepts related to nuclear physics, including radioactivity and half-life. Students compare the three main types of radioactivity, as well as differentiate between chemical reactions and nuclear reactions. Students also complete a laboratory activity to graphically analyze the process of half-life and further develop scientific literacy skills through the completion of a scientific lab report for the activity. In addition, students examine the processes of nuclear fission and nuclear fusion and create a multimedia presentation analyzing the pros and cons of using nuclear fission as an energy source. Finally, students examine the relationship between various processes and the formation of Earth and its features.

💻 Unit Assignment(s):

Lesson: Nuclear Energy

Students apply scientific literacy skills to create a written argument establishing their position on the use of nuclear power. They defend this argument by utilizing supporting information from the lesson on the benefits and disadvantages of nuclear power as an energy source in a formal essay they submit to the teacher. Students also identify issues related to disposing of nuclear waste and compare the use of nuclear energy to other resource options.

🧪 Unit Lab Activities:

Lab: Half-Life

Students begin by developing an investigative question about the amount of time that it takes for half a radioisotope's nuclei to decay. Then they formulate a hypothesis to answer the question. Students develop a physical model of the process of radioactive decay using pennies or other small everyday objects in order to investigate the impact of half-life on the radioactivity of a sample element over a period of time. Students initially begin with 100 “radioactive” objects. They then simulate each half-life cycle by putting all of the “radioactive” objects in a container and shaking them. Any object that has become “stable” when the simulation occurs is removed. This process is repeated eight times. Students then conduct mathematical and graphical analysis using data tables and graphs to determine how radioactive decay affects the overall amount of radioactive material remaining and the number of stable atoms created from an initial sample over time or after a certain number of half-lives. As they work students record their data and at the end of the lab they analyze the data to create the detailed formal lab report.

Waves and Electromagnetic Radiation: Part 1

In this unit, students conduct mathematical and graphical analysis to differentiate between wave types and properties such as wavelength, frequency, and speed. Students also evaluate various wave interactions and identify everyday examples of these phenomena. In addition, students analyze the properties and applications of sound waves in everyday scenarios, including the use of radio waves in technology. Students identify properties of sound waves, as well as evaluate factors that can impact the intensity of sound. Students also investigate the relationship between sound and the Doppler effect, as well as investigate seismic waves and how they contribute to changes in Earth’s surface.

💻 Unit Assignment(s):

Lesson: Sound Waves

Students examine the characteristics of sound waves by reading an informational text called "The Ups and Downs of Wave Technology”. First students respond to a series of questions that assess their understanding of how sound waves are produced and transmitted, including the relationship between wavelength, frequency, and pitch of a sound wave and the relationship between amplitude and loudness of sound. They also complete a short writing to explain how factors such as temperature and type of medium affect the speed of sound waves. Then students read the scientific text and utilize the information in the article to analyze the author's purpose and to create a written comparison of the advantages of digital storage of music versus analog storage.

🧪 Unit Lab Activities:

Lab: Plate Boundaries and Movement

Students begin by developing an investigative question and formulating a hypothesis to answer the question. They then develop a scientific model that is used within the laboratory experiment to determine the impact of temperature differences on the movement of the mantle underneath Earth's surface, as well as how this movement affects plate tectonics. Students also utilize experimental methods and physical models to analyze how plate movement at different boundaries affects the formation of different features such as mountains, faults, etc. Finally, students reflect on the lab and communicate the results of the laboratory investigation in the formal written lab report.

Waves and Electromagnetic Radiation: Part 2

In this unit, students differentiate between the wave and particle models of light, as well as the regions of the electromagnetic spectrum. Students investigate various phenomena of light, including reflection, refraction, and diffraction. Students conduct graphical and mathematical analysis to predict image formation by mirrors and lenses and to determine how Snell's law and the law of reflection can be used to predict the reflection and refraction of light rays. Finally, students examine applications of nuclear and wave phenomena in everyday scenarios.

💻 Unit Assignment(s):

Lesson: Lenses

Students explore how lenses are used and designed by reading an informational text called "Designer Lens" and answering open ended comprehension questions that require them to explain what they learned from the text and apply it to new scenarios. After the reading students answer questions about the lesson content that require them to analyze and make predictions about images that are formed by concave and convex lenses using ray diagrams, the lens equation, and the magnification equation.

🧪 Unit Lab Activities:

Lab: Reflection and Refraction

Prior to the lab students answer a series of questions to apply concepts of reflection and refraction that require them to differentiate between reflection and refraction, use the law of reflection to make predictions, apply Snell's law to solve problems, and analyze and interpret ray diagrams.

After the activity students formulate a question about the angle of incidence and the angle of refraction for a given medium. The teacher reviews the safety protocol and the lab assignment with the class and students develop a hypothesis to address the question. Students use a transparent, semicircular dish, water, a laser, a refraction ray diagram, and a protractor to determine angles of refraction. They graph their results to determine the slope of the line of best fit and calculate the index of refraction for water. Following the lab students analyze the data, respond to questions the guide them to make comparisons and justify their findings and write a formal lab report.

Stars and the Origins of the Universe

In this unit, students examine evidence regarding the possible origin and evolution of the universe, as well as the process of formation and evolution of the universe. Students also describe the characteristics utilized to classify stars and evaluate the life cycle of stars utilizing the Hertzsprung-Russel diagram. In addition, students examine how fusion at the Sun's core occurs and creates helium and other elements, as well as the amount of energy produced in fusion reactions and the transfer of that energy from the Sun's core to its surface. Finally, students examine the processes of nuclear fission and nuclear fusion, including how chain reactions are caused by fission reactions and real-world examples of fusion reactions.

💻 Unit Assignment(s):

Lesson: Earth-Moon-Sun System

In this two part assignment, students first apply Kepler’s laws along with mathematics and computational thinking to solve problems. Students identify Kepler’s three laws and Newton’s universal law of gravitation, perform calculations using these laws, and use Kepler’s and Newton’s laws to examine the effects that the Earth, the moon, and the Sun have on one another. In the second part of the assignment students read a scientific article called “History of Planetary Motion” that explains the historical development of Kepler’s laws of planetary motion and Newton’s universal law of gravitation. Following the article students demonstrate comprehension of the concepts presented through a series of questions and then utilize the evidence it contains to create and support a written claim regarding who was responsible for the theory of planetary motion.

🧪 Unit Lab Activities:

Lesson: Earth-Moon-Sun System

The teacher begins by introducing students to Kepler's laws of planetary motion and Newton's Universal Law of Gravitation, then aids students in determining what the effects are of these planetary laws on the motion of the Earth and Moon in space. The teacher also aids students in examining various factors that affect the relationships between the Earth, Moon, and Sun, such as gravitational force between and tangential speed of celestial objects. Students then utilize background knowledge and scientific practices to develop and use a physical model of the Earth-Sun-Moon system to ask and answer questions regarding the interactions between these celestial objects in specific scenarios, such as during lunar phases, lunar eclipses, and solar eclipses. Throughout the investigation, the teacher provides appropriate guidance to the students regarding the position of the Earth, Moon, and Sun in relation to each other in real-world interactions. The teacher also aids students in developing hypotheses and predictions that are tested using the model. Students then use the model and the collected evidence to create a multimedia presentation explaining their conclusions about the interactions that occur between the Earth, Sun, and Moon, including the different kinds of eclipses and lunar phases. In addition, students investigate and describe the importance of Earth's rotation to the cycle of day and night.

Course Materials

Multimedia

Title	Author	Director	Name of video series	Date	Website	Medium of Publication
Interactive Labs	Edgenuity Inc.	[empty]	[empty]	[empty]	[empty]	Online Interactive Resource
Collaboration Corner	Edgenuity Inc.	[empty]	[empty]	[empty]	[empty]	Online Interactive Resource
Edgenuity CloseReader Interactive Reading Environment	Edgenuity Inc.	[empty]	[empty]	[empty]	[empty]	Online Interactive Resource

Title	Author	Director	Name of video series	Date	Website	Medium of Publication
Edgenuity eWriter Tool	Edgenuity Inc.	[empty]	[empty]	[empty]	[empty]	Online Interactive Resource
Edgenuity eNotes	Edgenuity Inc.	[empty]	[empty]	[empty]	[empty]	Online Interactive Resource
Edgenuity Instructional Videos	Edgenuity Inc.	[empty]	[empty]	[empty]	[empty]	Online Interactive Resource
Edgenuity Course Map	Edgenuity Inc.	[empty]	[empty]	[empty]	[empty]	Online Interactive Resource

Other

Title	Authors	Date	Course material type	Website
The History of Planetary Motion	Edgenuity Staff	2014	Informational Text	[empty]
The Ups and Downs of Wave Technology	Edgenuity Staff	2014	Informational Text	[empty]
Earth’s Magnetic Field	Edgenuity Staff	2014	Informational Text	[empty]
Designer Lenses	Edgenuity Staff	2014	Informational Text	[empty]
Wet Lab Guides	Edgenuity Staff	[empty]	Instructional Guides	[empty]

Additional Information

Course Author:

Lynette McVay
Program Director/Coordinator
lynette.mcvay@edgenuity.com
7708203767 ext.