Hoboken Public Schools

Project Lead The Way Curriculum
Grade 6

Project Lead The Way Grade Six

HOBOKEN PUBLIC SCHOOLS

Course Description

PLTW Gateway's 9 units empower students to lead their own discovery. The hands-on program boosts classroom engagement and excitement, drives collaboration, and inspires "aha! moments" and deep comprehension. And as students engage in PLTW's activities in computer science, engineering, and biomedical science, they see range of paths and possibilities they can look forward to in high school and beyond.

Course Resources

PLTW Materials
Samsung tablets
Chromebooks

Pacing Guide

Unit Titles	Time Frame
Unit 1: Flight and Space	**3-4 Months**
Unit 2: Science of Technology	**3-4 Months**
Unit 3: Magic of Electrons	**3-4 Months**

Unit 1 – Flight and Space

3- 4 Months

Unit 1
The exciting world of aerospace comes alive through Flight and Space. During this unit, students delve into the history of flight and space, discover the science behind aeronautics, and explore traveling and living in space. Students are then challenged to use their knowledge to design, build, and test an airfoil.

Essential Questions

- How are different flight vehicles designed differently?
- How did the first technological advancements lead to the advancement of flight?
- How do the difference between airplane flight and space flight differ?
- How are aircraft categorized into heavier-than-air and lighter-than-air vehicles?
- How do airplanes fly?
- How is a propulsion system used to move an aircraft and a spacecraft?\
- How do the forces of lift, drag, gravity, and thrust affect the flight of an airplane?
- How does the shape of a wing have anything to do with how much lift it generates?
- How does a rocket travel from Earth to the moon? From Earth to Mars?
- How is living in space different from living on Earth?
- How do humans live in space? What do humans need to be able to live in space? How do they breathe? What will they eat? How will they produce power? How will they shower and use the bathroom?

- How are some technologies developed by engineers that helpful to astronauts living comfortably in space?
- How do the research and experiments conducted in space benefit life on Earth?

Essential Learning Outcomes

- Students will describe the roles and responsibilities of STEM professionals for high demand technological careers, especially in the aerospace industry.
- Students will apply their knowledge of research techniques to investigate an aerospace topic.
- Students will describe the flight characteristics of kites, whirly gigs, model airplanes, hot air balloons, and model rockets.
- Students will Write a script and develop a storyboard to explain an aerospace concept.
- Students will describe how center of gravity affects an aerospace vehicle in distributing weight.
- Students will recognize the tools and purpose of aeronautic design and testing.
- Students will distinguish between the forces of lift, drag, weight, and thrust that affect an object moving through a fluid.
- Students will explain the importance of the forces that affect an object moving through a fluid.
- Students will explain how Newton's laws apply to flight and space.
- Students will explain how Bernoulli's principle affects flight.
- Students will identify the characteristics of an airfoil and how they compare and contrast with the characteristics of wings.
- Students will analyze the features and benefits of different types of wings.
- Students will Research and design an airfoil that will create lift using a wing tester.
- Students will calculate fuel consumption and range of an airplane given speed and fuel capacity.
- Students will describe the major parts (fuselage, empennage, high lift devices, wings, undercarriage, propulsion, instruments, and controls) of aircraft and how they can affect the overall balance of an airplane during flight.
- Students will discuss the history and development of rocketry, space flight, and living in space.
- Students will know that a rocket must overcome the forces of gravity and drag in order to escape the atmosphere.
- Students will explain the basic principles of flight and rocketry.
- Students will investigate how changes in various design characteristics of a rocket will affect the rocket's performance.
- Students will List challenges that engineers face to provide safe travel and optimum living conditions in space.
- Students will explain how gravity relates to an object's orbit.

Technology Infusion

8.1.8.A.1	Demonstrate knowledge of a real world problem using digital tools.
8.1.8.A.2	Create a document (e.g. newsletter, reports, personalized learning plan, business letters or flyers) using one or more digital applications to be critiqued by professionals for usability.
8.1.8.A.3	Use and/or develop a simulation that provides an environment to solve a real world problem or theory.
8.1.8.A.4	Graph and calculate data within a spreadsheet and present a

	summary of the results
8.1.8.A.5	Create a database query, sort and create a report and describe the process, and explain the report results.

Standards Addressed

RL.6.1; RL.6.2; RL.6.3; RL.6.4; RL.6.5; RL.6.6;

W.6.3; W.6.3A; W6.3B; W.6.3C; W.6.3D; W6.3E

Differentiation

- Structure lessons around questions that are authentic, relate to students' interests, social/family background and knowledge of their community.
- Provide students with multiple choices for how they can represent their understandings (e.g. multisensory techniques-auditory/visual aids; pictures, illustrations, graphs, charts, data tables, multimedia, modeling).
- Provide opportunities for students to connect with people of similar backgrounds (e.g. conversations via digital tool such as SKYPE, experts from the community helping with a project, journal articles, and biographies).
- Provide multiple grouping opportunities for students to share their ideas and to encourage work among various backgrounds and cultures (e.g. multiple representation and multimodal experiences).
- Engage students with a variety of Science and Engineering practices to provide students with multiple entry points and multiple ways to demonstrate their understandings.
- Use project-based science learning to connect science with observable phenomena.
- Structure the learning around explaining or solving a social or community-based issue.
- Provide ELL students with multiple literacy strategies.

Assessments

- Class participation
- Completion of activity sheets
- Discussions demonstrating knowledge of subject matter
- Interactive journal responses
- Responses
- RST with Rubric Evaluation
- Academic Vocabulary

21st Century Learning Connection

"21st century skills" are the skills that today's students will need to be successful in this ever-changing world. The most recognizable of these skills are the 4C's: communication, collaboration, critical thinking and creativity. However, 21st century skills also include social and emotional intelligence, technological literacy and problem solving abilities. These skills emphasize "application of knowledge" and go beyond rote memorization.

Unit 2 Science of Technology
3-4 Months

Unit 2
Science impacts the technology of yesterday, today, and the future. Students apply the concepts of physics, chemistry, and nanotechnology to STEM activities and projects, including making ice cream, cleaning up an oil spill, and discovering the properties of nano-materials.

Essential Questions

- How is a chemical engineer's job defined?
- How is the difference between a chemical engineer and a chemist defined?
- How many meters are in a nanometer?
- How will nanotechnology affect my life?
- What tools are necessary to "see" and manipulate at the nanoscale?
- What is the purpose of using a simple or compound machine?
- How is the difference between a simple and compound machine defined?
- If energy cannot be created or destroyed, why do we need to be concerned about our energy sources?
- How is the relationship between potential energy and kinetic energy defined?
- How do subsystems interact to create a system?
- How is the design process used when creating new products?

Essential Learning Outcomes

- Students will describe the difference between a chemist and a chemical engineer.
- Students will describe how salt affects the melting point of ice.
- Students will describe how an adhesive bond holds two items together.
- Students will outline the steps required to clean up an oil spill.
- Students will apply science and engineering skills to make ice cream.
- Students will utilize the steps of the design process to create product.
- Students will Work as a part of a team to solve an oil spill engineering simulation problem.
- Students will identify facts regarding nanotechnology including properties of materials at nanoscale.
- Students will describe the relative size of a nanometer.
- Students will describe how nano-products are used in society today.
- Students will identify tools and processes used to see and manipulate matter at the nanoscale.
- Discuss the impact that nanotechnology has on their lives today and will have in the future.
- Identify examples of nanotechnology-enhanced products.
- Describe engineering and engineering technology careers related to the advancement of nanotechnology.
- Identify the six simple machines: the lever, pulley, wheel and axle, inclined plane, wedge, and screw.
- Identify a machine as something that helps use energy more efficiently.
- Describe work as the force applied over a distance.
- Explain the applications of the six simple machines.
- Distinguish between the three classes of levers.
- Determine mechanical advantage from assembled simple machines.
- Compare and contrast kinetic and potential energy.
- Predict the relative kinetic energy based on the mass and speed of the object.

- Recognize and demonstrate safety rules for using lab tools and machines.
- Build, test, and evaluate a model of a design problem.
- Analyze a product through testing methods and make modifications to the product.

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Unit 3 – Magic of Electrons

3-4 Months

Unit 3

Through hands-on projects, students explore electricity, the behavior and parts of atoms, and sensing devices. They learn knowledge and skills in basic circuitry design, and examine the impact of electricity on the world around them.

Essential Questions

- How and why are some materials good at conducting electricity and some are not?
- How do electricians measure electricity values?
- How are motors and generators the same? Different?
- How are series and parallel electrical circuits similar? Different?
- How and why is the mathematical relationship expressed through Ohm's Law so important for designing and evaluating electrical circuits?
- How is the difference between how humans and computers think and make decisions defined?
- How is it possible that modern computer systems rely on only two digits, 0 and 1, to communicate and process complex functions?
- How do constraints and trade-offs affect the logic circuit that an Engineer designs?

Essential Learning Outcomes

- Students will identify the roles of protons, neutrons, and electrons in an atom.
- Students will explain how charges interact to hold an atom together.
- Students will identify metals, metalloids, and non-metals on the periodic table.
- Students will explain the relationship between current, voltage, and resistance.
- Students will describe the properties of a magnet including polarity and defining characteristics.
- Students will explain the role of an electromagnet in the function of a DC motor and generator.
- Students will describe how electron transfer between atoms and the flow of electricity are related.
- Students will evaluate whether a material is a conductor, insulator, or semiconductor based upon its number of valance electrons and its position on the periodic table.

- Students will identify an element based on the atomic number given a periodic table.
- Students will identify metals, metalloids, and non-metals on the periodic table.
- Students will Measure voltage and current using a multimeter.
- Students will demonstrate the characteristics and functions of an electromagnet.
- Students will identify the primary parts of a DC motor and demonstrate how it functions.
- Students will identify the primary parts of a generator and demonstrate how it functions.
- Students will Compare and contrast the characteristics of a basic motor and generator.
- Students will Identify the characteristics of series, parallel, and combination electrical circuits.
- Students will identify standardized schematic symbols using a chart.
- Students will distinguish between the functions and operations of fixed resistors, variable resistors, and photo resistors.
- Students will construct series, parallel, and combination electrical circuits.
- Students will Sketch circuit diagrams using standardized schematic symbols.
- Students will construct and test physical electrical circuits based upon circuit diagrams.
- Students will Integrate DC sources, lamps, switches, diodes, light emitting diodes, resistors, and capacitors into electrical circuits to achieve specific functions.
- Students will determine the value of a fixed resistor based upon the color codes on those resistors.
- Students will Measure voltage, current, and resistance using a multimeter.
- Students will mathematically calculate voltage, current, and resistance using Ohm's law.
- Students will Design a circuit that uses a transistor as a switch.
- Students will identify the relationship between the binary number system and the decimal number system.
- Students will Describe the functions of NOT, AND, OR, NAND, NOR, and XOR gates.
- Students will convert binary numbers to Base-10.
- Students will Convert ACII characters to binary.
- Students will interpret logic scenarios to determine outputs based upon possible conditions within those scenarios.
- Students will Create truth tables for logic scenarios and match those gates to truth tables.
- Students will create a digital wave form and graph it for a binary sequence.
- Students will communicate using electronic circuit diagrams.
- Students will Use transistors as switches to create circuits that function as AND and OR gates.
- Students will determine the logic, sensors, gates, outputs, and other components needed to emulate existing electronic devices that utilize logic.
- Students will Design, construct, and test device solutions for emulating common electronic devices that utilize logic.

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