

Introduction to Drones Curriculum

Unit 1: Fundamentals of Flight

Enduring Understandings	Essential Questions	Objectives
<ul style="list-style-type: none"> • Drones and other UAVs offer unprecedented improvements for many industries. • Bernoulli's principle explains the importance of wing shape in relation to lift and flight. • A force is needed to change an object's state of motion. • Energy and momentum can change from one form or another without a net loss or gain. • Newton's law of motion (inertia) is defined as a body at rest tends to stay at rest while a body in motion tends to stay in motion. • Acceleration describes how quickly velocity changes when net forces are acted upon an object. • Flight occurs on 3 axes • An electric current can produce a magnetic field, and changing that field produces an electric current. • The electromagnetic spectrum is measured in frequency and in wavelengths. 	<ul style="list-style-type: none"> • What are drones used for in the 21st century? • How is lift achieved during flight? • What factors affect an object's momentum? • What are Newton's 3 laws and how do they impact our everyday lives? • How does displacement differ from distance? • What produces acceleration? • Can a magnetic field produce an electric current? • Explain the function and relation of a transmitter and receiver in relation to radio communications. • In what ways does weight distribution impact flight? • How does a drone steer? 	<ul style="list-style-type: none"> • Research industries utilizing drones and predict where they could be used in the future. • Create, test, and chart lift data achieved by various wing designs. • Demonstrate and create a project that showcases force and equilibrium. • Conduct labs to demonstrate laws of conservation of momentum, work, and energy. • Calculate work, energy, and momentum equations. • Graph projectile motion and gravitational pull. • Demonstrate linear motion through labs, project building, and graphing skills. • Learn the proper controls for manipulating the 3 axes of flight • Create and investigate the functions of a "simple motor" • Compare and contrast AM and FM broadcasts • Explain how radio waves are used, transmitted, and received • Communicate and understand the phonetic alphabet and other air traffic control terminology
<h3>Focus Areas</h3>		
<p>Focus 1 - Introduction to Drones (1 Week)</p> <ol style="list-style-type: none"> a. What is a drone b. Types of UAVs c. Commercial Uses d. Drone Components e. Safety Guidelines - labs, drone usage, etc. <p>Focus 2 - Flight 101 (2-3Weeks)</p> <ol style="list-style-type: none"> a. History of Flight b. What are aerodynamics? c. Newton's Laws of Force and Motion 		

- d. Bernoulli's Principle
- e. Forces of Flight
- f. 3 Axes of Flight
- g. Mechanical Design of aircraft; airplanes, airfoils, UAVs

Focus 3 - Propulsion and Control (2-3 Weeks)

- a. Into to Electric Motors
- b. Brush vs. Brushless
- c. Build a Motor Lab*
- d. Propellers Design Theory
- e. Fixed Pitch, Variable Pitch, Constant Speed Blades
- f. Intro to Flight Controllers
- g. Sensors and Guidance Systems
- h. What is a Radio Control System
- i. Controllers, Transmitters, & Receivers

Focus 4 - Load and Performance (1-2 Weeks)

- a. Determining Speed and Altitude
- b. Loading, Weight, & Balance
- c. Load Factor
- d. Stalls
- e. Drone Performance Lab*

Assessments

Unit 1 Assessment 1	https://drive.google.com/file/d/1e9nIRaqXnkO_buOgQ-hC-zoPyJDNxrbG/view?usp=sharing
Unit 1 Assessment 2	https://drive.google.com/file/d/1b8GxX6qkB5dVEIZ8_wVubAxNCIXpBWdd/view?usp=sharing

Standards Addressed in Unit 1

Standards

Engineering Design

HS-ETS1-2: Design a solution to a complex real-world problem by breaking it down into smaller, more manageable problems that can be solved through engineering.

HS-ETS1-3: Evaluate a solution to a complex real-world problem based on prioritized criteria and trade-offs that account for a range of constraints, including cost, safety, reliability, and aesthetics, as well as possible social, cultural, and environmental impacts.

High School Physical Sciences

HS-PS2-1: Analyze data to support the claim that Newton's second law of motion describes the mathematical relationship among the net force on a macroscopic object, its mass, and its acceleration. Examples of data could include tables or graphs of position or velocity as a function of time for objects subject to a net unbalanced force, such as a falling object, an object rolling down a ramp, or a moving object being pulled by a constant force. Assessment is limited to one-dimensional motion and to macroscopic objects moving at non-relativistic speeds.

HS-PS2-2: Use mathematical representations to support the claim that the total momentum of a system of objects is conserved when there is no net force on the system. Emphasis is on the quantitative conservation of momentum in interactions and the qualitative meaning of this principle. Assessment is limited to systems of two macroscopic bodies moving in one dimension.

HS-PS2-3: Apply scientific and engineering ideas to design, evaluate, and refine a device that minimizes the force on a macroscopic object during a collision. Examples of evaluation and refinement could include determining the success of the device at protecting an object from damage and modifying the design to improve it. Examples of a device could include a football helmet or a parachute. Assessment is limited to qualitative evaluations and/or algebraic manipulations.

HS-PS2-4: Use mathematical representations of Newton's Law of Gravitation and Coulomb's Law to describe and predict the gravitational and electrostatic forces between objects. Emphasis is on both quantitative and conceptual descriptions of gravitational and electric fields. Assessment is limited to systems with two objects.

HS-PS3-1: Create a computational model to calculate the change in the energy of one component in a system when the change in energy of the other component(s) and energy flows in and out of the system are known. Emphasis is on explaining the meaning of mathematical expressions used in the model. Assessment is limited to basic algebraic expressions or computations; to systems of two or three components; and to thermal energy, kinetic energy, and/or the energies in gravitational, magnetic, or electric fields.

HS-PS3-2: Develop and use models to illustrate that energy at the macroscopic scale can be accounted for as a combination of energy associated with the motions of particles (objects) and energy associated with the relative position of particles (objects). Examples of phenomena at the macroscopic scale could include the conversion of kinetic energy to thermal energy, the energy stored due to position of an object above the earth, and the energy stored between two electrically-charged plates. Examples of models could include diagrams, drawings, descriptions, and computer simulations.

HS-PS3-3: Design, build, and refine a device that works within given constraints to convert one form of energy into another form of energy. Emphasis is on both qualitative and quantitative evaluations of devices. Examples of devices could include Rube Goldberg devices, wind turbines, solar cells, solar ovens, and generators. Examples of constraints could include use of renewable energy forms and efficiency. Assessment for quantitative evaluations is limited to total output for a given input. Assessment is limited to devices constructed with materials provided to students.

HS-PS2-5: Plan and conduct an investigation to provide evidence that an electric current can produce a magnetic field and that a changing magnetic field can produce an electric current. Assessment is limited to designing and conducting investigations with provided materials and tools.

HS-PS3-5: Develop and use a model of two objects interacting through electric or magnetic fields to illustrate the forces between objects and the changes in energy of the objects due to the interaction. Examples of models could include drawings, diagrams, and texts, such as drawings of what happens when two charges of opposite polarity are near each other. Assessment is limited to systems containing two objects.

HS-PS4-2: Evaluate questions about the advantages of using a digital transmission and storage of information. Examples of advantages could include that digital information is stable because it can be stored reliably in computer memory, transferred easily, and copied and shared rapidly. Disadvantages could include issues of easy deletion, security, and theft.

Technology Literacy

8.1.12.A: Technology Operations and Concepts: Students demonstrate a sound understanding of technology concepts, systems and operations. Students will:

8.1.12.B: Creativity and Innovation: Students demonstrate creative thinking, construct knowledge and develop innovative products and process using technology.

8.1.12.C: Communication and Collaboration: Students use digital media and environments to communicate and work collaboratively, including at a distance, to support individual learning and contribute to the learning of others.

8.1.12.D: Digital Citizenship: Students understand human, cultural, and societal issues related to technology and practice legal and ethical behavior.

8.1.12.E: Research and Information Fluency: Students apply digital tools to gather, evaluate, and use information.

8.1.12.F: Critical thinking, problem solving, and decision making: Students use critical thinking skills to plan and conduct research, manage projects, solve problems, and make informed decisions using appropriate digital tools and resources.

8.2.12.A.2: Analyze a current technology and the resources used, to identify the trade-offs in terms of availability, cost, desirability and waste.

8.2.12.B.1: Research and analyze the impact of the design constraints (specifications and limits) for a product or technology driven by a cultural, social, economic or political need and publish for review.

8.2.12.C.2: Analyze a product and how it has changed or might change over time to meet human needs and wants.

Mathematics and Statistics

CCSS.Math.Content.HSA-CED.A.1: Create equations and inequalities in one variable and use them to solve problems. Include equations arising from linear and quadratic functions, and simple rational and exponential functions.

CCSS.Math.Content.HSA-CED.A.4: Rearrange formulas to highlight a quantity of interest, using the same reasoning as in solving equations. For example, rearrange Ohm's law $V = IR$ to highlight resistance R .

CCSS.Math.Content.HSA-REI.D: Represent and solve equations and inequalities graphically

CCSS.Math.Content.HSF-BF.A.1c: Compose functions. For example, if $T(y)$ is the temperature in the atmosphere as a function of height, and $h(t)$ is the height of a weather balloon as a function of time, then $T(h(t))$ is the temperature at the location of the weather balloon as a function of time.

CCSS.Math.Content.HSS-IC.B.6: Evaluate reports based on data.

CCSS.Math.Content.HSS-ID.B.6a: Fit a function to the data; use functions fitted to data to solve problems in the context of the data. Use given functions or choose a function suggested by the context. Emphasize linear, quadratic, and exponential models.

21st Century Life Skills

9.1.12: 21st Century Life Skills: All students will demonstrate creative, critical thinking, collaboration and problem solving skills to function successfully as global citizens and workers in diverse ethnic and organizational cultures

9.1.12.1: The ability to recognize a problem and apply critical thinking and problem-solving skills to solve the problem is a lifelong skill that develops over time.

9.1.12.2: Ethical behaviors support human rights and dignity in all aspects of life.

9.1.12.2: Leadership abilities develop over time through participation in groups and/or teams that are engaged in challenging or competitive activities.

9.1.12.C.4: Demonstrate leadership and collaborative skills when participating in online learning communities and structured learning experiences.

9.1.12.E.4: Predict the impact of emerging media technologies on international business and globalization.

9.2.12.A.5: Evaluate current advances in technology that apply to a selected occupational career cluster.

9.3.12.C.5: Identify transferable skills in career choices and design alternative career plans based on those skills.

Unit 2 - Take Off & FAA Regulations

Enduring Understandings	Essential Questions	Objectives
<ul style="list-style-type: none"> • National Airspace Systems are run by the FAA for the purpose of safe air travel • Pilots must be aware of the type of airspace they are flying in and the regulations for each. • Geographic coordinates identify precise locations on the Earth's surface • All airports have specific traffic patterns that are unique to their location and layout. • Weather impacts flight, communications, and UAV performance. • Electrical engineers are always researching for ways to improve efficiency of rechargeable batteries and ways to make them smaller • The FAA recreational and 107C standards outline the use for both recreational and professional pilots. 	<ul style="list-style-type: none"> • How is airspace classified? • In what ways do flight requirements and rules change from airspace to airspace? • How do pilots utilize supplemental charts to prepare for flights? • Why do pilots use geographic coordinates? • What purpose do airport markings and signs serve in regards to take off and landing? • How does weather impact the performance of a UAV? • What do weather briefings indicate to pilots? • Which two cell battery and electrolyte construction is best? • What are the FAA operating rules, limitations, and local laws regarding drone flight 	<ul style="list-style-type: none"> • Differentiate between controlled and uncontrolled airspaces • Compare and contrast flight expectations in class A,B,C,D,& E airspaces • Analyze supplemental chart data to draw conclusions and plot courses of action • Locate a specific point on the surface by utilizing geographic coordinates • Identify standard airport markings and take instruction from air traffic control (simulation) • Identify types of air masses and the weather associated with them. • Simulate convection currents and turbulent air scenarios. • Read and write out weather briefings, METAR, and TAF reports • Describe the energy transformations that take place when a battery connects to a circuit • Construct and graph a current produced by a battery • Apply FAA guidelines to flight scenarios.

Focus Areas

Focus 1 - National Airspace System (2-3 Weeks)

- a. Introduction to Airspace
- b. Airspace Classification
- c. Topography
- d. Airport Operations
- e. Airport Markings and Signs
- f. Collision Avoidance
- g. NOTAMS

Focus 2 - Weather (2-3 Weeks)

- a. Wind, Air Masses, & Fronts
- b. Atmospheric Stability
- c. Visibility, Clouds, Thunderstorms, Icing, Fog
- d. Density Altitude
- e. Weather Briefings, Reports, Forecasts, Charts

Focus 3 - Care and Maintenance (1 Week)

- a. Battery Chemistry, Cell Balancing, Charging, Battery Health
- b. Charge and Discharge Rates
- c. Preflight Checklist
- d. Repairs Lab*

Focus 4 - Regulations for Recreational and 107c (1 Week)

- a. Recreational Registration and Use
- b. Commercial Registration and Use
- c. Drone Registration
- d. Daylight Operations
- e. Operating Limits
- f. Right of Way
- g. Privacy and other Considerations

Assessments**Unit 2 Assessment 1**

<https://docs.google.com/forms/d/1h482U4REe5StCWt7pPAx9r6s6xxE93D8L952DtfMODI/edit>

Unit 2 Assessment 2

https://docs.google.com/forms/d/1FcaGPHjmW1nd9d96282msy8CMb7j528CCuij1T2Ppg/edit?usp=drive_web

Standards Addressed in Unit 2**High School Geosciences**

HS-ESS3-5: Analyze geoscience data and the results from global climate models to make an evidence-based forecast of the current rate of global or regional climate change and associated future impacts to Earth systems. Examples of evidence, for both data and climate model outputs, are for climate changes (such as precipitation and temperature) and their associated impacts (such as on sea level, glacial ice volumes, or atmosphere and ocean composition).

FAA Standards

https://drive.google.com/file/d/1ESJT5QxZT9Gf8xzWqbqRli_iWGXS86W9/view?usp=sharing