COURSE TITLE

Drones: Theory, Design, and Use

LENGTH

One Semester

DEPARTMENT

STEM Department

SCHOOL

Union Middle School

DATE

September 10, 2018

Drones: Theory, Design, and Use

I.   Introduction/Overview/Philosophy

Drones: Theory, Design, and Use is an elective course designed to seamlessly integrate the interdependent disciplines of Science, Technology, Engineering, Art, Math (STEAM) into a focused and invigorating real-world relevant curriculum. Also embedded are engineering (mechanical, electrical, & software), design, innovation, communications, small group collaboration, and 21st century critical thinking skills and knowledge relevant for student success in college, career and the community.

II.   Objectives

Course Outline:

1. Introduction to Drone Robotics
2. UGV - Unmanned Ground Vehicles
3. Electrical Engineering & Energy Transfer
4. Drone Code & Technologies
5. Applied Systems Thinking
6. Physics of Flight
7. UAV – Unmanned Aerial Vehicles
8. Culminating Project

Student Outcomes:

After successfully completing this course, the student will:
- Analyze, collect, organize and interpret data to create empirically based arguments.
- Construct, communicate, and interpret experimental findings with others.
- Gather and synthesize information as well as identify scientific questions to make predictions.
- Evaluate the strengths and weakness of data, claims, and arguments.
- Discuss, relate and associate scientific terminology, concepts, principles and theories and relate to investigations, discussions and activities.
- Develop the skill to utilize methods and processes to solve problems using scientific reasoning.
- Create models to describe relations and relate to differing functions.
- Use oral and written arguments to support scientific reasoning.
- Collaborate, share and work in groups in order to improve understanding of scientific concepts.

New Jersey Student Learning Standards

New Jersey Student Learning Standards

CAREER READY PRACTICES
CRP1   Act as a responsible and contributing citizen and employee.

Career-ready individuals understand the obligations and responsibilities of being a member of a community, and they demonstrate this understanding every day through their interactions with others. They are conscientious of the impacts of their decisions on others and the environment around them. They think about the near-term and long-term consequences of their actions and seek to act in ways that contribute to the betterment of their teams, families, community and workplace. They are reliable and consistent in going beyond the minimum expectation and in participating in activities that serve the greater good.

CRP2   *Apply appropriate academic and technical skills.*
Career-ready individuals readily access and use the knowledge and skills acquired through experience and education to be more productive. They make connections between abstract concepts with real-world applications, and they make correct insights about when it is appropriate to apply the use of an academic skill in a workplace situation

CRP4   *Communicate clearly and effectively and with reason.*
Career-ready individuals communicate thoughts, ideas, and action plans with clarity, whether using written, verbal, and/or visual methods. They communicate in the workplace with clarity and purpose to make maximum use of their own and others' time. They are excellent writers; they master conventions, word choice, and organization, and use effective tone and presentation skills to articulate ideas. They are skilled at interacting with others; they are active listeners and speak clearly and with purpose. Career-ready individuals think about the audience for their communication and prepare accordingly to ensure the desired outcome.

CRP5. *Consider the environmental, social and economic impacts of decisions.*
Career-ready individuals understand the interrelated nature of their actions and regularly make decisions that positively impact and/or mitigate negative impact on other people, organization, and the environment. They are aware of and utilize new technologies, understandings, procedures, materials, and regulations affecting the nature of their work as it relates to the impact on the social condition, the environment and the profitability of the organization.

CRP6. *Demonstrate creativity and innovation.*
Career-ready individuals regularly think of ideas that solve problems in new and different ways, and they contribute those ideas in a useful and productive manner to improve their organization. They can consider unconventional ideas and suggestions as solutions to issues, tasks or problems, and they discern which ideas and suggestions will add greatest value. They seek new methods, practices, and ideas from a variety of sources and seek to apply those ideas to their own workplace. They take action on their ideas and understand how to bring innovation to an organization.

CRP7. *Employ valid and reliable research strategies.*
Career-ready individuals are discerning in accepting and using new information to make decisions, change practices or inform strategies. They use reliable research process to search for new information. They evaluate the validity of sources when considering the use and adoption of external information or practices in their workplace situation.

CRP8. *Utilize critical thinking to make sense of problems and persevere in solving them.*
Career-ready individuals readily recognize problems in the workplace, understand the nature of the problem, and devise effective plans to solve the problem. They are aware of problems when they occur and take action quickly to address the problem; they thoughtfully investigate the root cause of the problem prior to introducing solutions. They carefully consider the options to solve the problem. Once a solution is agreed upon, they follow through to ensure the problem is solved, whether through their own actions or the actions of others.

CRP11. Use technology to enhance productivity.
Career-ready individuals find and maximize the productive value of existing and new technology to accomplish workplace tasks and solve workplace problems. They are flexible and adaptive in acquiring new technology. They are proficient with ubiquitous technology applications. They understand the inherent risks-personal and organizational-of technology applications, and they take actions to prevent or mitigate these risks.

TECHNOLOGY

Standard 8.1 Educational Technology: All students will use digital tools to access, manage, evaluate, and synthesize information in order to solve problems individually and collaborate and to create and communicate knowledge.
Strand A. Technology Operations and Concepts: Students demonstrate a sound understanding of technology concepts, systems and operations.
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.
Strand B. Creativity and Innovation: Students demonstrate creative thinking, construct knowledge and develop innovative products and process using technology.
8.1.8.B.1- Synthesize and publish information about a local or global issue or event (ex. telecollaborative project, blog, school web).
Strand 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.
8.1.8.C.1- Collaborate to develop and publish work that provides perspectives on a global problem for discussions with learners from other countries.
Strand D. Digital Citizenship: Students understand human, cultural, and societal issues related to technology and practice legal and ethical behavior.
8.1.8.D.1- Understand and model appropriate online behaviors related to cyber safety, cyber bullying, cyber security, and cyber ethics including appropriate use of social media.
8.1.8.D.2- Demonstrate the application of appropriate citations to digital content.
8.1.8.D.3- Demonstrate an understanding of fair use and Creative Commons to intellectual property.
8.1.8.D.4- Assess the credibility and accuracy of digital content.
8.1.8.D.5- Understand appropriate uses for social media and the negative consequences of misuse.
Strand E: Research and Information Fluency: Students apply digital tools to gather, evaluate, and use information.
8.1.8.E.1- Effectively use a variety of search tools and filters in professional public databases to find information to solve a real world problem.
Strand 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.
8.1.8.F.1- Explore a local issue, by using digital tools to collect and analyze data to identify a solution and make an informed decision.

Standard 8.2 Technology Education, Engineering, Design, and Computational Thinking - Programming: All students will develop an understanding of the nature and impact of technology, engineering, technological design, computational thinking and the designed world as they relate to the individual, global society, and the environment.

Strand D. Abilities for a Technological World: The designed world is the product of a design process that provides the means to convert resources into products and systems.

8.2.8.D.3- Build a prototype that meets a STEM-based design challenge using science, engineering, and math principles that validate a solution.

Strand E. Computational Thinking: Programming: Computational thinking builds and enhances problem solving, allowing students to move beyond using knowledge to creating knowledge.

8.2.8.E.3- Develop an algorithm to solve an assigned problem using a specified set of commands and use peer review to critique the solution.

8.2.8.E.4- Use appropriate terms in conversation (e.g., programming, language, data, RAM, ROM, Boolean logic terms).

21ST CENTURY LIFE AND CAREERS

9.2 Career Awareness, Exploration, and Preparation
Strand B: Career Exploration

9.2.8.B.1 Research careers within the 16 Career Clusters® and determine attributes of career success.

9.2.8.B.3 Evaluate communication, collaboration, and leadership skills that can be developed through school, home, work, and extracurricular activities for use in a career.

9.2.8.B.4 Evaluate how traditional and nontraditional careers have evolved regionally, nationally, and globally.

COMPANION STANDARDS FOR SCIENCE AND TECHNICAL SUBJECTS

RST.6-8.3. Follow precisely a multistep procedure when carrying out experiments, taking measurements, or performing technical tasks.

RST.6-8.7. Integrate quantitative or technical information expressed in words in a text with a version of that information expressed visually (e.g., in a flowchart, diagram, model, graph, or table).

RST.6-8.9. Compare and contrast the information gained from experiments, simulations, video, or multimedia sources with that gained from reading a text on the same topic.

WHST.6-8.5. With some guidance and support from peers and adults, develop and strengthen writing as needed by planning, revising, editing, rewriting, or trying a new approach, focusing on how well purpose and audience have been addressed.

WHST.6-8.6. Use technology, including the Internet, to produce and publish writing and present the relationships between information and ideas clearly and efficiently.

WHST.6-8.8. Gather relevant information from multiple print and digital sources, using search terms effectively; assess the credibility and accuracy of each source; and quote or paraphrase the data and conclusions of others while avoiding plagiarism and following a standard format for citation.

III. Proficiency Levels

Drones: Theory, Design, and Use is an elective course for 7th and 8th grade students.

IV.   Methods of Assessment

Student Assessment
The teacher will provide a variety of assessments during the course of the year. The assessment may include but is not limited to: chapter and unit tests and quizzes, simulations, application problems, and projects.

Curriculum/Teacher Assessment
The teacher will provide the subject area supervisor with suggestions for changes on an ongoing basis.

V.   Grouping

This class is heterogeneously grouped for 7th and 8th grade students.

VI.   Articulation/Scope & Sequence/Time Frame

Course length is one semester.

VII.   Resources

Texts/Supplemental Reading/References
- Chromebooks
- Internet video sources
- Current UAV electronic components
- School MacBooks
- Open space for data accumulation and skill acquisition

VIII.   Suggested Activities
Appropriate activities are listed in the curriculum map.

IX.   Methodologies

The following methods of instruction are suggested: lecture, working in groups/working with a partner, cooperative learning groups, and technology-aided instruction.

X.   Interdisciplinary Connections

Drones: Theory, Design, and Use has virtually unlimited possibilities because it is defined by integrated subject areas: science, technology, engineering, arts, and math.

XI.   Differentiating Instruction for Students with Special Needs: Students with Disabilities, Students at Risk, English Language Learners, and Gifted & Talented Students

Differentiating instruction is a flexible process that includes the planning and design of instruction, how that instruction is delivered, and how student progress is measured. Teachers recognize that students can learn in

multiple ways as they celebrate students' prior knowledge. By providing appropriately challenging learning, teachers can maximize success for all students.

Differentiating in this course includes but is not limited to:

Differentiation for Support (ELL, Special Education, Students at Risk)
- Peer mentoring on problems
- Differentiated teacher feedback on assignments
- Modeling out problems on whiteboard
- Visual aids as we project problems on whiteboard
- Study guides
- Tiered assignments
- Scaffolding of materials and assignments
- Re-teaching and review
- Guided note taking
- Exemplars of varied performance levels
- Multi-media approach to accommodating various learning styles

Differentiation for Enrichment
- Supplemental reading material for independent study
- Flexible grouping
- Tiered assignments
- Topic selection by interest
- Enhanced expectations for independent study
- Elevated questioning techniques using Webb's Depth of Knowledge matrix

XII. Professional Development

The teacher will continue to improve expertise through participation in a variety of professional development opportunities.

XII.   Curriculum Map/Pacing Guide

Unit Topic	Time Allocated	Differentiating Instruction for Students with Disabilities, Students at Risk, English Language Learners, & Gifted & Talented Students	Standards	Assessments
"Introduction to Drones" Examining what a Drone is and does	2 weeks	*For Support:* Use of Visuals, Guided Notes, Teacher Modeling, Student-led Discussion, Whole-class Instruction *For Enhancement:* Independent Study, On-line Research, Community Research, Reaching Activities, Conferencing, Tiering	8.1.8.A.1,2,3,4,5 8.1.8.C.1 8.1.8.D.1,2,3,4,5 8.1.8.E.1 9.2.8.B.1,3,4 CRP1,4,7,8,9,11,12 RST.6-8.3,7,9 WHST.6-8.5,6,8	*Formative Assessment:* Internet research on various types of drones *Summative Assessment* Individual class presentations sharing researched information
"UGV - Unmanned Ground Vehicles" Exploring uses and construction of ground based drones	2 weeks	*For Support:* Modification of Content, Guided Notes, Teacher Modeling, Student-led Discussion, Whole-class Instruction *For Enhancement:* Curriculum Compacting, On-line Research, Community Research, Reaching Activities, Conferencing, Tiering	8.1.8.A.1,2,3,4,5 8.1.8.B.1 8.1.12.B.2 8.1.8.C.1 8.1.8.D.1,2,3,4,5 8.1.8.E.1 9.2.8.B.1,3,4 CRP1,4,7,8,9,11,12 RST.6-8.3,7,9 WHST.6-8.5,6,8	*Formative Assessment:* Ability to construct a well built ground based drone *Summative Assessment* Production of a ground based drone that functions as intended
"Electrical Engineering & Energy Transfer" Fundamentals of electricity	2 Weeks	*For Support:* Multi-sensory Formats, Guided Notes, Teacher Modeling, Student-led Discussion, Whole-class Instruction *For Enhancement:* Interest-Based Content, On-line Research,	8.1.8.A.1,2,3,4,5 8.1.8.B.1 8.1.12.B.2 8.1.8.C.1 8.1.8.D.1,2,3,4,5 8.1.8.E.1 9.2.8.B.1,3,4	*Formative Assessment:* Research about electricity and how it works *Summative Assessment* Demonstration of functional electric motors and explanation

Unit Topic	Time Allocated	Differentiating Instruction for Students with Disabilities, Students at Risk, English Language Learners, & Gifted & Talented Students	Standards	Assessments
		Community Research, Reaching Activities, Conferencing	CRP1,4,7,8,9,11,12 RST.6-8.3,7,9 WHST.6-8.5,6,8	of motor control boards
"Drone Code & Technologies" Learning coding/programming skills	3 Weeks	*For Support:* Guided Notes, Teacher Modeling, Student-led Discussion, Whole-class Instruction *For Enhancement:* Student interest content, On-line Research, Community Research, Reaching Activities, Conferencing, Tiering	8.1.8.A.1,2,3,4,5 8.1.8.B.1 8.1.12.B.2 8.1.8.C.1 8.1.8.D.1,2,3,4,5 8.1.8.E.1 9.2.8.B.1,3,4 CRP1,4,7,8,9,11,12 RST.6-8.3,7,9 WHST.6-8.5,6,8	*Formative Assessment:* Students are able to demonstrate functional levels of code mastery *Summative Assessment* Drones are able to complete complicated tasks as directed by written code/program
"Physics of Flight" Learning Newton's Three Laws as applied to flight	2 Weeks	*For Support:* Visual Learning Accommodations, Guided Notes, Teacher Modeling, Student-led Discussion, Whole-class Instruction *For Enhancement:* On-line Research, Community Research, Reaching Activities, Conferencing, Tiering	8.1.8.A.1,2,3,4,5 8.1.8.B.1 8.1.12.B.2 8.1.8.C.1 8.1.8.D.1,2,3,4,5 8.1.8.E.1 9.2.8.B.12,3,4 CRP1,4,7,8,9,11,12 RST.6-8.3,7,9 WHST.6-8.5,6,8	*Formative Assessment:* Student demonstration of basic physical science concepts *Summative Assessment* Student discussion of data relating to how changed variables affect flight outcomes
"UAV – Unmanned Aerial Vehicles" Research into current industry drone production	2 Weeks	*For Support:* Scaffolding, Guided Notes, Teacher Modeling, Student-led Discussion, Whole-class Instruction *For Enhancement:* On-line Research, Community Research,	8.1.8.A.1,2,3,4,5 8.1.8.B.1 8.1.12.B.2 8.1.8.C.1 8.1.8.D.1,2,3,4,5 8.1.8.E.1 9.2.8.B.1,3,4	*Formative Assessment:* Research into current industry drone production *Summative Assessment* Student presentation to class and class-wide evaluation of

Unit Topic	Time Allocated	Differentiating Instruction for Students with Disabilities, Students at Risk, English Language Learners, & Gifted & Talented Students	Standards	Assessments
		Reaching Activities, Conferencing, Tiering	CRP1,4,7,8,9,11,12 RST.6-8.3,7,9 WHST.6-8.5,6,8	research
"Culminating Project" **End-of-the unit activity**	2 Weeks	*For Support:* Teacher Think-Aloud, Guided Notes, Teacher Modeling, Student-led Discussion, Whole-class Instruction *For Enhancement:* On-line Research, Community Research, Reaching Activities, Conferencing, Tiering	8.1.8.A.1,2,3,4,5 8.1.8.B.1 8.1.12.B.2 8.1.8.C.1 8.1.8.D.1,2,3,4,5 8.1.8.E.1 9.2.8.B.1,3,4 CRP1,4,7,8,9,11,12 RST.6-8.3,7,9 WHST.6-8.5,6,8	*Formative Assessment:* Demonstration of ability to combine previous content material *Summative Assessment* Production of a functional drone