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[**WABS ACCESS STEM PBL Unit/Lesson Plan Template**](https://docs.google.com/document/u/1/d/1lzkUygoxlsEvaoczfdcXTIwzbba2y2ON/edit)

**U**NIT OVERVIEW

| **Title of PBL Unit: Drone Project: Applying the Engineering Design Process to Solve a Local Problem**  **Target Grade Level(s): Middle School**  **Subject(s): STEM**  **Author(s): Suzanne Stojka and Kitty Barnett (Renton School District Teachers), Jennifer Anderson (Team Mentor, Everett School District Teacher), Abhishek Gupta (Amazon Engineer), Virginia Nickelson (Boeing Engineer)** |
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| **Problem Statement: You work for a company that is applying for funding for a project that uses drones to solve a problem within your local community (school or town). This funding is very important to the success of your company - and your job. You and your team need to identify a local problem your drone could solve, build a prototype drone, sketch your design solution, prepare a report on drone performance/maintenance, and create an ad and make a presentation promoting your drone solution. The Board of your company will choose the best proposal to apply for funding.** |
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**NGSS:**

**MS: ENGINEERING DESIGN**

**DCIs, SEPs and CCCs**

| **The performance expectations above were developed using** [**the following elements from the NRC document *A Framework for K-12 Science Education***](https://www.nextgenscience.org/topic-arrangement/msengineering-design##framework)**:** | | |
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| Science and Engineering Practices[Asking Questions and Defining Problems](http://www.nap.edu/openbook.php?record_id=13165&page=54) [**Asking questions and defining problems in grades 6–8 builds on grades K–5 experiences and progresses to specifying relationships between variables, and clarifying arguments and models.**](http://www.nap.edu/openbook.php?record_id=13165&page=54)   * [**Define a design problem that can be solved through the development of an object, tool, process or system and includes multiple criteria and constraints, including scientific knowledge that may limit possible solutions. (MS-ETS1-1)**](http://www.nap.edu/openbook.php?record_id=13165&page=54)  [Developing and Using Models](http://www.nap.edu/openbook.php?record_id=13165&page=56) [**Modeling in 6–8 builds on K–5 experiences and progresses to developing, using, and revising models to describe, test, and predict more abstract phenomena and design systems.**](http://www.nap.edu/openbook.php?record_id=13165&page=56)   * [**Develop a model to generate data to test ideas about designed systems, including those representing inputs and outputs. (MS-ETS1-4)**](http://www.nap.edu/openbook.php?record_id=13165&page=56)  [Analyzing and Interpreting Data](http://www.nap.edu/openbook.php?record_id=13165&page=61) [**Analyzing data in 6–8 builds on K–5 experiences and progresses to extending quantitative analysis to investigations, distinguishing between correlation and causation, and basic statistical techniques of data and error analysis.**](http://www.nap.edu/openbook.php?record_id=13165&page=61)   * [**Analyze and interpret data to determine similarities and differences in findings. (MS-ETS1-3)**](http://www.nap.edu/openbook.php?record_id=13165&page=61)  [Engaging in Argument from Evidence](http://www.nap.edu/openbook.php?record_id=13165&page=71) **[Engaging in argument from evidence in 6–8 builds on K–5 experiences and progresses to constructing a convincing argument that supports or refutes claims for either explanations or solutions about the natural and designed world.](http://www.nap.edu/openbook.php?record_id=13165&page=71)**   * **[Evaluate competing design solutions based on jointly developed and agreed-upon design criteria. (MS-ETS1-2)](http://www.nap.edu/openbook.php?record_id=13165&page=71)** | Disciplinary Core Ideas[ETS1.A: Defining and Delimiting Engineering Problems](http://www.nap.edu/openbook.php?record_id=13165&page=204)  * [**The more precisely a design task’s criteria and constraints can be defined, the more likely it is that the designed solution will be successful. Specification of constraints includes consideration of scientific principles and other relevant knowledge that are likely to limit possible solutions. (MS-ETS1-1)**](http://www.nap.edu/openbook.php?record_id=13165&page=204)  [ETS1.B: Developing Possible Solutions](http://www.nap.edu/openbook.php?record_id=13165&page=206)  * [**A solution needs to be tested, and then modified on the basis of the test results, in order to improve it. (MS-ETS1-4)**](http://www.nap.edu/openbook.php?record_id=13165&page=206) * [**There are systematic processes for evaluating solutions with respect to how well they meet the criteria and constraints of a problem. (MS-ETS1-2), (MS-ETS1-3)**](http://www.nap.edu/openbook.php?record_id=13165&page=206) * [**Sometimes parts of different solutions can be combined to create a solution that is better than any of its predecessors. (MS-ETS1-3)**](http://www.nap.edu/openbook.php?record_id=13165&page=206) * [**Models of all kinds are important for testing solutions. (MS-ETS1-4)**](http://www.nap.edu/openbook.php?record_id=13165&page=206)  [ETS1.C: Optimizing the Design Solution](http://www.nap.edu/openbook.php?record_id=13165&page=208)  * [**Although one design may not perform the best across all tests, identifying the characteristics of the design that performed the best in each test can provide useful information for the redesign process—that is, some of those characteristics may be incorporated into the new design. (MS-ETS1-3)**](http://www.nap.edu/openbook.php?record_id=13165&page=208) * [**The iterative process of testing the most promising solutions and modifying what is proposed on the basis of the test results leads to greater refinement and ultimately to an optimal solution. (MS-ETS1-4)**](http://www.nap.edu/openbook.php?record_id=13165&page=208) | Crosscutting Concepts[Influence of Science, Engineering, and Technology on Society and the Natural World](http://www.nap.edu/openbook.php?record_id=13165&page=212)  * [**All human activity draws on natural resources and has both short and long-term consequences, positive as well as negative, for the health of people and the natural environment. (MS-ETS1-1)**](http://www.nap.edu/openbook.php?record_id=13165&page=96) * [**The uses of technologies and limitations on their use are driven by individual or societal needs, desires, and values; by the findings of scientific research; and by differences in such factors as climate, natural resources, and economic conditions. (MS-ETS1-1)**](http://www.nap.edu/openbook.php?record_id=13165&page=96) |

**Performance Expectations:**

| **MS-ETS1-1.** | **Define the criteria and constraints of a design problem with sufficient precision to ensure a successful solution, taking into account relevant scientific principles and potential impacts on people and the natural environment that may limit possible solutions.** |
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| **MS-ETS1-2.** | **Evaluate competing design solutions using a systematic process to determine how well they meet the criteria and constraints of the problem.** |
| **MS-ETS1-3.** | **Analyze data from tests to determine similarities and differences among several design solutions to identify the best characteristics of each that can be combined into a new solution to better meet the criteria for success.** |
| **MS-ETS1-4.** | **Develop a model to generate data for iterative testing and modification of a proposed object, tool, or process such that an optimal design can be achieved.** |

| **21st-Century Skills:**   * **Learning Skills: Also known as the "four Cs" of 21st century learning, these include critical thinking, communication, collaboration, and creativity.** * **Life Skills: Flexibility, initiative, social skills, productivity, leadership** * **Literacy Skills: Information literacy, media literacy, technology literacy** |
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| **Locally and/or Personally Relevant for Students:**  **The focus of this project was for students to create a product that would provide a useful service to their school or local community** |
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| **Connections to Career and Educational Pathways:**  **Students are placed in teams with roles that correspond to real world teams including: project managers, engineers, designers, programmers, and marketers. The project roles correspond to real-word team positions in engineering. Along with team leadership, students learn about team accountability and hold team meetings to report progress daily. Project managers lead the team and are responsible for reporting back to their supervisor (teacher) about team progress, solutions, problems, etc.** |
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**LESSON 1 - INTRODUCTION TO DRONE PROJECT**

| **Lesson Number and Title: Lesson 1 - Introduction to Drone Project** |
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| **Problem Statement: How are drones used today?** |
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| **Lesson Objectives: Students will be able to activate prior knowledge and explore additional ways drones are currently used in the real-world. Students will be introduced to their Drone project and project roles.** |
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| **Lesson Standards:** SEP: [Asking Questions and Defining Problems](http://www.nap.edu/openbook.php?record_id=13165&page=54) [**Asking questions and defining problems in grades 6–8 builds on grades K–5 experiences and progresses to specifying relationships between variables, and clarifying arguments and models.**](http://www.nap.edu/openbook.php?record_id=13165&page=54)   * [**Define a design problem that can be solved through the development of an object, tool, process or system and includes multiple criteria and constraints, including scientific knowledge that may limit possible solutions. (MS-ETS1-1)**](http://www.nap.edu/openbook.php?record_id=13165&page=54)     **DCI:** [ETS1.A: Defining and Delimiting Engineering Problems](http://www.nap.edu/openbook.php?record_id=13165&page=204)   * [**The more precisely a design task’s criteria and constraints can be defined, the more likely it is that the designed solution will be successful. Specification of constraints includes consideration of scientific principles and other relevant knowledge that are likely to limit possible solutions. (MS-ETS1-1)**](http://www.nap.edu/openbook.php?record_id=13165&page=204)  CCS: [Influence of Science, Engineering, and Technology on Society and the Natural World](http://www.nap.edu/openbook.php?record_id=13165&page=212)  * **[The uses of technologies and limitations on their use are driven by individual or societal needs, desires, and values; by the findings of scientific research; and by differences in such factors as climate, natural resources, and economic conditions. (MS-ETS1-1)](http://www.nap.edu/openbook.php?record_id=13165&page=96)** |
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| **Materials:**  [**Pre-Questions**](https://docs.google.com/document/d/1RmtSmZ4PG-GYnM0dIyAj3WIWGw-mETV9ppIxGj0U3uE/edit) **- Use to assess students' prior knowledge.**  [**Programming Experience Questionnaire**](https://docs.google.com/forms/d/1G1E089epzSyusP0beSoYSYxgGRdQ_a3jKi3DZ2PR5VU/edit?usp=sharing)  [**5 minute video**](https://drive.google.com/file/d/1ws7pdLmDd1adg7YgtSnVWbzMT6CHo0ht/view?usp=sharing) **compilation of various uses of drones (observing phenomenon)**  [**Drone Project Engineering Design Process Journal**](https://docs.google.com/document/d/10UGHeuYJ4OUjM6ZVBCb28Xs8VxlgbIqPQifyt-UqFQ0/view)  **Computers and Internet for Research** |
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**If relevant to a single lesson, please include:**

| **Lesson S21st-Century Skills:**   * **Literacy Skills: Information literacy, media literacy, technology literacy** |
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**LESSON PREPARATION**

| **Time Required: 1 class period** |
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| **Grouping of Students for Instruction: This lesson is done whole class. Students work on this part of their Design Journals independently.** |
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| **What is the instruction? (Consider the PBL procedure that is being addressed here):**  **In this lesson students complete the following in their** [**Drone Project Engineering Design Process Journals:**](https://docs.google.com/document/d/1K8TnIG9SF9_hXrkiw3FLILZdai-KLrgjztYRceyxXCU/edit?usp=sharing)   * [**Pre-Questions**](https://docs.google.com/document/d/1RmtSmZ4PG-GYnM0dIyAj3WIWGw-mETV9ppIxGj0U3uE/edit) **to activate prior knowledge - individually** * **Building Background: Students will view a** [**video**](https://drive.google.com/file/d/1ws7pdLmDd1adg7YgtSnVWbzMT6CHo0ht/view?usp=sharing)**- whole class, answer questions individually and discuss - whole class.** * **Research Other Uses for Drones - individually** * **The project’s problem and roles will be introduced and discussed. Students are able to ask questions to make sure they clearly understand the problem and roles.** * **Students complete a google form** [**(see sample**](https://forms.gle/MaX5zDnRAcHFFUPL7)**) selecting their top 3 project roles.** |
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| **Possible Accommodations:** |
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| **Possible Extensions:** |
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| **Possible Assessment: Formative Assessment - Pre-Questions and Building Background/Other Uses of Drones in Packet.** |
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| **References and Resources: Linked above.** |
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**LESSON OVERVIEW**

This section should be repeated for each individual lesson that makes up the unit.

| **Lesson Number and Title: Lesson #2 - Drone Project: Research and Brainstorming** |
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| **Problem Statement: What local problems (school or local community) could be solved by using a drone?** |
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| **Lesson Objectives: Students will be able to identify the project criteria and constraints, and then follow them to brainstorm a possible problem and design solution.** |
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| **Lesson Standards:**  **DCIs:** [ETS1.A: Defining and Delimiting Engineering Problems](http://www.nap.edu/openbook.php?record_id=13165&page=204)  * [**The more precisely a design task’s criteria and constraints can be defined, the more likely it is that the designed solution will be successful. Specification of constraints includes consideration of scientific principles and other relevant knowledge that are likely to limit possible solutions. (MS-ETS1-1)**](http://www.nap.edu/openbook.php?record_id=13165&page=204)  [ETS1.B: Developing Possible Solutions](http://www.nap.edu/openbook.php?record_id=13165&page=206)  * [**A solution needs to be tested, and then modified on the basis of the test results, in order to improve it. (MS-ETS1-4)**](http://www.nap.edu/openbook.php?record_id=13165&page=206) * [**There are systematic processes for evaluating solutions with respect to how well they meet the criteria and constraints of a problem. (MS-ETS1-2), (MS-ETS1-3)**](http://www.nap.edu/openbook.php?record_id=13165&page=206) * [**Sometimes parts of different solutions can be combined to create a solution that is better than any of its predecessors. (MS-ETS1-3)**](http://www.nap.edu/openbook.php?record_id=13165&page=206) * [**Models of all kinds are important for testing solutions. (MS-ETS1-4)**](http://www.nap.edu/openbook.php?record_id=13165&page=206)   **SEPs:** [Asking Questions and Defining Problems](http://www.nap.edu/openbook.php?record_id=13165&page=54) [**Asking questions and defining problems in grades 6–8 builds on grades K–5 experiences and progresses to specifying relationships between variables, and clarifying arguments and models.**](http://www.nap.edu/openbook.php?record_id=13165&page=54)   * [**Define a design problem that can be solved through the development of an object, tool, process or system and includes multiple criteria and constraints, including scientific knowledge that may limit possible solutions. (MS-ETS1-1)**](http://www.nap.edu/openbook.php?record_id=13165&page=54)   **CCCs:** [Influence of Science, Engineering, and Technology on Society and the Natural World](http://www.nap.edu/openbook.php?record_id=13165&page=212)  * **[The uses of technologies and limitations on their use are driven by individual or societal needs, desires, and values; by the findings of scientific research; and by differences in such factors as climate, natural resources, and economic conditions. (MS-ETS1-1)](http://www.nap.edu/openbook.php?record_id=13165&page=96)** |
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| **Materials:**  [**Drone Project Engineering Design Process Journal**](https://docs.google.com/document/d/10UGHeuYJ4OUjM6ZVBCb28Xs8VxlgbIqPQifyt-UqFQ0/view) |
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| **Lesson S21st-Century Skills:**   * **Learning Skills: Also known as the "four Cs" of 21st century learning, these include critical thinking, communication, collaboration, and creativity.** * **Life Skills: Flexibility, initiative, social skills, productivity, leadership** * **Literacy Skills: Information literacy, media literacy, technology literacy** |
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**LESSON PREPARATION**

| **Time Required: 1 Class Period** |
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| **Grouping of Students for Instruction:**  **Students are now working on their individual teams. Teams were made after students had picked their top 3 roles (google form in lesson 1). Students were divided up so each team had a project manager, engineers, programmers, designers, and marketers.** |
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| **What is the instruction? (Consider the PBL procedure that is being addressed here):**   * **Students work with their assigned team to identify the problem, criteria and constraints. This information is then added to their group’s journal (the project manager shares their packet with the whole team and everyone collaborates in the one document).** [**Drone Project Engineering Design Process Journal**](https://docs.google.com/document/d/10UGHeuYJ4OUjM6ZVBCb28Xs8VxlgbIqPQifyt-UqFQ0/view) * **Research - all team members will add to the research section of their team journal.** * **Then the designers and marketers will lead a brainstorming session of possible problems and solutions for their group’s drone. All team ideas will be recorded in the team journal.** * **The team will need to vote on a possible problem and solution. If a consensus can not be reached within the class period, the project manager will select a problem/solution. The team’s chosen problem and solution should be recorded in the team journal.** |
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| **Possible Accommodations:** |
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| **Possible Extensions:** |
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| **Possible Assessment: Each part of the Engineering design process is evaluated at the end of the project in the team scoring. For this lesson, the team will be evaluated on how well they identified the problem, criteria and constraints.** |
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| **References and Resources:** |
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**LESSON OVERVIEW**

This section should be repeated for each individual lesson that makes up the unit.

| **Lesson Number and Title: Lesson 3: Time to Do My Part** |
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| **Problem Statement: How can I contribute to my team’s presentation of our problem and design solution?** |
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| **Lesson Objectives: Individual team members will now work on their individual parts of the project to be able to contribute to the success of the team.** |
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| **Lesson Standards:**  **DCIs:** [ETS1.B: Developing Possible Solutions](http://www.nap.edu/openbook.php?record_id=13165&page=206)  * [**A solution needs to be tested, and then modified on the basis of the test results, in order to improve it. (MS-ETS1-4)**](http://www.nap.edu/openbook.php?record_id=13165&page=206) * [**There are systematic processes for evaluating solutions with respect to how well they meet the criteria and constraints of a problem. (MS-ETS1-2), (MS-ETS1-3)**](http://www.nap.edu/openbook.php?record_id=13165&page=206) * [**Sometimes parts of different solutions can be combined to create a solution that is better than any of its predecessors. (MS-ETS1-3)**](http://www.nap.edu/openbook.php?record_id=13165&page=206) * [**Models of all kinds are important for testing solutions. (MS-ETS1-4)**](http://www.nap.edu/openbook.php?record_id=13165&page=206)  [ETS1.C: Optimizing the Design Solution](http://www.nap.edu/openbook.php?record_id=13165&page=208)  * [**Although one design may not perform the best across all tests, identifying the characteristics of the design that performed the best in each test can provide useful information for the redesign process—that is, some of those characteristics may be incorporated into the new design. (MS-ETS1-3)**](http://www.nap.edu/openbook.php?record_id=13165&page=208) * [**The iterative process of testing the most promising solutions and modifying what is proposed on the basis of the test results leads to greater refinement and ultimately to an optimal solution. (MS-ETS1-4)**](http://www.nap.edu/openbook.php?record_id=13165&page=208)   **SEPs:** [Developing and Using Models](http://www.nap.edu/openbook.php?record_id=13165&page=56) [**Modeling in 6–8 builds on K–5 experiences and progresses to developing, using, and revising models to describe, test, and predict more abstract phenomena and design systems.**](http://www.nap.edu/openbook.php?record_id=13165&page=56)   * [**Develop a model to generate data to test ideas about designed systems, including those representing inputs and outputs. (MS-ETS1-4)**](http://www.nap.edu/openbook.php?record_id=13165&page=56)   **CCCs:** [Influence of Science, Engineering, and Technology on Society and the Natural World](http://www.nap.edu/openbook.php?record_id=13165&page=212)  * **[The uses of technologies and limitations on their use are driven by individual or societal needs, desires, and values; by the findings of scientific research; and by differences in such factors as climate, natural resources, and economic conditions. (MS-ETS1-1)](http://www.nap.edu/openbook.php?record_id=13165&page=96)** |
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| **Materials:**  [**Sample Daily Task Slides for Individual Team Members**](https://docs.google.com/presentation/d/15wq3u4r0o1Qk3zZBMaMw5wTj1zT50f0djh4DXpFQmYs/edit?usp=sharing)  [**More Daily Task Slides for Projec**](https://docs.google.com/presentation/d/1r6bYnwoh7GYdbQXgFMbzWUfNgnPKjwKDsSaZ2Tyy1GU/edit?usp=sharing)**t**  **Engineering: Materials for building a drone.** |
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**LESSON PREPARATION**

| **Time Required: About a week** |
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| **Grouping of Students for Instruction: Students are working with corresponding team members: engineers with their other team engineer, team designers and marketers work together, programmers may need to work with other team programmers, and project managers help team members as needed and motivate team members to keep on track.** |
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| **What is the instruction? (Consider the PBL procedure that is being addressed here):**  **Teacher is meeting with individual groups to give mini-lessons on:**  **Building the drone (engineers)**  **Sketching design solutions (designers)**  **How to create an Ad (marketers)**  **Coding (Programmers)**  **Note: These mini-lessons have not all been formally created, but they are important. Doing this project once, I realized that individual team members needed more direct instruction to help them be successful. Just providing resources for them to use wasn’t enough.**  **Some resources are listed below in the resource section.**  **Students are working on their teams in their respective roles. Everyone has tasks to complete and sketches, pictures, videos and information to add to the group’s final presentation. The project manager is in charge of making sure everything is added and compiled. The designers and marketers are responsible for the overall creation of the final presentation.** |
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| **Possible Extensions:** [**Drone Flight Calculator Using Scratch**](https://drive.google.com/file/d/1Q6m3l7n7E8y-fAGmSS6r8zxd3RlyhbV4/view?usp=sharing)  **These resources were prepared by our Amazon Software Engineer, Abhishek Gupta after my students had completed the Drone Project, but these resources would make a great extension activity for programmers already familiar with Scratch. The lessons allow students to calculate flight time, a major limitation to drones.** |
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| **Possible Assessment: Individual team products will be assessed in the scoring of team presentations. Students complete team and individual self-assessments also.** |
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| **References and Resources:**  **Designers:**  [**Using Google Draw to Create Engineering Drawings Tutorial**](https://youtu.be/kwDCjDZyCX0)  [**Google Drawing - The Power of Creativity**](https://youtu.be/NA_862mt9M0)  [**Google Drawing Tutorial**](https://youtu.be/MWHVchoTlik)  [**Google Drawing The Complete Overview for Beginners**](https://youtu.be/m_SRYwmj41Y)  [**5 Google Drawings Features You Don’t Know About**](https://youtu.be/8nDTtEU1C1I)  **Marketers:**  [**Create an Ad**](https://acrobat.adobe.com/link/review?uri=urn:aaid:scds:US:a0a7acd1-7d08-45e2-b40a-423afc4dfc3d)  **Engineers:**  Website: <https://www.sciencebuddies.org/stem-activities/diy-mini-drones>  We used this design to actually make drones. I was able to buy the supplies with a Honors money, the total cost was about $300, but the most expensive parts are reusable - motors and propellers.  Programmers: Most of my programmers had experience with scratch, but here are some resources if students need them.  [Scratch MIT](https://scratch.mit.edu/help/videos/)  [Scratch](https://tello.oneoffcoder.com/scratch.html)  [How to Learn Scratch](https://www.create-learn.us/blog/how-do-i-learn-scratch-coding-with-scratch-for-kids-explained/)  [How to Make a Scrolling Background in Scratch](https://youtu.be/CvSOVWyyjJI) |
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**LESSON OVERVIEW**

This section should be repeated for each individual lesson that makes up the unit.

| **Lesson Number and Title: Lesson 4: Drone Project: Final Presentations** |
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| **Problem Statement: Which drone project will receive the grant?** |
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| **Lesson Objectives: Students will be able to present their design problem and solution for final judging.**  **We invited guest judges and students also evaluated their peers’ presentations. Students also evaluated their own teams and their individual contributions to their teams.** |
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| **Lesson Standards:** [ETS1.B: Developing Possible Solutions](http://www.nap.edu/openbook.php?record_id=13165&page=206)  * [**A solution needs to be tested, and then modified on the basis of the test results, in order to improve it. (MS-ETS1-4)**](http://www.nap.edu/openbook.php?record_id=13165&page=206) * [**There are systematic processes for evaluating solutions with respect to how well they meet the criteria and constraints of a problem. (MS-ETS1-2), (MS-ETS1-3)**](http://www.nap.edu/openbook.php?record_id=13165&page=206) * [**Sometimes parts of different solutions can be combined to create a solution that is better than any of its predecessors. (MS-ETS1-3)**](http://www.nap.edu/openbook.php?record_id=13165&page=206) * [**Models of all kinds are important for testing solutions. (MS-ETS1-4)**](http://www.nap.edu/openbook.php?record_id=13165&page=206)  [ETS1.C: Optimizing the Design Solution](http://www.nap.edu/openbook.php?record_id=13165&page=208)  * [**Although one design may not perform the best across all tests, identifying the characteristics of the design that performed the best in each test can provide useful information for the redesign process—that is, some of those characteristics may be incorporated into the new design. (MS-ETS1-3)**](http://www.nap.edu/openbook.php?record_id=13165&page=208) * [**The iterative process of testing the most promising solutions and modifying what is proposed on the basis of the test results leads to greater refinement and ultimately to an optimal solution. (MS-ETS1-4)**](http://www.nap.edu/openbook.php?record_id=13165&page=208)   **SEPs:** [Developing and Using Models](http://www.nap.edu/openbook.php?record_id=13165&page=56) [**Modeling in 6–8 builds on K–5 experiences and progresses to developing, using, and revising models to describe, test, and predict more abstract phenomena and design systems.**](http://www.nap.edu/openbook.php?record_id=13165&page=56)   * [**Develop a model to generate data to test ideas about designed systems, including those representing inputs and outputs. (MS-ETS1-4)**](http://www.nap.edu/openbook.php?record_id=13165&page=56)  [Constructing Explanations and Designing Solutions](http://www.nap.edu/openbook.php?record_id=13165&page=67) [**Constructing explanations and designing solutions in 6–8 builds on K–5 experiences and progresses to include constructing explanations and designing solutions supported by multiple sources of evidence consistent with scientific ideas, principles, and theories.**](http://www.nap.edu/openbook.php?record_id=13165&page=67)   * [**Apply scientific ideas or principles to design an object, tool, process or system. (MS-PS2-1)**](http://www.nap.edu/openbook.php?record_id=13165&page=67)  [Engaging in Argument from Evidence](http://www.nap.edu/openbook.php?record_id=13165&page=71) [**Engaging in argument from evidence in 6–8 builds from K–5 experiences and progresses to constructing a convincing argument that supports or refutes claims for either explanations or solutions about the natural and designed world.**](http://www.nap.edu/openbook.php?record_id=13165&page=71)   * [**Construct and present oral and written arguments supported by empirical evidence and scientific reasoning to support or refute an explanation or a model for a phenomenon or a solution to a problem. (MS-PS2-4)**](http://www.nap.edu/openbook.php?record_id=13165&page=71)   **CCCs:** [Influence of Science, Engineering, and Technology on Society and the Natural World](http://www.nap.edu/openbook.php?record_id=13165&page=212)  * **[The uses of technologies and limitations on their use are driven by individual or societal needs, desires, and values; by the findings of scientific research; and by differences in such factors as climate, natural resources, and economic conditions. (MS-ETS1-1)](http://www.nap.edu/openbook.php?record_id=13165&page=96)** |
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| **Materials:**  [**More Daily Task Slides for Projec**](https://docs.google.com/presentation/d/1r6bYnwoh7GYdbQXgFMbzWUfNgnPKjwKDsSaZ2Tyy1GU/edit?usp=sharing)**t**  **Sample Student Presentations**  [**Medical Drones**](https://docs.google.com/presentation/d/1RNiPBjUOJ619wbLVLR8-u2XrM6G2CAdPn1IIGlZ44w8/edit?usp=sharing)  [**Disaster Drones**](https://docs.google.com/presentation/d/1wAyUR8-lqwlJAOklzkrCb1Yg-uLeV-GYtV_6e9pPJQ0/edit?usp=sharing)  [**Aerial Yearbook Drones**](https://docs.google.com/presentation/d/1OmFvfGm8j17LsNFEecbamT3JyxLF-Jbl9BAUvJqmKOU/edit?usp=sharing)  [**Presentation Scoring Sheets**](https://docs.google.com/document/d/1hUh8Rzck3QDm2m6HJp_JGk8IDnkt12EQ0m-lsfNqmao/edit?usp=sharing)  [**Group and Self-Evaluations**](https://docs.google.com/document/d/1s7b3j_Fd1wE6MHarV0zFvdeA19GGDV5H5iPdOoxULrs/edit?usp=sharing)  [**Student Scoring Sheets**](https://docs.google.com/document/d/1JH9lSRwcVNVuTOTFsXzZE4ZKzdEROqaD-yRQ_4eE1e4/edit?usp=sharing) |
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| *Lessons learned:*  *Students learned a lot about leadership and collaboration. Every team member had to contribute to the team’s final product, and they often had to help each other. Students came up with some really clever uses of their drones, and I was very impressed with their final products.*  *As mentioned before, some groups needed additional mini-lessons to help them complete their roles, and to learn additional skills. Just providing them with the resources is not always enough. My programmers were mostly self-directed and helped each other when needed.*  *The building of the drones had some challenges. Some drones did not work even though we checked and rechecked the connections. The DIY drones that we built are not wireless, so that presented difficulties - mainly that the drones were held down by the wires and battery pack and didn’t always lift off. I am going to look at other alternatives, but the ones we built this year were engaging and students learned about Quadcopter propellers and motors.*  *I may try to get a few drone kits next year.* |
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**LESSON PREPARATION**

| **Time Required: 2 Days** |
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| **Grouping of Students for Instruction: Students are working as a team to create their final presentation of the drone design solution.** |
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| **What is the instruction? (Consider the PBL procedure that is being addressed here):**  **Students can be shown samples of finished presentations.**  **A checklist is provided in the** [**Drone Project Engineering Design Process Journal**](https://docs.google.com/document/d/10UGHeuYJ4OUjM6ZVBCb28Xs8VxlgbIqPQifyt-UqFQ0/view) **to help students prepare their final presentations.**  **Each group is given time to practice presenting the final presentation the day before.**  **Students assess other teams' projects, and guest judges come to evaluate each team. At the end of the presentations,the guest judges determine which idea is the “winner of the grant”.**  **Afterwards, all individuals do a team and individual self assessment.** |
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| **Possible Assessment: Individual team products will be assessed in the scoring of team presentations. Students complete team and individual self-assessments also.** |
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| **References and Resources:**  **Designers:**  [**Using Google Draw to Create Engineering Drawings Tutorial**](https://youtu.be/kwDCjDZyCX0)  [**Google Drawing - The Power of Creativity**](https://youtu.be/NA_862mt9M0)  [**Google Drawing Tutorial**](https://youtu.be/MWHVchoTlik)  [**Google Drawing The Complete Overview for Beginners**](https://youtu.be/m_SRYwmj41Y)  [**5 Google Drawings Features You Don’t Know About**](https://youtu.be/8nDTtEU1C1I)  **Marketers:**  [**Create an Ad**](https://acrobat.adobe.com/link/review?uri=urn:aaid:scds:US:a0a7acd1-7d08-45e2-b40a-423afc4dfc3d)  **Engineers:**  Website: <https://www.sciencebuddies.org/stem-activities/diy-mini-drones>  We used this design to actually make drones. I was able to buy the supplies with Honors money, the total cost was about $300, but the most expensive parts are reusable - motors and propellers.  Programmers: Most of my programmers had experience with scratch, but here are some resources if students need them.  [Scratch MIT](https://scratch.mit.edu/help/videos/)  [Scratch](https://tello.oneoffcoder.com/scratch.html)  [How to Learn Scratch](https://www.create-learn.us/blog/how-do-i-learn-scratch-coding-with-scratch-for-kids-explained/)  [How to Make a Scrolling Background in Scratch](https://youtu.be/CvSOVWyyjJI) |
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