UAS Team Operations

Session Time: Twelve, 50-minute sessions

DESIRED RESULTS

ESSENTIAL UNDERSTANDINGS

A combination of theory and hands-on learning is necessary for students to become proficient remote pilots capable of planning and executing missions.

Effective teamwork is essential to ensure safe and successful UAS operations.

ESSENTIAL QUESTIONS

1. How can students work as a team to plan and execute an operation that will have a real impact on their school or wider community?
2. How can a team synthesize its results to make a meaningful presentation about what they have accomplished?

LEARNING GOALS

Students Will Know

- How to listen to a client and how to plan an operation that will safely accomplish their goals.
- How teams can function to complete safe and successful drone operations.
- How to present information in a succinct, informative, and engaging manner.

Students Will Be Able To

- *Apply concepts* learned throughout the semester to plan and execute an operation using the classroom drone. [DOK-L4]
- *Design* a project that will use an sUAS to benefit a group or organization within the school or the broader community. [DOK-L4]
- *Synthesize* their teams' results into a deliverable that they can present to their client. [DOK-L4]

ASSESSMENT EVIDENCE

Warm-up
Students will gather with their teammates from the previous lesson (Lesson 9.A.3: Learning to Fly: Fundamentals of Control). They will be informed of the final project of the semester, in which they will create an open-ended sUAS operation that benefits a group or organization outside the class.

Formative Assessment
There is no formative assessment for this lesson.

Summative Assessment
Teams will take turns presenting their completed sUAS operation projects to the class and hand in their project packets and final deliverable to the instructor. If time allows, students will also hand in a reflective paper.

LESSON PREPARATION

MATERIALS/RESOURCES

- UAS Team Operations Presentation
- UAS Team Operations Teaching Aid
- UAS Team Operations Project Packet
    - Project Instructions **(1 per student)**
    - Team Project Information Sheet **(1 per student)**
    - Team Milestone Sheet **(1 per student)**
    - Team Daily Goal Sheets **(12 per student)**
    - Team Mission Planning Sheets **(several per student)**
    - Team Flight Sheets **(several per student)**
    - Individual Responsibility Sheets **(12 per student)**
    - Team Project Presentation Sheet **(1 per student)**
    - Rubric **(1 per student)**
    - Client Feedback Form

UAS Team Operations Days 1–12

- Classroom or personal drone(s)
- Several fully charged batteries per drone
- Class rules regarding safety
- First aid kit (recommended)
- Tool kit (recommended)
    - See **UAS Team Operations Teaching Aid** for suggested tools.
- Any additional materials or resources that are specific to each team's project

Flight Simulation Materials (if needed)

- Computer(s) or mobile device(s) with drone flight simulation software
- Physical or software ground control station

LESSON SUMMARY

Lesson 1: UAS Team Operations

This lesson will begin with a warm-up in which students regroup with their team members from the previous lesson (9.A.3: Learning to Fly: Fundamentals of Control). Students will then be informed of their final project of the semester in which they will work with a group or organization to complete a creative, open-ended sUAS mission. Students will also be informed that in addition to delivering a product or a service to their chosen group or organization, they will be required to give a team summary to the class on Day 12 of this lesson. Student teams will end the warm-up by brainstorming possible projects and reviewing the project packet and project instructions sheet, which explains the full breadth and scope of this semester's final lesson.

During the next part of the lesson (Days 2–11), students will work with their team members to meet with their chosen group or organization, fly sUAS missions, and create a project that they will deliver to their client by Day 11. Throughout these sessions, student teams will need to meet four basic milestones to complete their project.

On the last day (Day 12), each team will give a 7–10 minute summary of their overall project for their chosen group or organization as well as the final product or service they created. Student teams will then hand in their product or project summary.

BACKGROUND

Transitioning from an academic learning and training environment into professional roles as sUAS pilots, or members of an sUAS crew, requires hard work and on-the-job training and experience. Professionals in every industry all began somewhere, and, as is often the case, it takes years of day-to-day experience to become a skilled tradesperson in any field or craft. The sUAS industry is no different. Flying sUAS missions for a group, business, or organization with a team of coworkers is a large part of becoming a professional sUAS pilot.

As the drone industry continues to grow and evolve, sUAS pilots and drone industry professionals will be required to continually learn and grow along with the industry. New sUAS technology and applications will emerge, and industry professionals will need to update their skills to stay current and well-informed. This is why the FAA requires remote pilots to take a recurrent knowledge test every 24 months. This ensures that every FAA certificated Part 107 commercial drone pilot is up-to-date with their knowledge as well as their skills.

MISCONCEPTIONS

Because many drones have advanced automated capabilities (e.g., obstacle avoidance, waypoint GPS navigation, and Return to Home), some students may have the misconception that remote pilots can fly missions with just a basic understanding of a UAS controller or simply by entering flight commands. While advanced drones do have many automated capabilities, it is important that remote pilots do not rely on these. A remote pilot should be able to manually fly a drone, not only in the case of emergencies, but also because hands-on manual flying lays the groundwork for more advanced UAS knowledge and programming.

Some students may incorrectly assume that if they have a Part 107 commercial drone pilot's certificate, they will easily land professional UAS jobs and missions for businesses, companies, or organizations. Having a license in any field does not guarantee that a person will find work. Professionals must develop marketing strategies such as website creation, use of social media, and communication skills. Additional skills such as photography, video cinematography, and computer proficiency are also helpful to work in the UAS industry. While knowing how to fly a drone is important, understanding how other industry applications rely on drone technology is an important part of becoming a well-rounded UAS pilot.

DIFFERENTIATION

While this project is already highly differentiated, you may find it helpful to provide extra support and guidance to some teams or students. For instance, you may want to assign team roles to teams that struggle to work together. Other teams may flourish, and so you may want to challenge those teams to push themselves to extend their thinking.

LEARNING PLAN

ENGAGE

Teacher Materials: UAS Team Operations Presentation, UAS Team Operations Teaching Aid

Session 1

Slides 1–3: Introduce the topic and learning objectives of the lesson.

Slides 4–8: Conduct the **Warm-Up**.

Teaching Tips

This semester's final lesson has been created to allow students a great deal of autonomy. As their teacher, your role for this lesson is primarily that of facilitator or coach.

Prior to beginning this lesson, review the **UAS Team Operations Teaching Aid** and familiarize yourself with the documents in the student Project Packet. The **UAS Team Operations Teaching Aid** will provide you with helpful suggestions, information, and general guidance depending on your classroom resources and circumstances. Make use of this document throughout the lesson.

Warm-Up

Slide 4: As you begin to discuss the breadth and scope of this 12-session lesson, inform students that they will continue working with their team members from the previous lesson (9.A.3: Learning to Fly: Fundamentals of Control).

Inform students that for the duration of this lesson, teams will be meeting and working together to execute and create a project using an sUAS for a group or organization outside the class.

Slide 5: Throughout the project, students will create sUAS-based content for a school-based organization or group such as the following:

- School administration
- Academic or extracurricular club
- Sports, cheerleading, or dance team
- School band or chorus
- Other student groups

Slide 6: Additionally, students may also be encouraged to work outside school with community-based organizations such as the following:

- Local parks and recreation centers
- Boy Scouts/Cub Scouts/Girl Scouts/Brownies
- 4-H
- Community centers
- Farmers
- Fire companies
- Local nonprofit organizations

Slide 7: During the last session (Day 12), each team will deliver a brief (7–10 minute) presentation to the class in which they explain their project mission for the group or organization and display and share the results of their work.

Slide 8: Inform students that these projects will be open-ended and will allow them to be creative. The following are some possible team projects:

- Capture footage for and edit a promotional video
- Create an instructional video or presentation to teach others how to use drones safely
- Create a web page that uses drone images for a school club

- Inspect a roof or a chimney for a local resident

Teaching Tips

At your discretion, add any elements to the lesson you deem necessary: for example, whether you have specific safety guidelines, whether projects take place on or off school grounds, and whether students will be permitted to use personal drones. Your decisions may depend on factors such as school policy, school drone availability, weather, and location. Continue to refer to the **UAS Team Operations Teaching Aid** for helpful suggestions.

To save teams time prior to the project, make inquiries to groups or organizations, particularly around the school. You can then assign each team a group or organization for which they will create a project. Missions could range from performing a roof inspection to conducting crop surveys to shooting footage for promotional videos.

EXPLORE

Teacher Materials: UAS Team Operations Presentation, UAS Team Operations Teaching Aid

Slide 9: Have student teams spend 5–10 minutes brainstorming ideas for their projects. Ask students to consider the following:

- What group or organization would your team like to help?
- What type of project could your team create?
- What resources will you need to fly missions and accomplish the project?
- Who will be the team leader?

Slide 10: Inform students that this process will require team communication outside of class. Regular communication is an important aspect of successful teamwork.

EXPLAIN

Teacher Materials: UAS Team Operations Presentation, UAS Team Operations Teaching Aid
Student Material: UAS Team Operations Project Packet

Slide 11: Hand out the **UAS Team Operations Project Packet** and ask students to begin by reviewing the **Project Instructions**. Remind students that the instructions are not exhaustive; teams should think creatively and work together with their chosen group or organization to accomplish their project.

The project packet contains the following sheets:

- Project Instructions Sheet (1 per student)
- Team Project Information Sheet (1 per student)
- Team Milestone Sheet (1 per student)
- Team Daily Goal Sheets (12 per student)
- Team Mission Planning Sheets (several per student)
- Team Flight Sheets (several per student)
- Individual Responsibility Sheet (1 per student)
- Team Project Presentation Sheet (1 per student)
- Rubric (1 per student)

- Client Feedback Form

Teaching Tips

After handing out the **Project Packet** for each team, ask students to take a few minutes to familiarize themselves with the contents of their packet, including the rubric, while reviewing slides 12–18.

Slide 12: While displaying the lesson timeline slide, explain to students that to help keep teams on track and from falling behind, this project has four milestones. Some milestones may overlap as different team members accomplish different mission tasks throughout the project. Ask students to review the Before You Start section of the **Project Instructions Sheet** and the **Team Milestone Sheet** as you proceed through the following four slides. The four project milestones are as follows:

- Choosing a project
- Planning the UAS mission
- Flying the UAS mission
- Preparing the product or service and presentation

Teaching Tips

Remind students that to produce quality work throughout the project, it will be necessary for teams to meet outside class. Team communication and time management will be among the project goals.

Slide 13: Milestone 1 is **Choosing a Project**. At the end of this lesson, team members will continue to finalize the type of club, group, or organization for which they will use a sUAS to provide a product or service and how they will develop this mission. Once teams have decided on their goals, they should record them on the **Team Milestone Sheet**. Ask students to consider and settle on the following:

- Who will the client be?
- What will be required for the sUAS mission(s)?
- What will the final product/service for the client be (e.g., website, photographs, video, map, inspection, lesson, etc.)?

Slide 14: Milestone 2 is **Planning the UAS Mission**. Once each team has agreed on a project, they should begin planning the mission phase of the project. Ask students to consider and settle on the following:

- Where will the UAS mission take place?
- Is weather a factor for UAS missions?
- Are there any UAS regulations or restrictions to be aware of?
- What will be each team member's role?
- How will the sUAS need to be flown and maneuvered?
- What communication methods will be used?

Slide 15: Milestone 3 is **Flying the UAS Mission**. Flying a UAS mission will require advanced planning. Instruct teams to use the **Team Mission Planning Sheet** and the **Team Flight Sheet** to plan sUAS flights in advance. Ask students to consider the following:

- How will you communicate with team members outside school?
- Where will you meet team members outside school?
- How will you and your team members create the final product or service for the client?

Slide 16: Milestone 4 is **Preparing the Product/Service and Presentation**. This is the final portion of the lesson. Each team will both prepare and deliver the product or service for their client (e.g., website, photographs, video, map, inspection, lesson, etc.) and prepare a 7–10 minute presentation that it will give to the class on Day 12, explaining and exhibiting the project they created. Ask students to consider the following:

- How will your team deliver the finished product or service to the client?
- How will your team give its class presentation?
- How will each team member contribute to the presentation?

Teaching Tips

Remember to sign off on each milestone before each team proceeds to the next milestone. Students might use this time to practice presenting a pitch to their chosen club or organization.

Slide 17: Let students know that not every team member needs to perform every role for each aspect of the mission to complete the project. For example, not everyone needs to be present during mission flights. Some team members may be accomplishing other tasks, such as meeting with the group or organization or editing photo or video images for the client. Every team member will need to contribute throughout the duration of the project, either during the mission itself or in preparing the final product or service. All members of the team need to be a part of the planning process.

Slide 18: Instruct students to use the **Project Instructions Sheet** to guide them through the project. Each team will meet with you during the next 10 sessions. Remind students to fill out the additional Project Packet sheets to assign roles to team members, plan project missions, meet team milestones, and know their individual responsibilities.

Teaching Tips

Inform students that teams should choose a mission that, while ambitious in scope, should not require extensive travel or involve problematic locations.

Slide 19: For the remainder of the session, students should continue to brainstorm their project idea with their team. Circle the room to oversee team discussions and respond to questions.

Remind students to fill out the **Team Project Information Sheet** prior to the next session. Emphasize that teams can change their initial plans later, but the changes will require your approval. All changes should be noted by the team leader and the teacher, along with the date they were made.

Slide 20: At the end of the first session, remind students of the following:

- Work together with team members to accomplish project milestone goals outside class.

- Communicate with your group or organization.
- Meet with the teacher during each session to make sure your team is achieving project milestone goals.
- Remember to work on your team's presentation in addition to the product or service you are creating.
- Make sure you are working toward your goals.
- Take individual responsibility for helping your team.

Sessions 2–11

Slide 21: Display this slide for each day of sessions 2–11 to outline the goals for that day. Display any previous lesson plan slides as needed. During each session, remind teams of the steps they need to take to prepare:

- Discuss project plans
- Plan sUAS flight missions in advance
- Agree on team member roles
    - Fill out the **Individual Responsibility Sheet** and **Team Daily Goal Sheet** as needed
- Accomplish milestones
- Meet with you to show progress and ask any questions

Additionally, remind teams to complete the **Team Project Presentation Sheet**. This resource does not need to be completed all at once or during a particular session. It must be completed by Session 12, when teams give their presentations. Instead, suggest that teams begin thinking about their presentation right away, and gradually fill out the **Team Project Presentation Sheet** as their ideas are finalized.

Teaching Tips

During class sessions 2–11, meet with individual teams to keep track of their progress. Remember to sign off on each milestone before each team proceeds to the next one. During later sessions, students might use class time to practice giving their presentations.

EXTEND

Teacher Materials: UAS Team Operations Presentation, UAS Team Operations Teaching Aid
Student Material: UAS Team Operations Project Packet

Session 12

Slide 22: This day is devoted to team presentations. Have each team present its project or service in a brief, 7–10 minute presentation.

EVALUATE

Teacher Materials: UAS Team Operations Presentation, UAS Team Operations Teaching Aid
Student Material: UAS Team Operations Project Packet

Summative Assessment

Each team's presentation and deliverable serves as its Summative Assessment for this lesson. Use the **Rubric** and **Client Feedback** Form provided in the **Project Packet** to score teams.

[DOK-L4; *design, synthesize, apply concepts*]

Teaching Tips

The **Rubric** used for the presentation and deliverable gives equal weight to the eight elements in the rubric. At the teacher's discretion, additional weight may be assigned to the deliverable.

GOING FURTHER

If time allows, instruct students to write a reflection paper discussing their individual experiences and roles throughout the project and what they learned during its course.

STANDARDS ALIGNMENT

NGSS STANDARDS

Three-Dimensional Learning

- **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.
    - Science and Engineering Practices
        - Asking Questions and Defining Problems
        - Constructing Explanations and Designing Solutions
    - Disciplinary Core Ideas
        - ETS1.A: Defining and Delimiting Engineering Problems
    - Crosscutting Concepts
        - None
- **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.
    - Science and Engineering Practices
        - Constructing Explanations and Designing Solutions
    - Disciplinary Core Ideas
        - ETS1.B: Developing Possible Solutions
    - Crosscutting Concepts
        - Influence of Science, Engineering, and Technology on Society and the Natural World

- **HS-ETS1-4** - Use a computer simulation to model the impact of proposed solutions to a complex real-world problem with numerous criteria and constraints on interactions within and between systems relevant to the problem.
    - Science and Engineering Practices
        - Using Mathematics and Computational Thinking
    - Disciplinary Core Ideas
        - ETS1.B: Developing Possible Solutions
    - Crosscutting Concepts
        - Systems and System Models

COMMON CORE STATE STANDARDS

- **RST.11-12.2** - Determine the central ideas or conclusions of a text; summarize complex concepts, processes, or information presented in a text by paraphrasing them in simpler but still accurate terms.
- **RST.11-12.7** - Integrate and evaluate multiple sources of information presented in diverse formats and media (e.g., quantitative data, video, multimedia) in order to address a question or solve a problem.
- **RST.11-12.9** - Synthesize information from a range of sources (e.g., texts, experiments, simulations) into a coherent understanding of a process, phenomenon, or concept, resolving conflicting information when possible.
- **WHST.11-12.2** - Write informative/explanatory texts, including the narration of historical events, scientific procedures /experiments, or technical processes.
- **WHST.11-12.4** - Produce clear and coherent writing in which the development, organization, and style are appropriate to task, purpose, and audience.
- **WHST.11-12.6** - Use technology, including the Internet, to produce, publish, and update individual or shared writing products in response to ongoing feedback, including new arguments or information.
- **WHST.11-12.7** - Conduct short as well as more sustained research projects to answer a question (including a self-generated question) or solve a problem; narrow or broaden the inquiry when appropriate; synthesize multiple sources on the subject, demonstrating understanding of the subject under investigation.
- **WHST.11-12.8** - Gather relevant information from multiple authoritative print and digital sources, using advanced searches effectively; assess the strengths and limitations of each source in terms of the specific task, purpose, and audience; integrate information into the text selectively to maintain the flow of ideas, avoiding plagiarism and overreliance on any one source and following a standard format for citation.
- **WHST.11-12.9** - Draw evidence from informational texts to support analysis, reflection, and research.

REFERENCES

None