GRADE 12
UNIT 1
SECTION B
LESSON 1

A WORLD OF UAS
TECHNOLOGY AND TEAMBUILDING
TEAM CHALLENGE

v1.0

YOU CAN FLY
AOPA FOUNDATION
HIGH SCHOOLS

Scavenger Hunt

Session Time: One, 50-minute session

DESIRED RESULTS

ESSENTIAL UNDERSTANDINGS

Prior to this lesson, review the list of suggested targets and maneuvers in the **Scavenger Hunt Student Activity**. Since every school is different, you (possibly with your students) should feel free to modify the list to better suit your school environment.

Additionally, since students will need to submit photos or video clips, you will need to establish a means for students to share their collections. This may be through shared online folders, slideshows, or any other mechanism you prefer.

The lesson itself covers a lot of ground, so remain mindful of the time and limit the minutes allotted to **ENGAGE**, **EXPLORE**, and **EXPLAIN** in order to allow sufficient time for the scavenger hunt in **EXTEND**. If necessary, the reflection activity for **EVALUATE** may be completed as homework.

ESSENTIAL QUESTIONS

1.
How can an sUAS crew work together to plan and fly a defined mission in a safe and efficient manner?

LEARNING GOALS

Students Will Know	Students Will Be Able To
• How they are best suited to accomplish tasks within a UAS mission based upon their skill sets.	• *Formulate* a plan of action in order to accomplish an sUAS mission. [DOK-L3] • *Assess* actions that the crew took to accomplish the mission. [DOK-L3]

ASSESSMENT EVIDENCE

Warm-up
Students divide into flight crews and review the list of targets and maneuvers in preparation for the scavenger hunt.

Formative Assessment
There is no formative assessment for this lesson.

Summative Assessment
Students reflect in writing on their experience of the scavenger hunt.

LESSON PREPARATION

MATERIALS/RESOURCES

- Scavenger Hunt Presentation
- Scavenger Hunt Student Activity
- Scavenger Hunt Teaching Aid
- Scavenger Hunt Rubric

LESSON SUMMARY

Lesson 1: Scavenger Hunt
Lesson 2: Drone Race

The lesson will begin with a warm-up in which students divide into flight crews. Each crew will use one of the classroom's drones to complete a scavenger hunt around the school. Crew members will choose roles for the mission and review the tasks to complete.

During the next part of the lesson, students will review the responsibilities for each role on their flight crew. Crews will then create a plan of action for safely completing the scavenger hunt and earning as many points as possible. Crews will also use the PAVE checklist to complete a preflight review. Crews will then have time to complete the scavenger hunt.

Following the scavenger hunt, students will return the equipment to storage, submit their photos and videos to the instructor for review, and reflect on their experience.

NOTE: Prior to this lesson, review the list of suggested targets and maneuvers in the **Scavenger Hunt Student Activity**. Since every school is different, you (possibly with your students) should feel free to modify the list to better suit your school environment.

Additionally, since students will need to submit photos or video clips, you will need to establish a means for students to share their collections. This may be through shared online folders, slideshows, or any other mechanism you prefer.

The lesson itself covers a lot of ground, so remain mindful of the time and limit the minutes allotted to **ENGAGE**, **EXPLORE**, and **EXPLAIN** in order to allow sufficient time for the scavenger hunt in **EXTEND**. If necessary, the reflection activity for **EVALUATE** may be completed as homework.

BACKGROUND

Since the advent of small drones, safety has become a major issue. Though lightweight, modern drones feature multiple spinning blades and can fly at relatively high speeds, making a collision with a person or structure on the ground a serious matter. Recognizing the risks involved, drone pilots have adopted many of the same safety policies and risk management procedures found in crewed flight.

One such risk management technique is the use of the PAVE checklist. Applying PAVE before and during each flight provides a formal framework for considering risk. Another valuable technique is to conduct a thorough preflight briefing before each flight, however short and seemingly simple. This lesson will provide opportunities for students to apply these and other risk management methods to ensure the safe conduct of their drone flights during a schoolwide scavenger hunt. Students will also perform a post-flight review of the mission for the purpose of improving their performance during future flights.

MISCONCEPTIONS

Students may believe that, because this is a fun, casual mission, it is unimportant to spend too much time with flight planning or safety considerations. This and the previous lesson in this unit, Mission Briefing, aim to counter this

misconception with a thorough review of preflight, in-flight, and post-flight procedures and related risks. Remind students that, while it's fun to fly drones, every mission should be taken seriously; sUAS pilots and crews should maintain an attitude of safety and professionalism throughout. After all, every mission carries potential safety risks.

DIFFERENTIATION

In order to help students remember the different crew roles and components of the PAVE checklist, provide descriptions of each role and the checklist. This may be done with a handout or by writing them on the board. When answering questions and guiding discussion during the **EXPLAIN** section of the lesson, have students take notes.

In the **EVALUATE** section of the lesson, you may wish to have students conduct a class-wide discussion of the results rather than write down their answers to the questions.

LEARNING PLAN

ENGAGE

Teacher Materials: Scavenger Hunt Presentation, Scavenger Hunt Teaching Aid
Student Material: Scavenger Hunt Student Activity

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

Slides 4-5: Conduct the **Warm-Up**.

> **Warm-Up**
>
> Give students five minutes to divide themselves into flight crews. Crews may vary in number, but each crew should include:
>
> - a pilot in command (PIC)
>
> - an operator of the drone's controls
>
> - a visual observer
>
> - a safety representative
>
> Each crew may also have one additional visual observer and one additional safety representative, but try to limit crews to no more than six members. Furthermore, each crew should have at least one representative from each of the four PAVE groups formed during the previous lesson (Pilot, Aircraft, enVironment, External pressures).
>
> Then, distribute the **Scavenger Hunt Student Activity** sheet, which lists the targets that crews will need to photograph and the maneuvers they will need to perform during the scavenger hunt. Explain that each target or maneuver has a point value: easier tasks are worth 1 point, while more difficult tasks are worth 2 or 3 points. Each crew should attempt to safely accumulate as many points as possible during the time allotted for the scavenger hunt.
>
> [DOK-L3; *formulate*]

💡 **Teaching Tips**

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The **Scavenger Hunt Student Activity** sheet is intended to be a "quick-start guide" that you may use "as is" or modify as needed to better suit your school's environment. Alternatively, you may use the blank template in the **Scavenger Hunt Teaching Aid** to create a fully-customized mission for your class.

Be sure to comply with all applicable rules and regulations regarding sUAS operation in your area.

EXPLORE

Teacher Materials: Scavenger Hunt Presentation, Scavenger Hunt Teaching Aid
Student Material: Scavenger Hunt Student Activity

Slide 6: Briefly review the roles and responsibilities that each crew member will take on during the scavenger hunt.

- The **Pilot in Command (PIC)** is in charge of the mission, assumes ultimate responsibility for its outcome, and has the final say on all decisions before, during, and after the mission.

- The **operator** actually manipulates the drone's controls to carry out the required actions in a manner consistent with FAR Part 107 regulations.

  - Essentially, the PIC determines where the drone will fly and what it will do, and the operator carries out those instructions.

- **Visual observers** maintain visual contact with the drone at all times during the mission. If visual contact is ever lost (for example, if the drone goes around a corner or behind a tree), the observer should advise the PIC and operator immediately, and they should pause flight until the observer can reestablish contact. The visual observer also uses their phone or another device to record the drone as it performs the required maneuvers.

- **Safety representatives** remind other crew members of possible risks, take the lead in implementing mitigation strategies, and keep other people away from the drone's flightpath.

  - Although the PIC is ultimately responsible for ensuring a safe flight, the safety representatives are the first line of defense against potential safety issues.

> 💡 **Teaching Tips**
>
> Make sure that students understand these roles are binding for the duration of the scavenger hunt. Once they have accepted their role, crew members should not exchange it for another, nor should they attempt to do any part of someone else's job.

Slides 7-8: Give each crew time to develop its plan of action for accomplishing the mission and to conduct a preflight PAVE review.

- To determine its plan of attack, a crew should identify the targets it intends to photograph and the maneuvers it intends to complete, as well as the order in which to complete them. One member of the crew should record the plan at the bottom of the **Scavenger Hunt Student Activity**. When discussing each task, crew members should consider:

  - How will we get the drone to the location?

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- About how long will it take to get to the location and complete the task?
  - Remind crews that time will be a significant constraint in the scavenger hunt. To ensure they complete their mission, they will need to plan an efficient route around the school.
- What are potential risks when attempting the task?
  - These should be noted to discuss during the preflight review.
- What is each crew member's responsibility before, during, and after completing the task?
  - Remind students that visual observers will need to record videos of their drones performing the maneuvers.

> 💡 **Teaching Tips**
>
> If a map of the school is accessible, provide a copy to each crew. It would be a helpful resource for determining the order of tasks to complete during the scavenger hunt.
>
> Remind students that it is acceptable—and likely safer—to carry the drone from task to task; crews are not expected to fly their drone for the duration of the scavenger hunt.

- Next, each crew should conduct a thorough preflight PAVE review of the risks and mitigations associated with the mission.
  - When considering the pilot aspect of PAVE, each crew member should reflect on how they are feeling and note any potential risks. The visual observers and safety representatives may not actually be flying the drones or making final decisions, but their physical and mental states are nevertheless integral to mission safety.
  - When considering the aircraft aspect of PAVE, crew members should thoroughly inspect their assigned drone, including its camera, as well as the remote control unit that the operator will use to control the drone. Crews should also confirm that their drone's battery is fully charged.
  - When considering the environment aspect of PAVE, crew members should pay special attention to the weather (for tasks completed outside) and the proximity to other students (for tasks completed inside as well as outside).
  - When considering the external pressures aspect of PAVE, crew members should be especially cognizant of the risky desire to earn a high score by performing advanced maneuvers beyond their abilities. Also, while time is a constraint, it is important that crews do not rush.

> 💡 **Teaching Tips**
>
> To help relieve external pressure, remind students that you are not grading them on their ability to complete any particular task. The ultimate goal of today's lesson is not to earn a certain number of points but to practice flying safely. Feel free to remove the point structure from the mission if you think doing so will encourage safer flights.

EXPLAIN

Teacher Materials: Scavenger Hunt Presentation, Scavenger Hunt Teaching Aid
Student Material: Scavenger Hunt Student Activity

Slide 9: Regroup as a class, and answer any remaining questions. Remind students they will be flying their drones among other people, and it is imperative to prioritize safety. Students should think of today's mission as a chance to practice operating as a professional drone crew. Everyone should maintain a demeanor of professionalism at all times.

EXTEND

Teacher Materials: Scavenger Hunt Presentation, Scavenger Hunt Teaching Aid
Student Material: Scavenger Hunt Student Activity

Slide 10: Crews will now have time to complete their plan of action for the scavenger hunt.

- To earn points for photographing targets, crews will use the drone's camera to take the photo.

- To earn points for performing maneuvers, crews will use a member's phone camera (or other device) to record a video of the maneuver.

> 💡 **Teaching Tips**
>
> Before beginning the scavenger hunt, remind students one last time to follow all regulations, rules, laws, and ordinances pertinent to UAS usage on school property.

Slide 11: At the conclusion of the scavenger hunt, monitor crews to confirm they return all equipment to the appropriate storage locations and submit their photos and videos for you to review.

EVALUATE

Teacher Materials: Scavenger Hunt Presentation, Scavenger Hunt Rubric

Slide 12: Complete the **Summative Assessment**.

Summative Assessment

Individually, students should reflect on their experience of the scavenger hunt by responding in writing to the following questions:

1.
What was your role in your crew? Why did you choose this role, what were your responsibilities, and how do you think you performed them?

2.
If you could redo this activity, would you choose the same role again? Why or why not?

3.
Which parts of the mission did your crew perform effectively? Why do you think you were successful?

4.

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Which parts of the mission did your crew perform ineffectively? Why do you think you were unsuccessful, and how could you change your approach to be successful next time?

5.
Do you have any suggestions for how to improve this activity for future classes?

If there is not enough class time after the scavenger hunt, assign the reflection for homework. Use the **Scavenger Hunt Rubric** to assess students' responses.

[DOK-L3; *assess*]

Summative Assessment Scoring Rubric

Points	Performance Levels
23-25	Consistently demonstrates criteria
20-22	Usually demonstrates criteria
17-19	Sometimes demonstrates criteria
0-16	Rarely to never demonstrates criteria

STANDARDS ALIGNMENT

COMMON CORE STATE STANDARDS

- **RST.11-12.3** - Follow precisely a complex multistep procedure when carrying out experiments, taking measurements, or performing technical tasks; analyze the specific results based on explanations in the text.

- **RST.11-12.4** - Determine the meaning of symbols, key terms, and other domain-specific words and phrases as they are used in a specific scientific or technical context relevant to *grades 11-12 texts and topics*.

- **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.

- **WHST.11-12.4** - Produce clear and coherent writing in which the development, organization, and style are appropriate to task, purpose, and audience.

- **WHST.11-12.10** - Write routinely over extended time frames (time for reflection and revision) and shorter time frames (a single sitting or a day or two) for a range of discipline-specific tasks, purposes, and audiences.

REFERENCES

- Federal Aviation Regulations Part 107: https://www.ecfr.gov/current/title-14/chapter-I/subchapter-F/part-107