UAS Operation and Safety

Session Time: One, 50-minute session

DESIRED RESULTS

ESSENTIAL UNDERSTANDINGS

Develop interest in one or more aviation/aerospace career pathways and learn what is required to pursue future employment in the industry. (EU3)

Aspire to the highest level of technical proficiency as it relates to flight operations and engineering practices. (EU5)

ESSENTIAL QUESTIONS

1. Are UAS toys or tools?
2. What considerations are necessary to ensure responsible and ethical UAS use?
3. What professional standards exist that encourage the drone community to operate above minimum regulations?

LEARNING GOALS

Students Will Know

- Basic rules and regulations for flying UAS
- Ethical considerations when flying UAS
- How to become a certified UAS pilot
- Where to discover information and rules about proper UAS operation

Students Will Be Able To

- *Draw conclusions* about ethical considerations for flying UAS. (DOK-L3)
- *Summarize* safe and smart practices for flying UAS. (DOK-L2)

ASSESSMENT EVIDENCE

Warm-up
Students will consider why using birds of prey to capture drones is relevant to flying responsibly and ethically.

Formative Assessment
Students create posters on the safe and ethical use of drones. They should include five to ten items that focus on both the rules and the ethics of flying.

Summative Assessment
Students will work in groups to create a blog post with a checklist for operating drones ethically.

LESSON PREPARATION

MATERIALS/RESOURCES

- UAS Operation and Safety Presentation
- UAS Operation and Safety Student Notes

Safety Poster Activity

- Poster board or rolled paper
- Markers and other art supplies

LESSON SUMMARY

Lesson 1 - UAS Fundamentals
Lesson 2 - UAS Operation and Safety

Lesson two will begin with a video about a bird that has been trained to snatch drones out of the sky. Students will consider why using birds of prey to capture drones is relevant to flying responsibly and ethically.

The teacher then will lead a class discussion about the three types of UAS pilots, requirements for becoming a commercial UAS pilot, and rules and guidelines for flying recreationally. The students will consider the importance of being responsible and being a good neighbor when piloting a UAS. Individually or in small groups, students will create posters on the safe and ethical use of drones.

In groups of three to four, have students take turns flying the class drone. Before flying, reference back to the safety guidelines and rules for flying a drone.

Finally, students will work in groups to create a blog post with a checklist for operating drones ethically.

BACKGROUND

The drone community is growing fast. There are already more registered drones than there are manned aircraft. Drones are the fastest-growing segment in aviation, with tens of thousands of pilots now flying everything from small systems for fun to large drones used to patrol, record, observe, inspect, and conduct many other missions across the country.

With all of these new aircraft in the skies, safety and ethical considerations are critical. Operators and pilots must receive the proper guidance, training, and aeronautical knowledge to ensure they enjoy their aircraft, use them effectively for their missions, and operate safely among all other aircraft.

MISCONCEPTIONS

Some students probably own, have flown, or have seen UAS; however, they might be unfamiliar with the rules and regulations pertaining to UAS operation. They also may be unaware of the ethical considerations for piloting UAS. It will be important to explain that while some behaviors are not illegal, UAS operators always should be considerate of those around them as they fly.

DIFFERENTIATION

In the **EXPLAIN** section of the lesson plan, poster requirements could be limited for students who need more support. As a more advanced option, students could create a safety video.

To increase social awareness and relationship skills, have students share their work in the **EXPLAIN** and **EXTEND** s ections with their peers and provide their views of other's work.

LEARNING PLAN

ENGAGE

Teacher Material: UAS Operation and Safety Presentation

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

Slide 4: Conduct the **Warm-Up**. Show students a short video of a bird that has been trained to snatch drones out of the sky. Ask students to write their responses in three to five sentences. Ask volunteers to share their answers and discuss. Take up to 5 minutes to complete the warm-up. [DOK 2; infer]

- "Police Train Birds of Prey to Catch Drones" (Length 1:05) http://video.link/w/AGJd

Warm-up

Ask students to write three to five sentences in response to the following questions regarding why using birds of prey to capture drones is relevant to flying responsibly and ethically.

- Why do you think some law enforcement officers are training birds to catch drones in flight?
- Are there other areas where this could be helpful?
- What are some of the limitations to ideas like these?

Questions

Why do you think some law enforcement officers are training birds to catch drones in flight?

Birds could catch drones that are flying illegally or in places they shouldn't be. There are rules and regulations for when and where people can fly drones. Trained birds can be a tool to catch drones that could interfere with manned aircraft, cause injury to people on the ground, or be used for criminal purposes.

Are there other areas where this could be helpful?

Other examples could include private areas around homes as an invasion of privacy, around events with large numbers of people, etc.

What are some of the limitations to ideas like these?

The rules and regulations may not be broad enough and capture every situation.

EXPLORE

Teacher Material: UAS Operation and Safety Presentation

Slides 5-6: Explain the difference between recreational users (hobbyists), commercial users (professionals) and government users. Recreational or hobby UAS flying is for enjoyment and not for work, business purposes, or for compensation or hire. According to the Federal Aviation Administration (FAA), UAS use for hobby is a "pursuit outside one's regular occupation engaged in especially for relaxation." UAS use for recreation is "refreshment of strength and spirits after work; a means of refreshment or diversion."

Shows students a video that describes these three types of users.

- "Three Classifications of Drones Pilots" (Length 1:38)

  http://video.link/w/iOTd

EXPLAIN

Teacher Material: UAS Operation and Safety Presentation
Student Material: UAS Operation and Safety Student Notes

Slides 7-8: Explain the requirements for becoming a commercial drone pilot. These include being at least 16 years old, being able to read, speak, write and understand English, passing a knowledge exam, and obtaining a security background check.

Slides 9-10: Share with students **UAS Operation and Safety Student Notes,** which lists the rules and ethical responsibilities of flying drones.

If students are flying drones today, they are likely operating them as a hobbyist. Review the rules and safety guidelines for recreational UAS pilots. Underscore to students that they should always ensure they have permission to fly in a certain area before they launch their drone.

Students need to know drone laws before they take flight or else they risk big fines. Review important guidelines that students should follow at all times.

Slide 11: Explain to students that the "Know Before You Fly" website provides guidance on the recreational use of UAS. The website provides UAS operators with the information and guidance they need to fly safely and responsibly. Teachers may wish to navigate the site with students and show them how to find and use the Academy of Model Aeronautics (AMA) Flying Sites Map so that they will know where it is acceptable to fly in their area: http://knowbeforeyoufly.org/for-recreational-users/.

Slide 12: Explain to students that another resource they can consult, especially on the go, is the B4UFLY app. B4UFLY is a free smartphone app from the Federal Aviation Administration that helps unmanned aircraft operators determine whether there are any restrictions or requirements in effect at the locations where they want to fly. The app is available for Apple and Android users (search B4UFLY).

Encourage students to continue exploring these resources on their own outside of class. They may also download the app in class and check if there are any restrictions in their immediate vicinity.

Slides 13-14: Describe the importance of being responsible and being a good neighbor when piloting a UAS. Ask students to provide examples of when this might be important. Lead students through a scenario where they are filming their friends with a drone at a skatepark.

Slide 15: Lead the class in a discussion and ask about smart practices for new UAS pilots (regardless of the pilot being a recreational or commercial operator). Have students explain the rationale behind their suggestions.

Questions

Possible responses include:

When just starting, fly in open spaces. The more congested an area is, the more likely to injure someone or come in contact with an obstacle. Choose a field or an isolated area; fly at times when these areas aren't full of people.

Avoid trees. One of the easiest ways to accidentally crash a drone is to fly it in areas that are densely packed with trees.

Avoid bodies of water such as lakes, rivers, beaches, etc. Getting the hang of flying a drone near water is quite challenging.

Slide 16: Ask students to consider what ethical flying means to them. Have them discuss scenarios where they will need to consider other people.

Slide 17: Show students the video on drone safety and then complete the Formative Assessment.

- "Drone Safety 101" (Length 1:01)

  https://vimeo.com/203860120

Provide students with poster board or rolled paper and markers to create posters. This activity should provide good information about the student's understanding about responsible and ethical drone use. [DOK 4; create, DOK 2; summarize]

Formative Assessment

Individually or in small groups, have students create posters on the safe and ethical use of drones. They should include five to ten items that focus on both the rules and the ethics of flying. Display the posters around the classroom.

EXTEND

Teacher Material: UAS Operation and Safety Presentation

Slide 18: In groups of three to four, have students take turns flying the class drone. Before flying, reference back to the safety guidelines and rules for flying a drone. Take proper precautions as to flying venue, location of obstacles, and positioning of students and observers.

Have the students move the controls slightly so as not to take flight, but enough to see which propellers spin with different control deflections. Have the students take flight to maneuver the drone off the ground, move it up and down, forwards and backwards, left and right.

If time allows and students are proficient enough, attempt landing on a precise spot or navigate a simple course, such as a rectangle.

EVALUATE

Teacher Material: UAS Operation and Safety Presentation

Slide 19: Conduct the **Summative Assessment**.

Ask students to work in small groups to create a blog post with a checklist for operating drones ethically and responsibly. If time allows, have students share their selections and reasoning.

Use the 10-point scoring rubric for grading. Take no more than 10 minutes of class time to complete the summative assessment. [DOK 3; argue, collect, restate]

Summative Assessment

In groups of two to three, have students imagine they have a blog for people interested in flying drones as a hobby. Each group should create a new page for the blog. They should first write a paragraph explaining why it is important to be ethical and considerate when flying drones. Students should also provide a checklist to ensure that readers are following the appropriate steps when flying a drone.

Summative Assessment Scoring Rubric

Follows assignment instructions

Writes paragraph explaining why it is important to be ethical and considerate when flying drones.

- Lists reasons for drone guidelines.
- Uses complete sentences and paragraph form.
- All concepts are accurate and reflect full participation during class.

Provides checklist for ethical and considerate drone use.

- Correctly lists guidelines for ethical drone use.
- Lists guidelines in checklist form.

Points	Performance Levels
9-10	Consistently demonstrates criteria
7-8	Usually demonstrates criteria
5-6	Sometimes demonstrates criteria
0-4	Rarely to never demonstrates criteria

GOING FURTHER

Consider registering for the UAS4STEM challenge: http://www.uas4stem.org/

Have students review "Flying Your Drone" for additional and concise safety suggestions, https://www.faa.gov/uas/resources/manufacturers/media/product_insert_print-ready_5x7_color_version.pdf.

STANDARDS ALIGNMENT

NGSS STANDARDS

Three-dimensional Learning

- **HS-ETS1-1** - Analyze a major global challenge to specify qualitative and quantitative criteria and constraints for solutions that account for societal needs and wants.
    - 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
        - Systems and System Models

        - Influence of Science, Engineering, and Technology on Society and the Natural World
- **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
        - Constructing Explanations and Designing Solutions
    - Disciplinary Core Ideas
        - ETS1.C: Optimizing the Design Solution
    - 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

COMMON CORE STATE STANDARDS

- **RST.9-10.2** - Determine the central ideas or conclusions of a text; trace the text's explanation or depiction of a complex process, phenomenon, or concept; provide an accurate summary of the text.
- **RST.9-10.4** - Produce clear and coherent writing in which the development, organization, and style are appropriate to task, purpose, and audience.
- **WHST.9-10.2** - Write informative/explanatory texts, including the narration of historical events, scientific procedures/ experiments, or technical processes.
- **WHST.9-10.6** - Use technology, including the Internet, to produce, publish, and update individual or shared writing products, taking advantage of technology's capacity to link to other information and to display information flexibly and dynamically.
- **WHST.9-10.8** - Gather relevant information from multiple authoritative print and digital sources, using advanced searches effectively; assess the usefulness of each source in answering the research question; integrate information into the text selectively to maintain the flow of ideas, avoiding plagiarism and following a standard format for citation.
- **WHST.9-10.9** - Draw evidence from informational texts to support analysis, reflection, and research.

REFERENCES

https://www.aopa.org/go-fly/aircraft-and-ownership/drones/best-practices-for-flying-your-drone-near- an-airport

https://www.aopa.org/go-fly/aircraft-and-ownership/drones/guide-to-remote-pilot-certification

https://www.faa.gov/uas/where_to_fly/b4ufly/
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