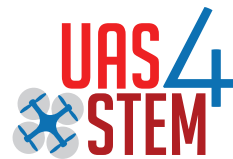




UAS4STEM

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**2023 ADVANCED
COMPETITION**
RULEBOOK V-2.1



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UAS4STEM



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How to choose your competition class:

All new UAS4STEM teams are encouraged to choose the beginner class.

Returning teams are encouraged to choose the advanced class.

Any returning UAS4STEM team who has placed First, Second, or Third within the past two years must select the advanced class. *If your team feels that there are extenuating circumstances in regard to your preferred class, reach out to the UAS4STEM competition staff.*

BEGINNER UAS4STEM CLASS:

Video component (simplified)
Simplified Special Instructions
Basic search mission
No pickup or dropoff

ALL TEAMS:

Ground school
Flight Readiness Review
Virtual preliminaries
International Competition

ADVANCED UAS4STEM CLASS:

Video component (training)
Detailed Special Instructions
Multiple target search mission
Delivery mechanism engineering challenge
Includes pickup and dropoff portions

BEGINNER AWARDS*

(per Team)

1st place: \$1250
2nd place: \$1000
3rd place: \$750

ADVANCED AWARDS*

(per Team)

1st place: \$2500
2nd place: \$2000
3rd place: \$1500

**Award amounts may be increased based on the total number of registered teams.*



5161 E. Memorial Dr., Muncie IN 47302
modelaircraft.org

UAS4STEM.ORG

If you have questions about the UAS4STEM program,
please contact the Education Department at education@modelaircraft.org,
or (800) 435-9262.

TEAM RULEBOOK

1. CONCEPT OF OPERATIONS (CONOPS)

A small group of people are stranded after a flash flood. While rescuers have determined a search area, they are unsure of the exact whereabouts and conditions of those stranded. Your team has been called upon to provide rapid response, via an Uncrewed Aircraft System (UAS), that can support the Search and Rescue (SAR) mission.

In order to support this mission, your UAS must comply with Special Instructions (SPINS) for departure and arrival procedures, and then remain within assigned airspace. It will be tasked to search an area for items of interest and to conduct point reconnaissance. As part of this mission you will be required to pick up and subsequently deliver a small payload to a designated area.

2. INTRODUCTION

2.1. THRUST

2.1.1. The principal thrust of the UAS4STEM drone challenge is the safe application and execution of systems engineering principles to develop and operate a sUAS to successfully accomplish the mission tasks. Teams who have competed in the previous two seasons of UAS4STEM and have podiumed are required to compete in the Advanced category.

2.2. SCORED ELEMENTS

2.2.1. The scored elements of this competition are:

2.2.1.1. Oral Briefing of a Flight Readiness Review (FRR)

2.2.1.2. Flight Mission Demonstration-Waypoint Challenge and Target Challenge

2.2.1.3. Overall Safety Score

2.2.1.4. Team average score from Online Ground School

2.2.1.5. A one to five minute video that creatively offers support/training to new UAS4STEM teams. Scoring this year is based on a pass/fail parameter.

2.3. OPPORTUNITIES

2.3.1. Student teams will be judged based on their performance and that of their system. Medals will be awarded for top performances. Opportunities for interaction with UAS engineers, scientists and leadership will be provided.

2.4. RULES

2.4.1. The Search and Rescue competition will be based upon the competition rules outlined within this document containing administrative

and performance objectives. These rules are aimed at a high school level curriculum. These rules may be updated with clarifications or updates and posted as the official rules for competition. The UAS4STEM committee reserves the right to make changes to these rules and issue updates or addendums at any time.

3. SCHEDULE

3.1. DATES AND LOCATIONS (SUBJECT TO CHANGE) SEE WWW.UAS4STEM.ORG OR REFER TO UAS4STEM EMAIL COMMUNICATIONS FOR UPDATED SCHEDULING INFORMATION.

4. MAJOR ELEMENTS OF THE COMPETITION

4.1. REGISTRATION PROCESS

4.1.1. Once the team manager sends all requested team information and pays the registration fee, AMA memberships for one team manager and up to 10 student team members will be processed and credentials for the virtual ground school will be created. Any assistant team managers must enroll as members of the Academy of Model Aeronautics (AMA).

4.1.2. It is required that all student members of the team successfully complete the online UAS4STEM Ground School course, as a matter of safety and because the team's average score is part of their competition points. Failing to do so will result in disqualification at the finals.

4.1.2.1. It is required that all participants comply with any national and local regulations regarding model aircraft and the national airspace at all times.

4.1.3. By participating in the Search and Rescue competition, the team, advisors and all support members, as well as judges and volunteers, agree to have any pictures of persons, vehicles or equipment photographed and released to the public on web pages, in papers and published trade magazines and journals, or posters.

4.2. VIRTUAL PRELIMINARY COMPETITION

The virtual preliminary competition occurs in the spring. Each team will have the opportunity to schedule an appointment slot with the judges; UAS4STEM email and online live/recorded communications will contain information about this process. Appointments will be in Eastern Time, with flexibility offered across time zones. These will last approximately 50 minutes total.

4.2.1. The virtual preliminary competition will include these components: a proof-of-flight video submission, a virtual Flight Readiness Review (FRR) presentation, a 15 minute mission-planning software assessment, and a support/

training video to new teams. (See 2.2.1.6.)

4.2.2. Prior to the competition, a proof-of-flight video shall be submitted to verify that the team's aircraft can fly in a safe manner. This is a pre-requisite for possible advancement to nationals. The aircraft should be in full autonomous configuration and perform the following:

- 1) Take off
- 2) Fly to at least one waypoint a minimum distance of 75 feet apart
- 3) Return to launch for landing

4.2.2.1. The proof-of-flight video shall identify the school and the team name. The video shall show the ground control station screen and aircraft flight. A link to the team's proof of flight video posted as a private video on the internet (www.youtube.com is preferred) shall be submitted by the specified date and time deadline. The video shall not exceed 3 minutes in length.

4.2.2.2. A new-team focused support/training video showcasing UAS4STEM is required. The video shall creatively showcase the UAS4STEM competition and team, offering insight, tips, tricks, or similar support for new teams. A link to the team's video posted as a private video on the internet (www.youtube.com is preferred) shall be submitted by the specified date and time deadline. The promotional video shall not exceed 5 minutes in length.

4.2.2.3. The FRR for the preliminary competition shall be an oral briefing presented virtually to a team of judges during which the teams substantiate, with data, their plans to safely accomplish the mission.

4.2.3. The FRR for the preliminary competition shall be an oral briefing presented virtually to a team of judges during which the teams substantiate, with data, their plans to safely accomplish the mission.

4.2.4. The intention is to demonstrate to the judges that the team is ready to compete safely, with low risk, in the flight mission phase of the competition. The FRR shall address the mission tasks the team plans to achieve during flight.

4.2.5. Following the FRR briefing, there will be a question-and-answer period with the judges and a mission-planning software assessment. Five verbal questions from the judges will be presented and worth one point each.

4.2.6. All team members present are encouraged to participate.

4.2.7. The FRR Briefing is a scored element worth 100 Points. The FRR briefing will be assessed on the team's ability to effectively articulate the scope and depth of the developmental testing performed, the ability of the system design to perform the planned flight tasks, and the preparations made to improve the chances of a successful Flight Mission.

4.2.8. The FRR briefing shall not exceed 20 minutes in duration, followed by a maximum period of 5 minutes where the judges will ask questions regarding the presentation and the team shall answer. A judge will time the presentation, may provide a 2-minute warning, and cut off extended presentations as needed.

4.2.9. FRR content and scoring (see below)

Flight Readiness Review (FRR) Presentation Content Guide and Scoring **(100 points total)**

1. Team Member Introductions
Including flight mission roles and experience for all team members. **(5%)**
2. New team support/training video presentation
Teams must present their support/training video to judges. **(5%)**
3. System Overview
Relating to flight tasks planned, expected performance, and any risk evaluation. **(15%)**
4. System Safety
With identified design and operational strategies. **(10%)**
5. Developmental Test Results
Including: test plan schedule (through ground testing to flight testing to mission performance testing), results of testing, and any corrective action taken to improve the effectiveness on mission completion. **(15%)**
6. Evidence of Mission Accomplishments.
Show the judges what you have achieved. **(10%)**
7. Pre-Mission Briefing
Including personnel resourcing for the flight, communication procedures, and go/no-go criteria. Judges will pose a hypothetical question to gather a team's sense of fallback plans should a technical issue arise during flight mission. **(10%)**
8. Other scoring factors
Participation and communication skills will be scored by judges factoring in aspects such as clarity, accuracy, logic, precision, relevance, depth, and suitability. Five judges questions will also be posed prior to the mission-planning software assessment. **(5%)**
9. The mission-planning software assessment will be a challenge in which the judges will give a mock mission, and the team must demonstrate how they would program the mission planning software to achieve the mission objective. Teams will have 15 minutes to complete this task. The team may confer

as this is accomplished. To do this, the team will need to have the mission planning software loaded onto the computer they are using for the virtual FRR presentation and share their screen with the judges. Failure to complete previous command will nullify any subsequent commands and the scoring will stop. Consider factors such as “automated take-off” and the setting of a reasonably suited home point as prerequisites to a successful mission. **(25%)**

10. In order to compete, each team member must successfully pass UAS4STEM ground school. In the case of a tie, team average ground school scores will be utilized to determine placement. Allowances for technical difficulties that may arise during virtual competitions will be at the discretion of the judges.

- *In order to compete, each team member must successfully pass UAS4STEM ground school.*
- *In the case of a tie, team average ground school scores will be utilized to determine placement.*
- *Allowances for technical difficulties that may arise during virtual competitions will be at the discretion of the judges.*

INTERNATIONAL COMPETITION (FINALS)

The international competition is in-person and attendance is by invitation only, extended to the highest scoring teams from the virtual preliminary competition. Teams are responsible for all associated travel, room and board costs. Requirements and scoring for the in-person competition are outlined below.

SPECIAL NOTE:

There may be grant opportunities available for teams in the event of extenuating circumstances that can help with the costs of attending the International Competition (finals). Please reach out with any questions to the UAS4STEM staff.

4.3. SAFETY INSPECTIONS

4.3.1. Safety inspections shall include a physical inspection, and may include a fail-safe check, and flight termination check.

4.3.2. Safety inspections shall be performed on all aircraft by designated competition safety inspectors prior to being allowed to make any competition flight.

4.3.3. The safety inspections are not a scored element. All decisions of the safety inspector(s) shall be final.

4.3.4. Physical inspection of the aircraft shall include:

4.3.4.1. Verify all components adequately secured to vehicle.

4.3.4.2. Verify rotor structural attachment integrity.

4.3.4.3. Visual inspection of all electronic wiring.

4.3.4.4. Check general integrity of any payload system

4.3.4.5. Verification of fail-safe mode operation covered by manual override and pilot-commanded flight termination may be requested by the judges.

4.4. FLIGHT READINESS REVIEW (FRR) BRIEFING

4.4.1. The FRR shall be an oral briefing presented to a team of judges during which the teams substantiate, with data, their plans to safely accomplish the mission.

4.4.2. The intention is to demonstrate to the judges that the team is ready to compete safely, with low risk, in the flight mission phase of the competition. The FRR shall address the mission tasks the team plans to achieve during flight.

4.4.3. Following the FRR briefing, there will be a question-and-answer period, followed by an inspection of the team’s UAS, including aircraft, ground station, test data, safety checklists, and other supporting evidence.

4.4.4. All team members present are highly encouraged to participate to maximize points.

4.4.5. The FRR will primarily be oral. Teams may use their aircraft or ground control station to demonstrate various aspects of the briefing. Teams may have access to digital displays to present slides or brief video elements. **TEAMS MAY NOT POWER UP THE AIRCRAFT. ONLY ONE ELECTRONIC DEVICE, LAPTOP OR TABLET MAY BE USED FOR BRIEFING.**

4.4.6. The FRR Briefing is a scored element worth 30% of the final score. The FRR briefing will be assessed on the team’s ability to effectively articulate the scope and depth of the developmental testing performed, the ability of the system design to perform the planned flight tasks, and the preparations made to improve the chances of a successful Flight Mission.

4.4.6.1. The in-person FRR briefing shall not exceed 20 minutes in duration, followed by a maximum period of 5 minutes where the judges will ask questions and the team shall answer. A judge will time the presentation and may provide a 2 minute warning followed by ending extended presentations as needed.

4.4.6.2. The breadth of the presentation will be scored based upon inclusion of the following elements with relative worth in percent:

4.4.6.2.1. Team member introductions including flight mission roles and experience/biographies **(5%)**



SAMPLE MAP KEY (example only)

- Red outline: No-fly-zone boundary
- Blue outline: Waypoint sequence
- Green outline: Search area
- White Star: Designated Take/Off and Landing Area
- White Circle: Payload delivery Search Area

4.4.6.2.2. Teams must present their support/training video to judges. **(5%)**

4.4.6.2.3. A brief system overview relating to flight tasks planned, expected performance, and any risk evaluation. **(15%)**

4.4.6.2.4. System Safety with identified design and operational strategies. **(10%)**

4.4.6.2.5. Developmental Test Results including: test plan schedule (through ground testing to flight testing to mission performance testing), results of testing, and any corrective action taken to improve the effectiveness on mission completion. **(25%)**

4.4.6.2.6. Evidence of Mission Accomplishments. **(15%)**

4.4.6.2.7. Pre-Mission Briefing, including personnel resourcing for the flight, communication procedures, go/no-go criteria and fallback plans should a technical issue arise during flight mission. **(15%)**

4.4.6.2.8. Team member participation and communication skills (clarity, accuracy, logic, precision, relevance, depth, and suitability). **(10%)**

REGARDING PRESENTATIONS:

We will allow the general public to come in and view the

oral presentations at nationals. Representatives from other teams (including students, team managers, parents) will not be allowed to view presentations of competitors during the event. Presentations may be recorded and made available for all teams and public to view next season. Your presentations represent the best of the best. We want new teams to have a great example to follow as they get started.

4.5. FLIGHT MISSION REQUIREMENTS

4.5.1. The flight mission evaluates the teams' ability to conduct a mission operation with their vehicle. This is the culminating event and a scored element of the competition.

4.5.2. A lead judge will be assigned to each team at the flight line. It is important that all team members follow the instructions of the judges. There will be additional judges assigned who are focused on different aspects of the competition (imagery, autonomy, safety, teamwork, etc.) depending on which tasks the team is planning to accomplish.

4.5.3. Only systems presented in the FRR, inspected by safety inspectors, and included in the preflight brief will be permitted to fly.

4.5.3.1 In order to compete, each team member must successfully pass UAS4STEM ground school.

4.5.3.2 In the case of a tie, team average groundschool scores will be utilized to determine placement.

4.5.4. OPERATIONAL TIMELINE

4.5.4.1. Setup Time = 15 minutes maximum. Setup time begins when the team arrives at the flight line. A lead judge will be assigned to each team and will start a dedicated stopwatch after communicating with the team Captain. After the fifteen setup minutes have elapsed, the flight timer will start regardless of the team's readiness to launch the mission.

4.5.4.2. Flying Time = 30 minutes maximum.

4.5.4.2.1. Flying Time shall start at the declaration by the Lead Judge who will have a dedicated Mission Clock Stopwatch. TEAMS MUST KEEP THEIR OWN TIME. ONCE ON THE CLOCK A TEAM MAY NOT ASK NON-STUDENT TEAM MEMBERS FOR REMAINING TIME.

4.5.4.2.2. A team may elect to cycle through the takeoff and landing sequence during the flying time more than once for a variety of valid reasons (change batteries, load payload, etc). No points will be lost, but flying time continues to be used.

4.5.4.2.3. Flying time stops when the vehicle has completed flight (landed, crashed, or terminated) and the team has disconnected flight battery. The lead judge will confirm with the team captain that the flying time period has stopped.

4.5.5. MISSION LIMITATIONS

4.5.5.1. Mission Boundaries

During the entire mission, aircraft shall remain in controlled flight and within the no-fly-zone boundary. A specific no-fly-zone boundary definition will be provided to teams following their FRR. Any vehicle appearing uncontrolled or moving beyond the no-fly-zone boundary during autonomous flight will be subject to immediate manual override. Failure of manual override will result in flight termination. Maximum flight altitude will be 200 ft. AGL unless otherwise specified.

4.5.5.2. Takeoff

4.5.5.2.1. Takeoff shall take place within the designated takeoff/ landing area, shown on the competition map.

4.5.5.2.2. Takeoff under manual control with transition to autonomous flight will be permitted but does not count as an autonomous takeoff.

4.5.5.2.3. The first takeoff will be scored, regardless if it is manual or autonomous. Only autonomous takeoff attempts on the first takeoff will earn points.

4.5.5.3. Landing

4.5.5.3.1. Landing shall take place within the designated takeoff/landing area shown on the competition map.

4.5.5.3.2. Landing under manual control is permitted.

4.5.5.3.3. Only autonomous landing attempts on the first landing will be scored.

APPROVED UAS COMPONENTS

Laptop guidelines

- Each team must provide their own laptop computer.
- Only a single laptop will be allowed on the flight line and with the team during the oral presentation.
- One additional monitor may be used on the flight line. This monitor may only display information from the computer and may NOT be used as an additional video viewing device. Example. You may duplicate a display on a laptop, or this can be the primary display for a desktop. It may not display video from the aircraft.

5.1. Teams will need to purchase UAS components that comply with provided specifications. If parts are damaged or destroyed they may only be replaced with comparable parts with the same specifications.

5.2. Reminder, a maximum of 2 video displays may be used during the competition.

5.3. In the pits and the airfield, the UAS4STEM Competition will ensure that teams are provided shade, a folding table, chairs and a single electrical power extension cord. Teams should plan to provide their own power strip, if required.

6. DESCRIPTION OF MISSION TASKS

PARAMETER	OBJECTIVE	POINTS
GCS DISPLAY ITEMS	Accurately display current aircraft position. GCS must also display airspeed and altitude to operators and judges. This is a minimum requirement for flight approval.	N/A
TAKEOFF	Achieve controlled autonomous takeoff. Scored on first takeoff attempt. Pilot or ground station operator may activate button or switch to initiate the takeoff. Takeoff is complete when drone reaches an altitude > or = 100ft and hovers for a minimum of 5 seconds	4 points
WAYPOINT NAVIGATION	Capture waypoints and commands in sequence. Waypoints and commands will be chosen no less than 30 ft from the "no-fly-zone" boundaries and will be provided to teams following completion of their FRR. Waypoints and commands will be provided to the teams the morning of the competition. Capture waypoints in sequence while in autopilot control with +/- 30 ft accuracy, and maintain navigation +/- 50 ft. along the planned flight path. ANY ALLOWED MISSION PLANNER COMMAND MAY BE ALLOWED DURING WAYPOINT NAVIGATION. This may include, but it is not limited to, loiter, POI (Point of Interest), adjust airspeed and others. Failure to complete previous command will nullify any subsequent commands. Example: Waypoint 5 requires hold of 5 seconds. If aircraft fails to hold for proper time, the following waypoints will be scored ZERO. Team must announce to the judges which waypoint and command is being attempted.	1 point for each waypoint and command achieved in proper order. Maximum 10.
LANDING	Achieve controlled autonomous landing. Scored on first landing attempt. Pilot or ground station operator may activate button or switch to initiate the landing.	4 Points

PARAMETER	OBJECTIVE	POINTS
LOCALIZATION	Determine Points of interest (POI) location within 25 ft.	Points are given based on accuracy of location. 5 points for 0'-5'; 4 points for 5'-10'; 3 points for 10'-15'; 2 points for 15'-20'; and 1 point for 20'-25'.
CLASSIFICATION	Identify item characteristics. Multiple targets will then be used for precision delivery.	1 each
PACKAGE DELIVERY	Payload may be picked up and delivered to the designated delivery target icon. Only one payload may be delivered to each target. Teams may descend to 0 altitude for package delivery. Only intact and unmolested payloads will be scored. incorrect payload deliveries will not be scored.	10 points for 0'-2'; 8 points for 2'-4'; 6 points for 4'-6'; 4 points for 6'-8'; and 2 point for 8'-10'.
COMPLETE SOLUTION	Locate and classify items of interest.	1 points. Teams must identify the location of all targets and receive a distance score for each target to qualify.
AUTONOMY	Level of autonomy for pickup and delivery scored from takeoff prior to pickup of each payload until after delivery of each payload.	10 points for each fully autonomous solution for package pickup and delivery. 1 point for each pickup and delivery completed entirely manually. 0 points for any unsuccessful pickup and delivery.

The Flight Mission has been divided into a series of tasks. Teams do not need to complete every task. The available tasks are listed in this section with the associated scoring associated with each task.

6.1. Capture waypoints and commands in sequence. Waypoints and commands will be chosen no less than 50 ft from the “no-fly-zone” boundaries and will be provided to teams following completion of their FRR. Waypoints and commands will be provided to the teams the morning of the competition. Capture waypoints in sequence while in autopilot control with +/- 25 ft accuracy and maintain navigation +/- 25 ft. along the planned flight path. ANY AVAILABLE MISSION PLANNER COMMAND MAY BE ALLOWED DURING WAYPOINT NAVIGATION. This may include, but it is not limited to, loiter, POI (Point of Interest), adjust airspeed, and others.

Failure to complete previous command will nullify any subsequent commands. *Example: Waypoint 5 requires hold of 5 seconds. If aircraft fails to hold for proper time, the following waypoints will be scored ZERO. Team must announce to the judges which waypoint and command is being attempted to be scored.*

6.2. Six Points Of Interest (POIs) will be in the target area. Three POIs will have one of the following three items:
 bottle of water (8 oz.)
 Bag of marshmallows (10 oz. bag)

Medical kit (*Thrive First Aid Kit [100 Pieces] 7.5 inches long x 4.5 inches wide x 3.0 inches thick, weighing ~3lbs*)

Three POIs will be delivery targets that correspond to the identified items. Teams must locate the targets with the items and fly to the target that corresponds.

6.2.1. Waypoint and Payload Delivery missions are independent of each other. Each must be completed separately before moving on to the other challenge.

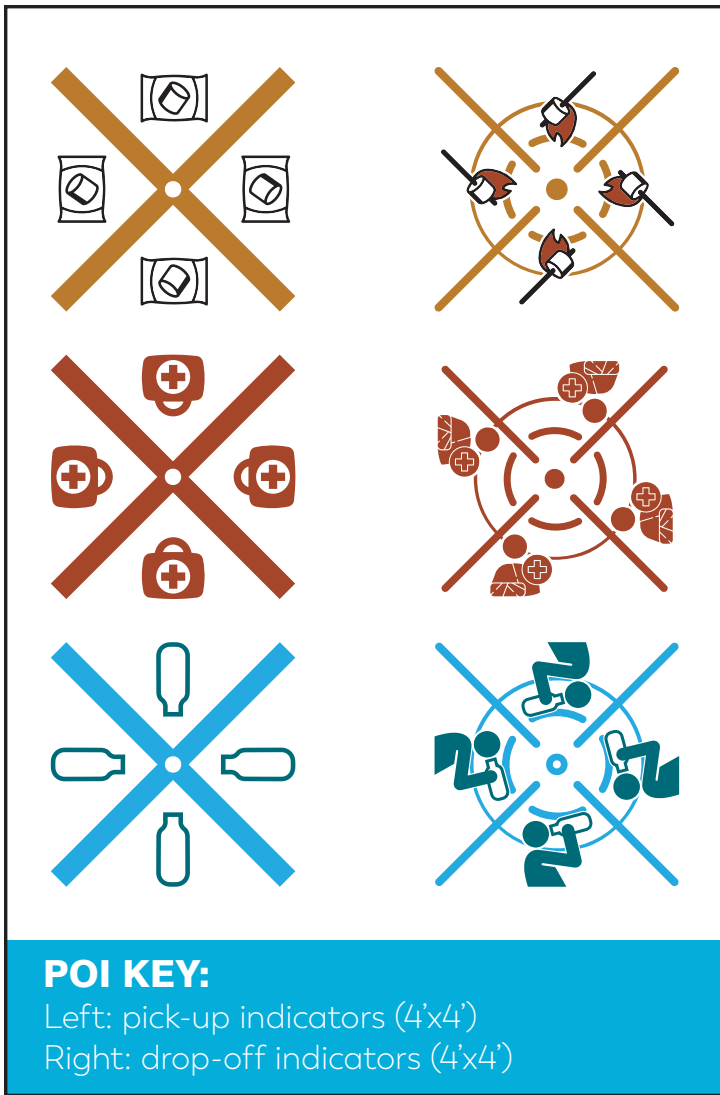
6.2.2. The vehicle shall search for items of interest. Each POI will be located within the search area. Each POI will be printed on a 4'x4' vinyl banner material and contain either a pick-up indicator, a letter, or a specific pictogram and QR code indicated drop-off indicator.

6.3. PAYLOAD DELIVERY SPECIFICATIONS

6.3.1. Payload delivery mechanism must be designed and built by team members. No commercially available payload mechanisms allowed. Payload delivery mechanisms may be made from the material of choice for each team. 3D printed, wood, and foam are just examples of allowed materials.

6.3.2. Payload delivery mechanism must be powered by primary battery source. No additional batteries are allowed on board.

6.3.3. Payload delivery mechanism(s) may be removable and installed only for the drop portion of the event.



6.3.4 No portion of the payload delivery mechanism may remain attached to payloads after delivery.

6.3.5. Each payload delivery mechanism must be capable of carrying the specified items.

6.3.5.1. Teams may use any 8oz water bottle. Bottle must be unmolested, as in, complete without any modifications other than removal from larger case to individual unit. If you are using your own water bottles you must notify judges prior to beginning your flight operations. If teams are not providing their own water bottles at competition, randomized 8oz water bottles will be utilized.

6.3.5.2. Medical kits will be provided for teams to use at the competition. If you would like to practice with the same style kit, you can utilize the following link: <https://a.co/d/b9XN6MV>

6.3.5.3. Marshmallows will be based on 10 oz. package of jet-puffed marshmallows.

7. SAFETY REGULATIONS

7.1. FLIGHT OPERATIONS

7.1.1. Flight operations of any type involve some level of risk to personnel and property. It is the responsibility of all personnel involved in and around flight operations to identify, evaluate, and mitigate risks to the maximum extent possible.

7.1.2. When teams are conducting flight tests, extra precautions must be in place to protect team members and others.

7.1.3. It is recommended that teams use an experienced RC Pilot to act as their Safety Pilot for test flights. The safety pilot for competition flights must be a student team member.

7.1.4. A Safety Score of a maximum of 10 points will be awarded.

7.2. THE SYSTEM

7.2.1. The system shall provide sufficient information to operators on a continuous basis to ensure that it is operating within no-fly/altitude boundaries.

7.2.2. The aircraft shall be capable of manual override by the safety pilot during any phase of autonomous flight.

7.2.3. The flight termination system, activated by a single switch, shall be capable of overriding all flight modes and executing the Return-To-Land command.

7.2.4. The aircraft shall automatically Return-to-Land (takeoff location) after loss of primary communications link signal within 5 seconds.

7.3. OTHER

7.3.1. No more than ten (10) team members will be allowed in the mission area.

7.3.2. Closed toe shoes are required to be worn during safety inspections, flight line operations, or when rotors are powered. Anyone wearing open-toed shoes will not be allowed to participate in any activity on the flight line.

7.3.3. Officials have the right to disqualify an entry or a team that they deem to be a hazard.

APPENDIX

AIRFRAME SPECIFICATIONS

- Quadcopter configuration (4 motors)
- 625mm maximum frame size (measured from one side of an arm to the other)
- Additional processors are allowed, but must cost less than \$150 USD.
- Autopilot system must cost less than \$600 USD Manufacture Suggested Retail Price (MSRP), including the Global Positioning System (GPS)
 - o This is a retail cost, meaning that even if a

more expensive autopilot is donated, it is not allowed.

- o It does not have to be a Pixhawk variant, but Pixhawk is recommended
- Maximum of 8 channels
 - o These include 4 for the motors, leaving four open to be utilized as the team sees fit
- Options include a camera gimbal, pickup, and drop mechanism controls
- If you use 2 for the gimbal, that leaves only 2 channels for pickup and drop mechanism(s)
- Maximum 4S 4500 battery size 30C rating
Batteries may be changed as often as necessary during the competition
- Maximum propeller size 11"
- Up to a 1080p video camera
 - o Camera Manufacturer's Suggested Retail Price (MSRP), must be less than \$100 USD
- Digital video is allowed
 - o Camera and receiver Manufacturer's Suggested Retail Price (MSRP), must be less than \$250 USD combined
- Up to a 250mw video transmitter
- Any antenna may be used for the video feed system
- 2.4 Ghz RC control system. Any brand legal in the US
- One primary Ground Control Station (GCS) –
Meaning only 1 laptop allowed on the flight line
- Maximum of 2 video receivers allowed during the competition
 - o One can attach directly to the GCS
- Recommended telemetry radio RFD 900+
- One additional sensor may be utilized. Sensor must be less than \$50 USD MSRP.

CLARIFICATIONS:

- Pickup of items requires lifting the item to a minimum of 5' AGL in order to receive any points.
- 0-10 points will be allowed for successful pickup and dropoff portions and the amount of autonomy present in the process based on judges discretion.
- Additional points will be awarded based on the location/distance the item comes to rest to the center of each target set. Items cannot occupy the same drop-off point.
- Unintentional drops will not score.
- Teams must communicate their intentions with judges as they relate to the pickup and delivery of the payloads.

SAMPLE MISSION SET:

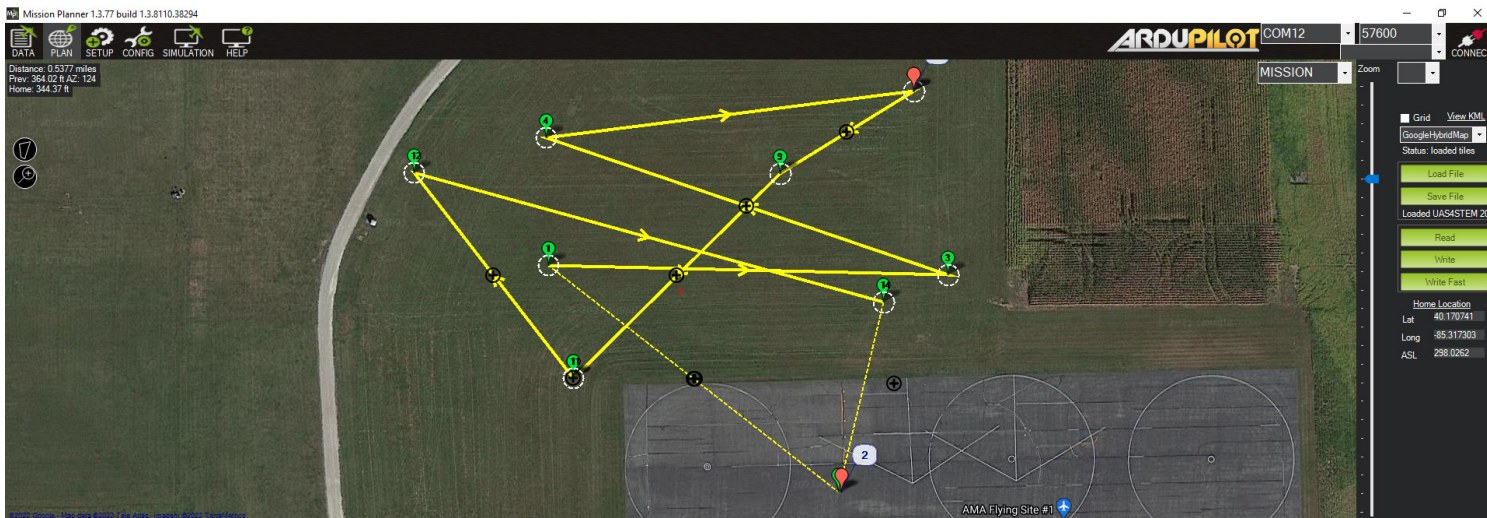
1. Fly to Waypoint 40.171337°, -85.318303° at 90' and hold for 3 seconds
2. Fly to Waypoint 40.171313°, -85.316926° at previous altitude while pointing the nose of the aircraft at your takeoff point
3. Fly to Waypoint 40.171674°,-85.318312° while climbing to 175' and make the aircraft rotate to face due north upon arrival at waypoint
4. Fly to Waypoint 40.171797°, -85.317044° while descending to 100' and perform 2 circles around the point in either direction
5. Fly to Waypoint 40.171580°, -85.317505° descending to 75' while pointing the nose at the previous waypoint
6. Fly to Waypoint 40.171041°, -85.318218° while climbing to 150' and descend to 50' once at the waypoint
7. Fly to Waypoint 40.171582°, -85.318768° at the previous altitude and rotate the aircraft in either direction 2 turns
8. Fly to Waypoint 40.171242°, -85.317147° while climbing to 100' and stop for 15 seconds

(Solution located on next page)

COMPLETE DRONE COMPONENT SOLUTIONS

If you would prefer to purchase a complete bundle of drone components for UAS4STEM, that option is available via Ready Made RC. They offer two bundles to choose from: a basic bundle if you already have a transmitter, batteries and charger or an all-inclusive bundle that also contains a transmitter, batteries and charger. Details at www.readymaderc.com.

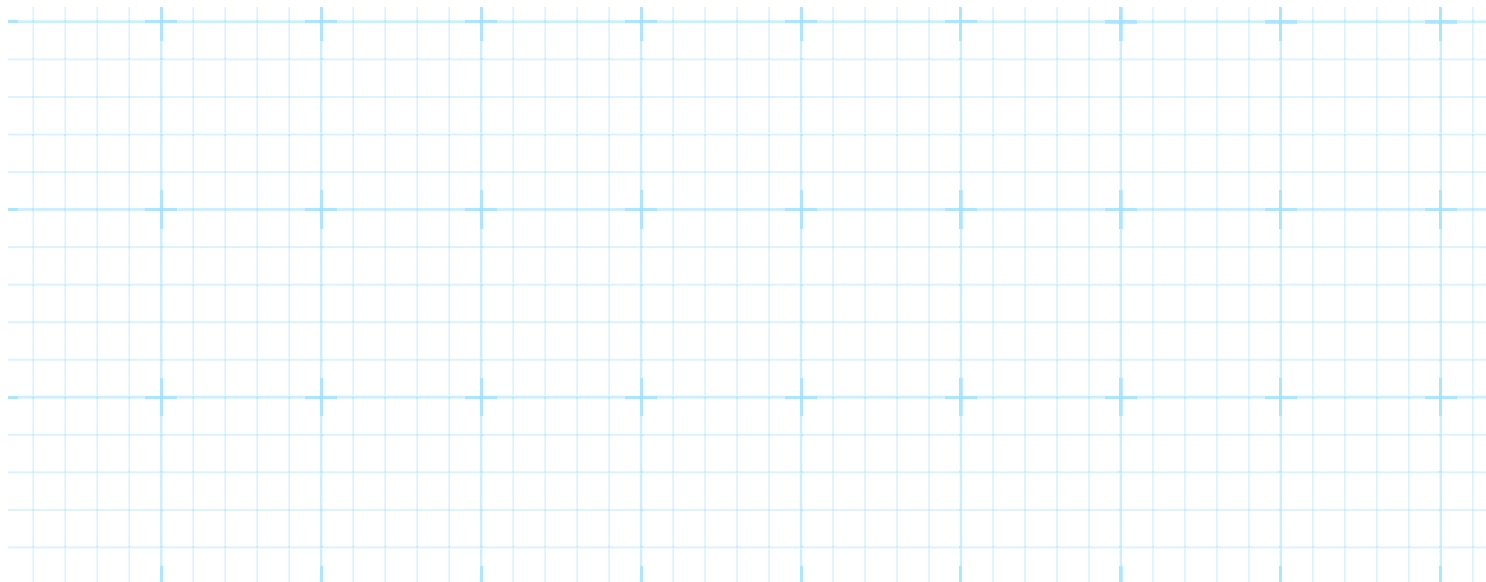
If you have any questions about your airframe or components, please contact UAS4STEM National Director Archie Stafford at archie@modelaircraft.org

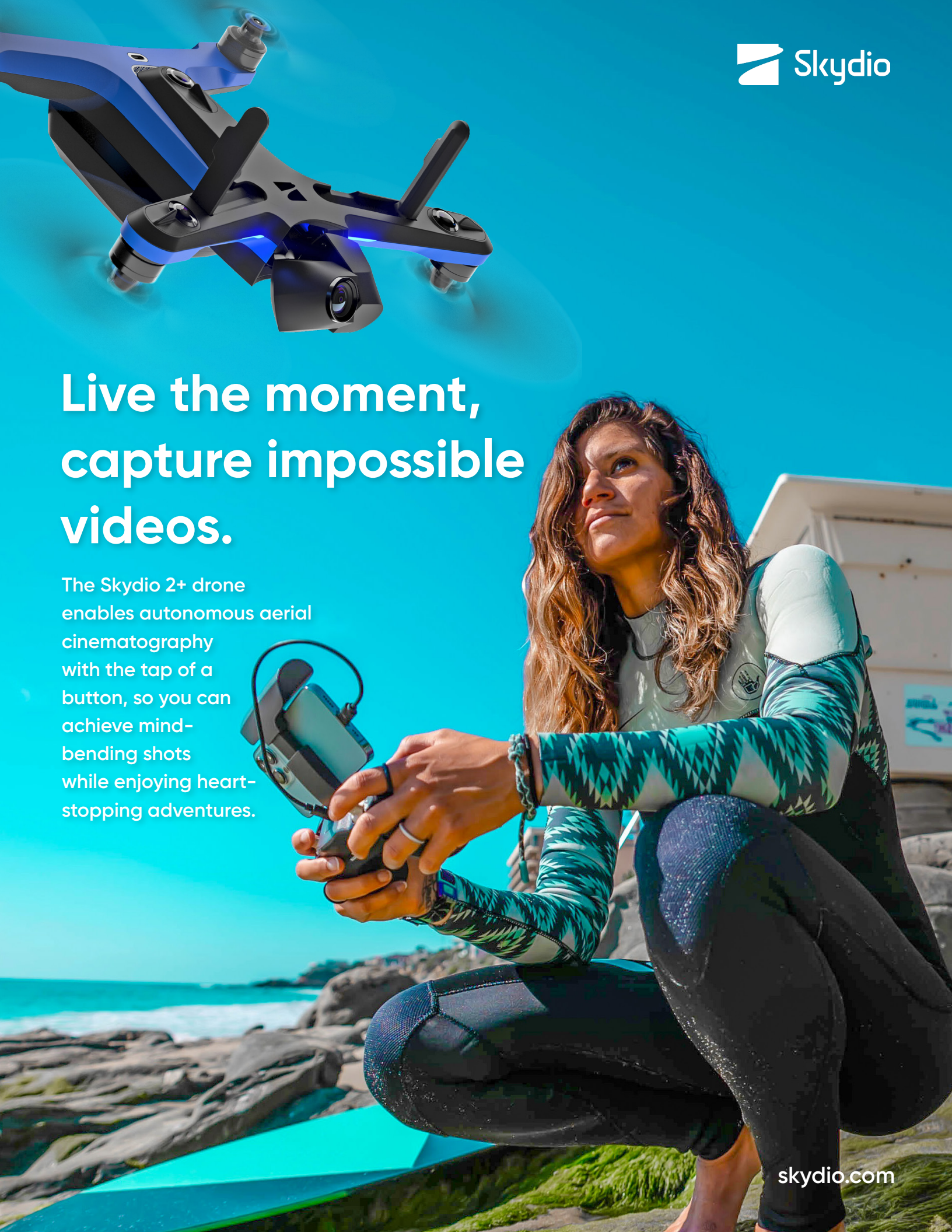


WP Radius: 10 | Loiter Radius: 60 | Default Alt: 400 | Relative | Verify Height | Add Below | Alt Warn: 0 | Spline

	Command	Delay				Lat	Long	Alt	Frame	Delete			Grad %	Angle	Dist	AZ
1	WAYPOINT	3	0	0	0	40.171337	-85.318303	90	Relative	X			25.5	14.3	364.8	308
2	DO_SET_ROI	0	0	0	0	40.170741...	-85.31729...	0	Relative	X			0	0	0	0
3	WAYPOINT	0	0	0	0	40.171313	-85.316926	90	Relative	X			38.8	21.2	249.1	26
4	WAYPOINT	0	0	0	0	40.171674	-85.318312	175	Relative	X			20.8	11.8	416.9	289
5	CONDITION_YAW	0	0	0	0	0	0	0	Relative	X			0	0	0	0
6	WAYPOINT	0	0	0	0	40.171797	-85.317044	100	Relative	X			-21.0	-11.9	364.1	83
7	LOITER_TURNS	2	0	5	0	0	0	0	Relative	X			0	0	0	0
8	DO_SET_ROI	0	0	0	0	40.171797	-85.317044	0	Relative	X			0	0	0	0
9	WAYPOINT	0	0	0	0	40.17158	-85.317505	75	Relative	X			49.7	26.4	168.5	238
10	WAYPOINT	0	0	0	0	40.171041	-85.318218	150	Relative	X			26.8	15.0	289.5	225
11	WAYPOINT	0	0	0	0	40.171041	-85.318218	50	Relative	X			-	-90.0	100.0	180
12	WAYPOINT	0	0	0	0	40.171582	-85.318768	50	Relative	X			0.0	0.0	249.9	322
13	LOITER_TURNS	2	0	0	0	0	0	0	Terrain	X			0	0	0	0
14	WAYPOINT	15	0	0	0	40.171242	-85.317147	100	Terrain	X			155.6	57.3	866.6	105

NOTES





Live the moment, capture impossible videos.

The Skydio 2+ drone enables autonomous aerial cinematography with the tap of a button, so you can achieve mind-bending shots while enjoying heart-stopping adventures.