SOUTHERN OREGON
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EDUCATION SERVICE DISTRICT

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Three Rivers School District
Quality Education Runs Deep

MARCH-MAY 2019

AFTER SCHOOL DRONE PROGRAM

ACADEMY OF MODEL AERONAUTICS (AMA)

LICENSED CURRICULUM

THE PROJECT

MARCH-MAY 2019

Each after school site will establish a drone team consisting of 10 members in the club. All team members will start by completing ground school including the FAA Part 107 Unmanned Aircraft Regulations course and then move into building and drone programming to compete in a mission in Grants Pass later this spring.

This incredible opportunity has been provided by SOAA through a partnership with with various agencies in Southern Oregon and in collaboration with Rogue Valley Flyers will be offering an after school Drone Club licensed by the Academy of Model Aeronautics(AMA) and sanctioned by Rogue Valley Flyers RVF).

AMA UAS4STEM

Concept: STEM program from the Academy of Model Aeronautics! UAS4STEM is designed to encourage students to explore the UAS (drone) phenomenon, teamwork, competition, andsuccess through STEM. The teams will then meet at the Grants Pass Skypark in conjunction with Rogue Valley Flyers and AMA Judges for a fly off demonstration.

THE MISSION

Teams will complete a mission using a drone in support of a Search and Rescue (SAR). To support this mission, your UAS must comply with Special Instructions (SPINS) for departure and arrival procedures, and then remain within the assigned airspace. You will be tasked to search an area for items of interest and to conduct point reconnaissance. A UAS that can accurately deliver supplies and information where directed will be in high demand!

UAS4STEM

HIGH SCHOOL TEAM RULEBOOK 2018

AMA®
ACADEMY OF MODEL AERONAUTICS

UAS4STEM

If you have questions about the UAS4STEM program, please contact Jessica Symmes at jessys@modelaircraft.org, or by calling 1-888-829-4060.

AMA®
ACADEMY OF MODEL AERONAUTICS

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ModelAircraft.org

UAS4STEM.ORG

TEAM HIGH SCHOOL RULE BOOK

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 Unmanned 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.

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 Quadzilla UAS to successfully accomplish the mission tasks.

2.2. SCORED ELEMENTS

2.2.1. The five scored elements of this competition are:

2.2.1.1. Flight Plan Report

2.2.1.2 Oral Briefing of a Flight Readiness Review (FRR)

2.2.1.3 Flight Mission Demonstration-Waypoint Challenge and Target Challenge

2.2.1.4 Overall Safety Score 2.2.1.5 Team average score from Online Ground School

2.3. OPPORTUNITIES

2.3.1. Student teams will be judged based on their performance and that of their system. Trophies 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 for updated scheduling information

4. MAJOR ELEMENTS OF THE COMPETITION

4.1. REGISTRATION PROCESS

4.1.1 Once the teachers/sponsors send their email address via the registration form, logins for teachers/students for online curriculum will be created.

4.1.2 It is required that all student members of the team successfully complete the online Fly Robotics UAS4STEM Ground School and become student members of Academy of Model Aeronautics (AMA).

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. PROOF-OF-FLIGHT

4.2.1 Prior to the competition, a proof-of-flight video shall be submitted as proof that the team's aircraft can attain, sustain, and land in a safe manner.

4.2.2 The proof-of-flight video does not need to have the craft in full autonomous configuration. It is

acceptable to demonstrate a Radio Controlled (RC) flight.

4.2.3 The proof-of-flight video shall identify the school and the team name. The video shall show the vehicle demonstrating safe Takeoff, Flight, and Landing.

4.2.4 A text file containing a link to the team's video posted on the internet (www.youtube.com is preferred) shall be submitted by the specified date and time deadline

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 encouraged to participate.

4.4.5 The FRR Briefing will be held at the flying location and will be oral only. Teams may use their aircraft or ground control station to demonstrate various aspects of the briefing. TEAMS MAY NOT POWER UP THE AIRCRAFT.

4.4.6 The FRR Briefing is a scored element worth TWENTY-FIVE 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.

- 4.4.6.1 The FRR briefing shall not exceed 15 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, provide a 2 minute warning, and cut off 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. (10 %)
  - 4.4.6.2.2 A brief system overview relating to flight tasks planned, expected performance, and any risk evaluation. (10%)
  - 4.4.6.2.3 System Safety with identified design and operational strategies. (10%)
  - 4.4.6.2.4 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. (30%) completion.
  - 4.4.6.2.5 Evidence of Mission Accomplishments. (10%)
  - 4.4.6.2.6 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. (20%)

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

4.4.6.2.8 Judges will ask 5 questions directly from the UAS4STEM Ground School Course. Each Question will be worth 1 point. Any team member may answer.

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.

4.5.4 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 maximum time, the judge may declare mission 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.

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 turned off transmitters. The lead judge will confirm with the team captain that the flying time period has stopped and the post processing time period starts.

4.5.4.2.4 Teams that are still flying after 30 minutes will be assessed a penalty of one point for each minute over the 30 minute time limit.

4.5.4.2.5 Teams that are still flying after 40 minutes will be disqualified.

4.5.4.3 Post Processing Time = 20 minutes maximum.

4.5.4.3.1 Post Processing Time begins immediately after the flying time stops. This time is for data processing. No RF transmission shall be performed during Post Processing Time.

4.5.4.3.2 Post Processing time stops when the team captain hands in the scoring sheets, or when the maximum post processing time is exceeded.

4.5.5 MISSION LIMITATIONS

4.5.5.1 Mission Boundaries

4.5.5.1.1 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.

Map of Competition Area (example)

4.5.5.1.2 Teams shall display their no-fly-zone (geofence boundary) prior to flight.

4.5.5.1.3 After takeoff and before landing, aircraft shall sustain flight at an altitude between 30 feet and 350 feet MSL for the duration of the mission. Flight below 30 feet or above 350 feet during autonomous flight shall require manual override. Failure of manual override will result in flight termination.

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 take off.

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

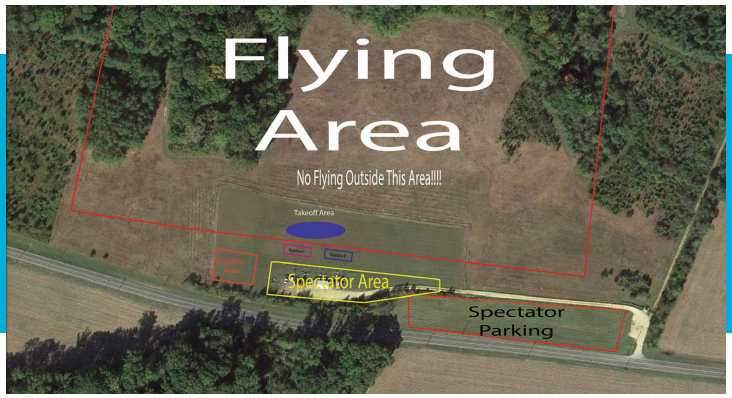
4.5.5.3.1 Landing shall take place within the designated takeoff/landing area shown on the competition map.

4.5.5.3.2 Landing under manual control is permitted.

4.5.5.2.3 The first landing will be scored, regardless if it is manual or autonomous. Only a successful autonomous landing during the first attempt will earn points.

MAP KEY

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



5. SYSTEM REQUIREMENTS

5.1. Newly registered teams will be provided with materials needed to complete a Quadzilla UAS. If parts are damaged or destroyed they may only be replaced with comparable parts with the same specifications. TEAMS WILL NEED TO PROVIDE THEIR OWN LAPTOP. ONLY A SINGLE LAPTOP WILL BE ALLOWED ON THE FLIGHT LINE WITH THE TEAM OR DURING THE ORAL PRESENTATION. Landing gear of ANY type are required on all Quadzilla aircraft. The landing gear must ensure the bottom plate of the aircraft is at least 3" off the ground.

5.1.1 All antennas must be of stock type. No cloverleaf or other aftermarket antennas are allowed

5.1.2 Upgraded items are optional this year and include ONLY:
- Any aurduino based autopilot system. These include, but are not limited to Pixhawk, and all versions of APM. Generic replacements are also acceptable.
- 720p video camera
- 250mw video transmitter
- Multiple 3S – 4200mah, maximum 35C batteries. Teams may change batteries as often as desired during flight.

5.1.3 All teams must use Mission Planner GCS Software. Version is not important. Step-by-step PDF documentation and a video guide to build the Quadzilla UAS can be found at www.quadzillacopter.com/build/

5.2 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.

6. DESCRIPTION OF MISSION TASKS

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 Autonomous Flight Task

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	Four points
Waypoint navigation	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 +/- 50 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	One 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.	Four Points

6.2 Search and Payload Delivery

Parameter	Objective	Points
Localization	Determine item location within 50 ft.	Points are given based on accuracy of location. 5 points for 0 – 10', 4 points for 11-20', 3 points for 21-30', 2 points for 31-40', and 1 point for 41-50'
Classification	Identify item characteristics. Multiple targets will then be used for precision delivery.	One point each
Package Delivery	A water balloon containing no less than 1 oz of liquid paint and 3 oz of liquid water will be dropped on identified target locations. Balloon must be dropped without intervention from the safety pilot. Balloon may be dropped using a mission planner command, or by a command by the GCS operator through mission planner. Balloon must be dropped at an altitude of 40' or higher. Lower altitude will mean a score of zero on the drop.	Points are given based on accuracy of location. 5 points for 0 – 10', 4 points for 11-20', 3 points for 21-30', 2 points for 31-40', and 1 point for 41-50'. Also bonus points of 15, 10, and 5 will be given to the 3 closest teams, regardless of location score as long as teams drop within 50'. MEANING IF DROPS ARE OUTSIDE 50' NO BONUS POINTS WILL BE GIVEN
Complete Solution	Locate, and Classify, items of interest.	Five points. Teams must identify location of all targets and receive a distance score for each target to qualify.

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 items of interest will be located within the search area. Each items will be of 2 dimensions and contain a colored letter. A Red X will signify a payload delivery target.

6.3 Payload Delivery Specifications

6.3.1 Payload delivery mechanism must be designed and built by team members. No commercially available drop mechanisms allowed. Payload delivery mechanisms may be made out of 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 may removeable and installed only for the drop portion of the event.

6.3.4 Each payload delivery mechanism must be capable of carrying a balloon filled with a minimum of 1oz of liquid paint and 3oz of liquid water. Teams may request larger balloons up to a maximum of 6 fluid ounces of liquid. Teams may carry multiple balloons simultaneously, up to a maximum of 3.

6.3.5 Teams must provide their own balloons for the competition. UAS4STEM organizers will fill and weigh each balloon before flight. **DO NOT BRING PREFILLED BALLOONS**

6.3.6 Each team may drop up to 2 balloons on any identified target.

6.3.7 Teams may return to launch point to load new payloads as often as necessary within the time permitted.

6.3.8 Payload must be dropped at an altitude of 40' or higher

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 required that teams use an experienced RC Pilot to act as Safety Pilot for any test flights. This should be one of the mentors assigned to the team.

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 Open toed shoes/flip flops should not be worn during safety inspections, flight line operations, or when rotors are powered.

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

APPENDIX B: ITEM REPORT SHEET

Use this sheet for submitting search results.

School Name: _____

Team Name:_ _____

ITEM NUMBER	ITEM DESCRIPTION	LATITUDE*	LONGITUDE**
1			
2			
3			
4			
5			

*Latitude in the following format: Degrees to the 6th decimal place with positive indicating North Latitude and negative indicating South Latitude
Example: 38.365458

**Longitude in the following format: Degree to the 6th decimal place with positive indicating East Longitude and negative indicating West Longitude
Example: -76.539108

APPENDIX D: MENTOR GUIDELINES AND EXPECTATIONS

- Complete necessary site specific requirements to be an approved volunteer
- Agree to exchange contact info with sponsor teachers at your designated site
- Aid students in completing AMA registration
- Aid schools in registering with AMA as a MASC club
- Agree to meet with teams at a minimum of two times a month
- Photo documentation

NOTES

AMA
ACADEMY OF MODEL AERONAUTICS

UAS4STEM

Introducing a new STEM program from the Academy of Model Aeronautics!

UAS4STEM is designed to encourage students to explore the sUAS (drone) phenomenon, teamwork, competition, and success through STEM.

SEARCH AND RESCUE CHALLENGE

THE MISSION: A small group of hikers has gone missing in a remote area. Your team has been called upon to provide rapid response using a small Unmanned Aircraft System (sUAS) that can support the search-and-rescue mission.

ELIGIBILITY: Teams consist of between four and ten members. All team members must be between 11 and 19 years old. All competitors are required to complete the sUAS ground school curriculum before kit shipment.

COST PER TEAM: $1,995

Price Includes:

- Ten sUAS Ground School licenses
- Quadzilla quadcopter
- AMA membership
- Regional and national competition entrance
- No additional regional or national event entry fees

For additional details and information, visit:

WWW.UAS4STEM.ORG

AMA FLIGHT SCHOOL

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