FLIGHT

See General Rules, Eye Protection & other Policies on www.soinc.org as they apply to every event.

1. **DESCRIPTION:** Prior to the tournament, teams will design, construct and test free flight rubber-powered aircraft to achieve maximum time aloft.

   A TEAM OF UP TO: 2 **IMPOUND:** No **APPROXIMATE TIME:** 15 minutes

2. **EVENT PARAMETERS:**
   a. Teams may bring up to 2 aircraft, each in its own team-provided box, any tools, and their Flight-Design Log. Teams may bring two different types of aircraft.
   b. Event Supervisors will provide all measurement tools and timing devices for scoring purposes.
3. **CONSTRUCTION PARAMETERS:**
   a. Aircraft may be constructed from published plans, commercial kits, competitor's designs, and/or other sources of design. Kits, if used, must not contain any pre-glued joints or pre-covered surfaces.
   b. Aircraft includes any heavier-than-air device capable of flight, including but not limited to: Airplanes of any wing configuration (e.g., monoplane, biplane, triplane, tandem wing, canard), Helicopters, Gliders, Ornithopters, and Gyrocopters. However, some aircraft have unique requirements as follows:
      i. Helicopters must have a flat balsa wood disc, large enough to cover a dime, as the upper most part of the helicopter, the part that would touch a flat ceiling first during the flight.
      ii. Gliders must have a hand-held launcher in its ready to use configuration that fits in the box with the glider when it is presented for inspection.
   c. Any materials except Boron filaments may be used in construction of the aircraft and boxes.
   d. The aircraft in its flight configuration and during the flight must fit into a team-provided rectangular box.
      i. For Division B, the external dimensions of the box, with or without a lid, must be no larger than 39.0 cm x 28.5 cm x 63.0 cm.
      ii. For Division C, the external dimensions of the box, with or without a lid, must be no larger than 33.0 cm x 27.0 cm x 43.0 cm.
   e. Boxes may be purchased or constructed by the participants.
   f. "Flight configuration" means the aircraft is fully assembled and ready to fly. For example, no change in chord, span, length, or total lifting area (as verified by returning aircraft to box after flying) can occur after removing the aircraft from its box and throughout the flight itself. Rotating components such as propellers or rotors may be rotated to allow the aircraft to fit into the box.
   g. Trimming is allowed as long as the constraints of 3.d.-e. are followed.
   h. For the aircraft to "fit" into the box, the aircraft's overall dimensions must not change after being removed from the box. This may be verified by showing that the aircraft slides into and out of the box without changing shape at the discretion of the Event Supervisor.
   i. All aircraft-lifting forces must be generated by wing(s) or rotor style flying surfaces.
   j. Total mass of the aircraft, excluding the rubber motor(s), must be 8.00 g or more.
   k. The propeller/rotor assembly/assemblies may be built by the participants or purchased pre-assembled. This may include a propeller, a shaft, a hanger, and/or a thrust bearing. Variable-pitch propellers that include mechanisms to actively change the propeller/rotor diameter or blade angle must not be used.
   l. The sole power for the aircraft must come from rubber motor(s).
      i. Each motor used for single-motor aircraft, including any attachments such as O-rings, must mass no more than 2.00 g.
      ii. Each set of motors for multi-motor aircraft must not exceed a combined mass of 2.00 g and must be checked in as a set. If different sets of motors are checked in, individual motors must not be interchanged between sets.
      iii. Motor(s) will be massed separately from aircraft. Motor(s) may be lubricated before and/or after check-in.
      iv. Up to 6 motors, or sets of motors for multi-motor aircraft, may be checked in.
   m. Participants may use any type of winder, but electricity may not be available.
   n. Participants must be able to answer questions regarding the design, construction, and operation of the device per the Building Policy found on www.soinc.org.
   o. Aircraft must be labeled so that the Event Supervisor can easily identify to which team it belongs.
4. **FLIGHT-DESIGN LOGS:**
   a. Teams must present a Flight Log of recorded data. This data must include 6 or more parameters (3 required and at least 3 additional) with units for 10 or more test flights prior to the competition.

i. The required parameters are:
   (1) Motor size before windup
   (2) Number of turns on the motor or torque at launch
   (3) Flight time
ii. The team must choose 3 additional data parameters beyond those required (e.g., turns remaining after landing, estimated/recorded peak flight altitude, the motor torque at landing, propeller pitch, etc.).

b. Teams must also present a Design Log. The log must include the following:
   i. A list of materials used to construct the aircraft
   ii. A labeled diagram or picture that identifies the parts of the aircraft
   iii. If a 3-D printer, laser cutter, CNC machine or similar device was used as a tool to build the team's device, or any component thereof, the following information must also be supplied in the Design Log. Any such parts purchased as an end item or as part of a kit do not require this information.
      (1) Information about the tool hardware, software, materials, and supplies used
      (2) Details of the source of any digital files (e.g., CAD, STL, OBJ) utilized by the tool, including but not limited to when and where the file was obtained, including the web address if downloaded from the internet
      (3) Descriptions of how the team constructed the final device from the tool-created components
c. Each log must have a front cover with the Team Name and the Team Number for the current tournament or be considered incomplete.
d. All numerical values should be labeled with standard units (e.g., SI or English) appropriate to the dimension being measured or be considered incomplete. SI units should be the default standard.
e. All logs will be returned to teams after inspection.

5. **THE COMPETITION:**
   a. The event will be held indoors. Tournament officials will announce the room dimensions (approximate length, width and ceiling height) in advance of the competition. Tournament officials and the Event Supervisor are urged to minimize the effects of environmental factors such as air currents.
   b. Once participants enter the cordoned off competition area to trim, practice, or compete they must not receive outside assistance, materials, or communication. Only participants may handle aircraft until the event ends. Teams violating this rule will be ranked below all other teams. Spectators will be in a separate area.
   c. At the Event Supervisor's discretion:
      i. Multiple official flights may occur simultaneously.
      ii. Test flights may occur throughout the contest but must yield to any official flight.
      iii. No test flights will occur in the final half-hour of the event's last period, except for teams that declare a trim flight during their 10-minute Flight Period.
   d. Check-in:
      i. Prior to check-in with the Event Supervisor, a self-check inspection station may be made available to participants for checking their box(es), aircraft, and motor(s).
      ii. At check-in, participants will present their Flight-Design Log, motor(s), and aircraft in box(es) for inspection immediately prior to their Flight Period.
      iii. The Event Supervisor will verify the external dimensions of the box(es). Only participants are allowed to handle the box(es).
      iv. After verifying the box(es') dimensions, at the direction of the Event Supervisor, only participants will remove the aircraft from the box(es) and mass the aircraft.
      v. All motor(s) will be collected, massed and returned to the team at the start of their 10-minute Flight Period.
   e. Flight Period:
      i. The 10-minute flight period begins when the Event Supervisor returns the motor(s) to the team.
      ii. Any flight beginning within the 10-minute Flight Period will be permitted to fly to completion. Participants may make adjustments/repairs/trim flights during their official 10-minute Flight Period. Before their launches, participants must indicate to the Timers whether a flight is official or a trim flight. A flight is considered official if a team fails to notify the Timer(s) of the flight's status. Teams must not be given extra time to recover or repair their aircraft.
      iii. Teams may make up to a total of 2 official flights using 1 or 2 aircraft.

iv. Time aloft for each flight starts when the aircraft leaves the participant's hand and stops when any part of the aircraft touches the floor, the lifting surfaces no longer support the weight of the aircraft (such as the aircraft landing on a girder or basketball hoop) or the Event Supervisors otherwise determine the flight to be over.
v. Event Supervisors are strongly encouraged to utilize three (3) timers on all flights. The median flight time in seconds to the precision of the device used is the official time aloft.
vi. Participants must not steer the aircraft during flight.
vii. In the unlikely event of a collision with another aircraft, a team may elect a re-flight. The decision to re-fly may be made after the aircraft lands. Timers are allowed to delay a launch to avoid a possible collision. The 10-minute Flight Period does not apply to such a flight.

f. After all flights are completed, the participants must (if requested by the Event Supervisor) demonstrate that each aircraft still meets the dimension requirements by placing the aircraft inside the team's box(es) in the as-flown configuration. Teams may not manipulate the configuration of the aircraft in order to fit into the box except to rotate components (such as propellers/rotors) that were spinning about an axis of rotation on the aircraft during the flight. Motor(s) may be removed from the aircraft or left in place during the demonstration.
g. The Event Supervisor will verify with the team the data being recorded on their scoresheet.
h. Teams filing an appeal must leave their aircraft, box(es), motor(s) and Flight-Design Log in the event area.

6. **SCORING:**

a. Highest Final Score wins. A team's Final Score is the larger of the team's Flight Scores. Flight Score for each official flight = Flight Time + Bonus (6.b.) - Penalties (6.c.-6.d.).
b. A bonus of 10% of the Flight Time will be added to the Flight Score of an aircraft that has the entire surface of the wing between at least 2 ribs or at least one of the wingtip fences or a vertical stabilizer completely marked with black marker or black tissue. If no ribs are present, the whole surface must be black. Aircraft with no wings or vertical stabilizer must have at least one black-colored lifting surface.
c. Teams with incomplete or missing Logs will have the following deduction from their Flight Time from each Flight Score.
   i. An incomplete Flight Log is a 10% deduction while a missing Flight Log is a 20% deduction.
   ii. An incomplete Design Log is a 5% deduction while a missing Design Log is a 10% deduction.
d. Teams that violate rule(s) under "CONSTRUCTION PARAMETERS" or "THE COMPETITION" that do not have a specific penalty will be ranked after all teams that do not violate those rules.
e. Ties will be broken by the longest non-scored official Flight Score.

Recommended Resources: The Science Olympiad Store (store.soinc.org) carries a variety of resources to purchase for this event; other resources are on the Event Pages at soinc.org

This event is sponsored by the National Free Flight Society (NFFS)