

2024 Science Olympiad Flight Events

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NFFS Education Committee

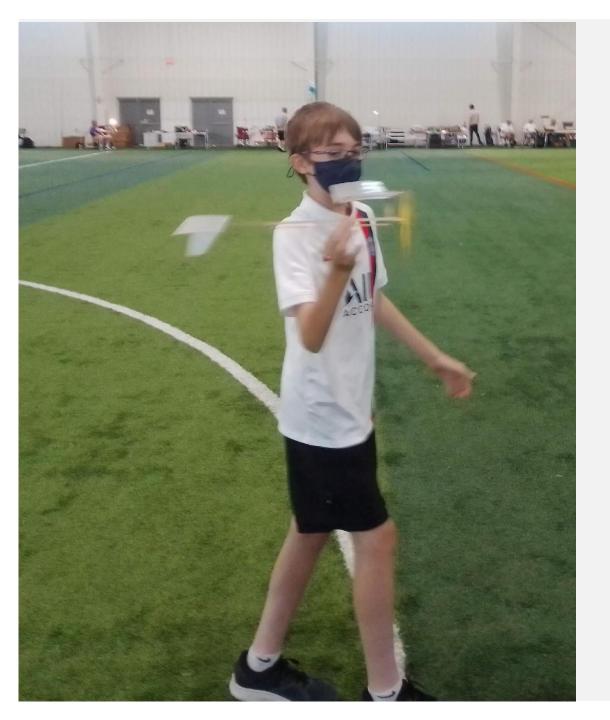


Presentation Order

- Event descriptions and rules
- Sources of materials and aid
- Building techniques
- Flying







Flight (B&C)

Indoor Airplane Duration



Flight Event Description • Prebuild event

- Powered Indoor Aircraft flown for Duration
- Made with any materials except Boron
- Presented in a box with outer dimensions specified
- Best of two flights duration
- Kits are permitted
- Student-Built







Flight Event Changes • Changes to box dimensions

- Only one box must be presented
- 1.5g motors
- No black marking bonus
- No build log
- No log cover sheets
- Flight log now a bonus, not penalty







Flight Event Direction

- NOT a design event, but a flight optimization event
- Data collection and recording is critical to success
- BUILD LIGHT, try to reach the minimum allowed weight
- Build accurately. Crooked, twisted planes do not fly well
- Take LOTS of data == Fly A Lot

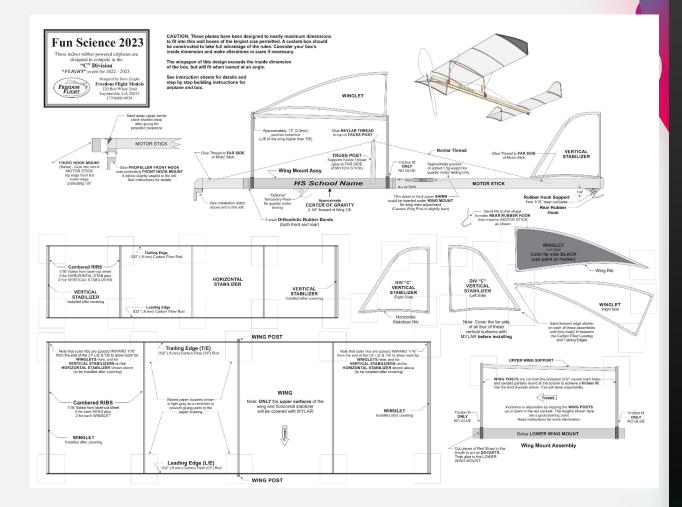






Event Parameters

- Kit, plans, or self-design
 - No pre-glued or pre-covered
- Must fit in specified box ready to fly
 - Team may buy or build a box
 - Only I box required ("measurement box")
 - B: 41 cm x 28.5 cm x 65 cm (long banker's box)
 - C: 32cm x 23cm x 47cm (<u>8-ream</u> paper box)
 - Box cannot change shape of airplane!
 - Team responsible to verify box dimensions
- Do not push the dimensions. Too big and you will be tiered
- Propeller built or purchased
- Labelled for identification
- Up to 2 planes presented for inspection
- 2-Student team
- Non-compliant planes/boxes tiered







Additional Event Parameters

- Propeller diameter not limited, but must be installed and fit in box
- Propeller built or purchased
- 8g minimum without rubber
 - Approx. 9.5g flying weight
- Rubber powered
 - 1.5g maximum rubber mass
 - Includes any o-rings
 - Before or after lube
 - 6 rubber motors, or sets for multiple propeller planes may be processed



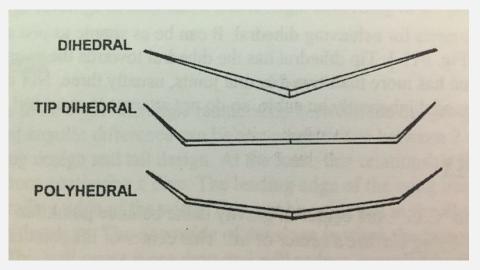


Flexibility of Design

- Plane configuration
 - Any wing configuration
 - Monoplane
 - Tandem
 - Biplane
 - Triplane
 - Helicopter
 - Glider
 - Tractor vs. pusher
- Which dimensions fit what part of box
 - Think diagonal!
- Format of wing (flat with tip plates, dihedral, polyhedral)



Tip plates in lieu of dihedral



Dihedral types





Flight Event Flight Log

- Complete log is 20% bonus
- Incomplete 10% bonus
- 10 flights minimum
- Required entries
 - Motor size (length, width, mass)
 - Number turns or torque AT LAUNCH
 - Flight Time
- Three additional minimum columns
 - Altitude
 - Torque
 - Remaining turns or torque
 - Unwinds
 - Propeller details
 - Any other

YOUTH DEVELOPMENT PROGRAM

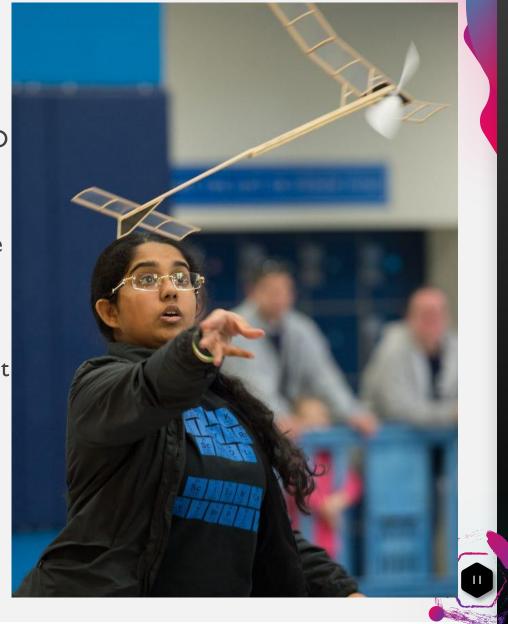
Log is critical to improving





Event Flying Process

- Indoors, with room dimensions published in advance
- No coaching or communication once in competition area
- ONLY PARTICIPANTS may touch plane and box. This means DO NOT let officials attempt to measure/weigh
- Flight log: 20% bonus if complete, 10% if incomplete
- Clock: A 10-minute flight clock when motor is given back to the team
 - No time-out for retrieval or repairs
 - A flight starting in 10-minute window may go to completion
- Trim flights permitted during 10-minute competition window, but <u>must</u> be announced as trim
- Score best duration of 2 official flights, plus bonuses
- Construction violations are tiered





ES Experience Issues and Observations

- Insufficient Logs
 - Only 10 entries (or less)
 - Too few columns
 - Meaningless columns (eg: date)
 - Logs are a critical element of improvement
- Crooked construction
 - Accurate construction is critical
- Untrimmed models
- Heavy models: Too much glue!

- Most planes reasonably built, but not reasonably trimmed
 - Need to do a circle for any reasonable duration
 - Trim plane for low power, then work on higher power adjustments
- Not flying the same in practice and competition
 - Do not let observations of others change your approach!



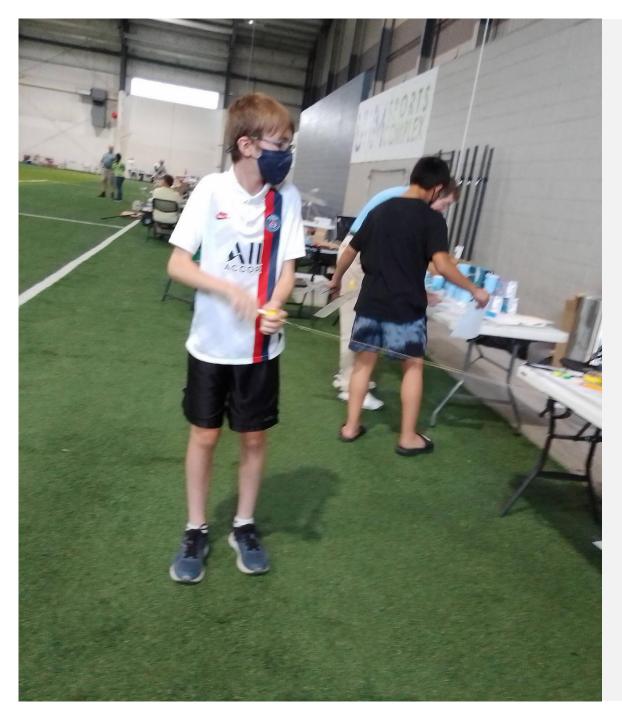
Thoughts for improvement

- Box dimensions (C Div) make short tail moment, challenging to trim
- Spend more time in gym than in build
- Keep detailed logs
- Read and follow rules carefully
- Use resources, especially the online forum at Scioly
- NFFS continues to develop resources and videos









Sources

Kits

Supplies

Help



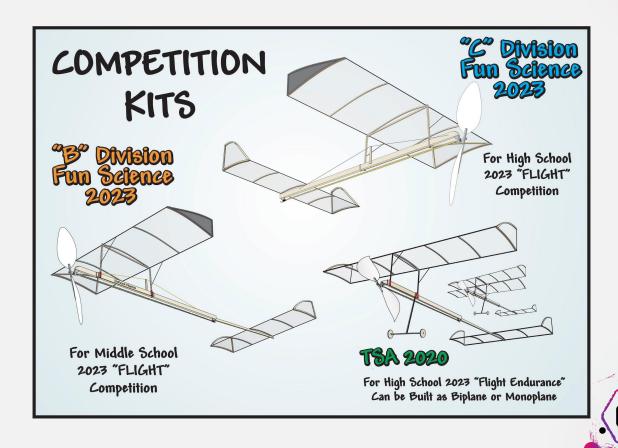
- Ward's Science
 - Official Science Olympiad Supplier
 - "Kit" includes tools, glues, etc. to get you started
 - Generally more "Open Ended" than other kits
 - Less direct design and guidance
 - Not as refined







- Freedom Flight Models
 - Complex but competitive, consistently in top 10 at Nationals
 - Consistent quality
 - EXTENSIVE instructions
 - https://www.freedomflightmodels.com
- Also a full stock of accessories
 - Torque meter
 - Winder
 - Counter
 - Rubber
 - Propellers





- J&H Aerospace
 - Competitive indoor flyer designs
 - Generally Josh kits two planes, entry level and advanced
 - Senior Flyer is simpler, easier to trim
 - Stinger has carbon, more wing, advanced trimming
 - Many good YouTube videos
 - https://jhaerospace.com/









- Laser Cut Planes
 - Simple building
 - Good flying design
 - Low cost
 - Photo-instructions, no plans
 - https://lasercutplanes.com/
 - Known for simple assembly
 - Two Designs for B and C

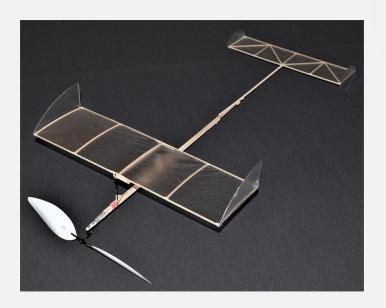








- Retro R/C
 - Complete line of kits and parts
 - Low prices, around \$50 for two kit package
 - Prop kits available
 - Unique biplane option
 - http://retrorc.us.com/scholastickitsandaccessories.aspx



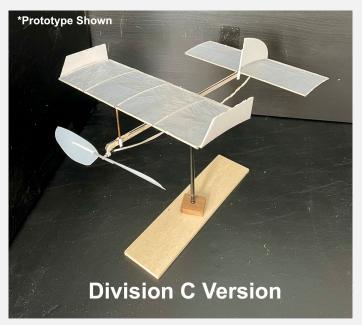






- Guru Engineering
 - Based out of WV, supported WS win at Nationals 6 years ago
 - Non-profit
 - Low cost options
 - http://main.guruengineeringtech.com/





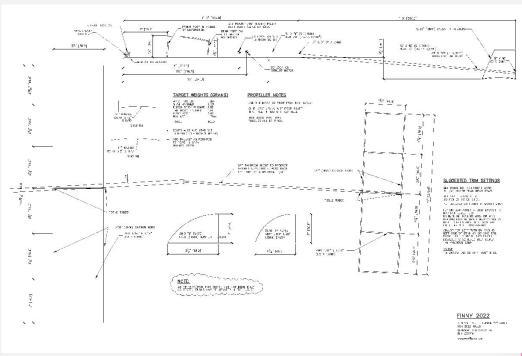




Plans

- NFFS Super Simple plane
 - https://www.youtube.com/watch?v=Mbxba3gIhMU
 - Craft store supplies
 - Stock prop
 - 2-minute flights
 - Builds in less than I hour
- Bill Gowen Finny
 - https://www.hippocketaeronautics.com/hpa_plans/index.php
 - Search for Finny
 - Annual design, may need to update yourself
 - Carbon spar construction







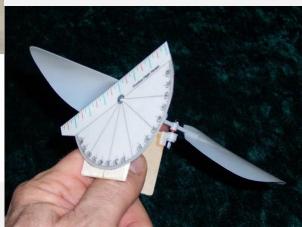
Accessories

- Rubber, Props, Winders, Torque meters, covering
 - Indoor Free Flight Supply
 - https://www.indoorffsupply.com/
 - Freedom Flight Models
 - https://www.freedomflightmodels.com
 - FAI Model Supply
 - https://www.faimodelsupply.com/
 - J&H Aerospace
 - https://jhaerospace.com/
 - Retro R/C
 - http://retrorc.us.com/scholastickitsandaccessories.aspx
 - Volare Products
 - https://volareproducts.com/wordpress/
- Covering, prop hangers, rubber stripper
 - Indoor Model Specialties
 - http://www.indoorspecialties.com/







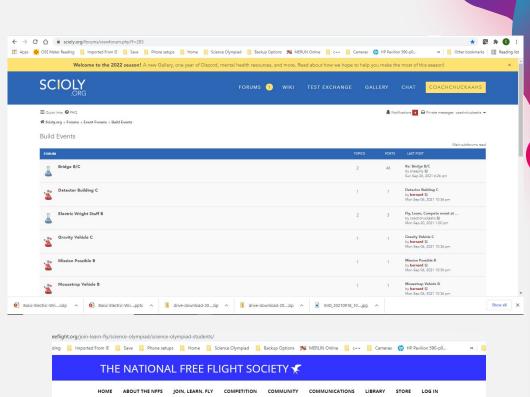




Resources and help

- Plans
 - Hip Pocket Aeronautics at http://www.hippocketaeronautics.com
 - National Free Flight Society at <u>https://freeflight.org/join-learn-fly/science-olympiad/</u>
- Online Resources
 - National Free Flight Society at <u>https://freeflight.org/join-learn-fly/science-olympiad/</u> includes videos, plans, how-to guides, etc.
 - SCIOLY online forums at https://scioly.org/forums/viewforum.php?f=283
 - Hip Pocket Aeronautics forums
 https://www.hippocketaeronautics.com/hpa_forum/index.php?board=33.0
 - Minimizing weight gain: <u>https://www.soinc.org/sites/default/files/uploaded_files/glueweight.pdf</u>
 - Basic Building: https://www.soinc.org/sites/default/files/uploaded_files/ScienceOlympiad5.0.pdf









Building Techniques

Part 2 of Coach's Clinic



Building

- Weight is EVERYTHING
 - Glue control
 - Thin CyA
 - Capillary applicator
 - Balsa Density
 - Weigh and grade balsa
 - Bring scale to store
 - 5-8 lb/cu ft is "contest grade"
 - Heavier wood may be used, generous weight budget
 - Kits have excellent wood
- Straight
 - Use fixtures
 - Foam board allows pins
 - Glass or shelving surface
- Strength
 - Wrap key joints with thread, dot of CA
 - Carbon is light, stiff









Covering

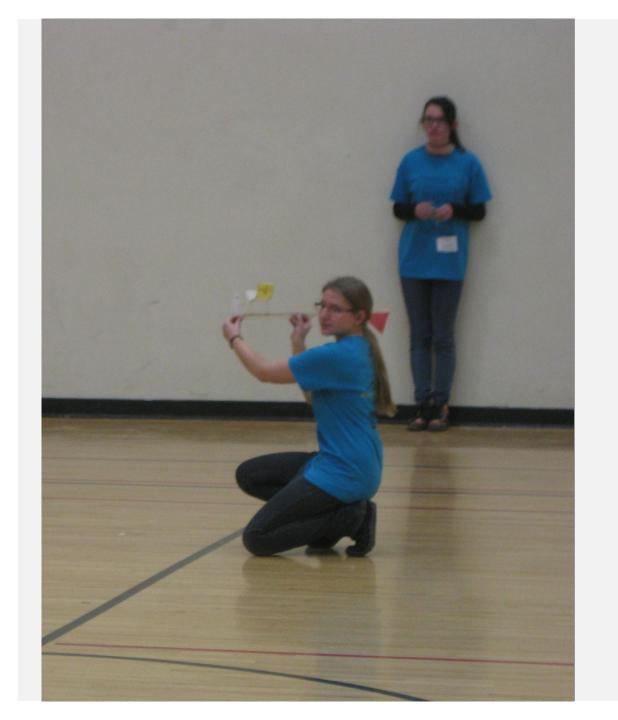
- Ultrafilm is used in most kits
 - Grocery veggie bags an excellent alternative
- Prepare
 - Build structure
 - Build a frame scrap balsa
- Film
 - Cut with solder iron if available, tears easily
 - Ball up as small as possible, twice
 - Unfurl with outward stretching motion
 - Attach to frame with lip balm or Vaseline
 - Carefully stretch to edges, not tight
- Adhesive

YOUTH DEVELOPMENT PROGRAM

- 3M 77 is best (easy, light enough)
 - Glue stick an alternative
- Light coating on top of structure separate from covering
- Press into framed film inverted
- Allow to cure
- Cut with soldering iron
 - Careful not to dwell on carbon







Flying Techniques

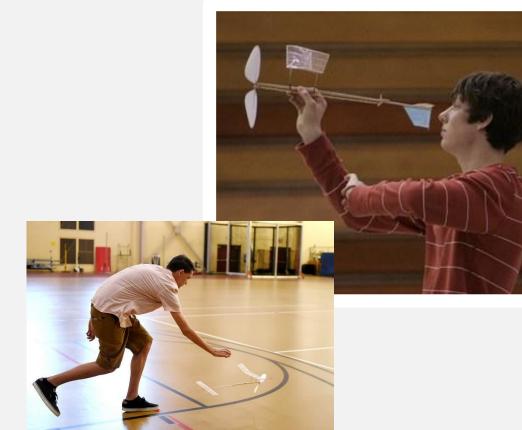


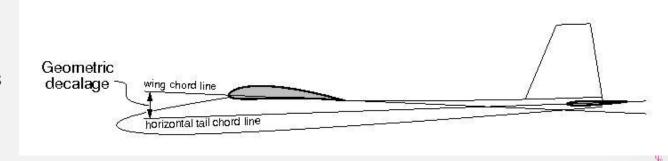
Trimming

- Verify mass
 - Check often, remove ballast as glue is added
 - Use modeling clay
- Verify CG (balance point) often (log it)
- Decalage to about 3-8mm
- Wind lightly, 400-600 turns on rubber
- Launch straight ahead with light toss
- Watch for stall

YOUTH DEVELOPMENT PROGRAM

- Increase decalage until stall observed
- Decrease until stall just goes away
- Watch for recovery from touches (ceiling)
 - If dives, move CG forward and re-trim
 - If quick recovery, may try more aft CG
- Trimming may take one or more flying sessions

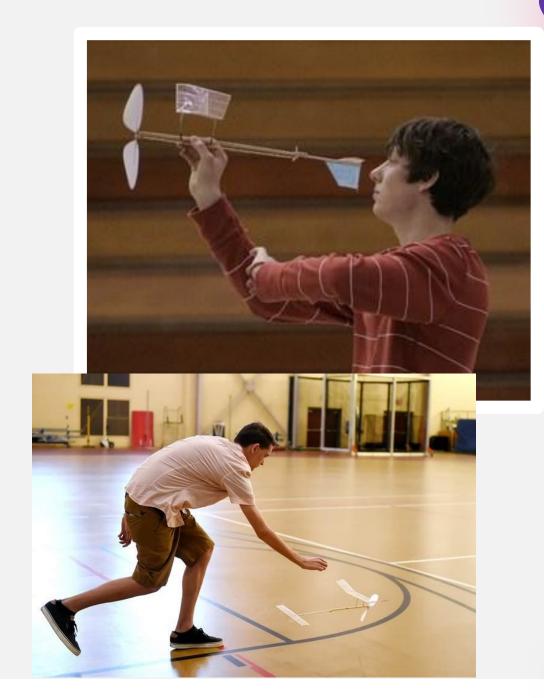






Trimming (cont.)

- Higher power launches
- Adjust launch torque to room height
- If roll in, add inboard wing wash-in (raise leading edge of left, or inner wing)
 - Common solution last year
- Adjust for circle to fit in 50-60% of gym size
 - Rudder has greater effect on high speed
 - Tail tilt has greater effect on low speed







Flying

- Record ALL parameters in log
 - Change ONETHING at a time
- Rubber/prop optimization is key
 - Change props
 - Adjust prop (pitch, flex)
 - Rubber width, length
 - Stopwatch tells the tale
 - If it won't climb, try thicker rubber, less pitch, or less diameter
- Half rubber flights
 - ½ altitude, ½ time
 - 1/2 rubber length, same thickness
 - Predictable higher ceiling performance
 - Lower risk
 - Replace ½ rubber with weighted stick
- GET IN THE GYM

Winning takes many flights

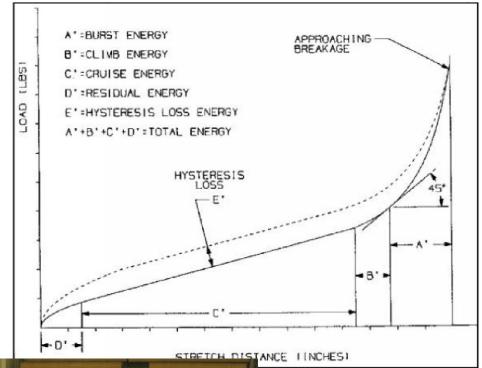


Flying

- Rubber winding
 - Hysteresis
 - · Wind off airplane!
 - Torque meter
 - Wind counting
 - <u>Lubricate</u>
 - Silicon oil
 - Armor-all
 - Wind to almost breaking (break some to know)
 - Usually based on torque
 - Back off to launch torque
 - Ceiling height
- Stretch winding
 - Stretch to 5-8X length
 - Wind ½ at full stretch, then walk in
- Rubber evaluation

YOUTH DEVELOPMENT PROGRAM

- Initial climb: Launch torque
- Cruise: rubber/prop balance
- Letdown: Prop flex
- Look at turns remaining
 - Ideally about ½ row of knots







Flight Adjustments

- If initial flights are decent, make SMALL changes and record differences
- Dives:

YOUTH DEVELOPMENT PROGRAM

- Increase decalage: Raise front of wing or back of tail stabilizer
- Move CG rearward
- Stalls (nose climbs then dips repeatedly)
 - Decrease decalage
 - Move CG forward
- Stalls only at high power
 - Add down thrust (angle propellor shaft downward)
 - Add incidence to BOTH surfaces (raise leading edge of wing AND stab)
- Flight is ok but climb limited
 - Decrease prop pitch
 - Add left wing wash-in (raise left wing leading edge slightly)
 - Increase decalage until stall, then back off slightly
 - Decalage usually should be set for low-power flight





Follow-up

Preferred followup is the Scioly Forum at https://scioly.org/forums

Official rules clarifications are thorough the SO FAQ process ONLY

