The New England's Section's Major STEM Event on March 10, 2018

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The event was organized by Charles Wilson, AIAA Senior Member, and summarized for other sections that want to sponsor a similar event.

1. Draft of June 2018 Aerospace America Article

 

The New England Section hosted an estimated 950 K-12 kids, parents and teachers at the *Rockets and Flight* event in the MIT Museum's Science on Saturday series on March 10, 2018 at MIT's Kresge auditorium. The intensity of the student response was magical. Several of the 65 volunteers put on a one-hour presentation in the auditorium. The students explored our 24 display tables in the lobby for the second hour. This event was the focus of the Section's 2017-2018 activities.

The presentations started with Lt. Col. Tucker Hamilton, the AIAA's STEM lead who traveled from Edwards AFB for a Distinguished Lecture and this event. Tucker gave the keynote presentation, impressing the audience with his entrance dressed in his flight suit. Other presenters were student branch members from MIT who demonstrated a wind tunnel built just for the event, students from Northeastern University, UMass Lowell and the MIT Graduate Women in Aerospace Engineering (GWAE). One volunteer helped kids operate a NASA Mars Lander app.

The volunteers at the 24 display tables distributed 150 AIAA balsa wood model airplanes, 100 protractors and many paper helicopters and airplanes. The tables were designed to interest kids from kindergarten through high school with themes covering: AIAA model airplanes, Apollo space suits, biomedical payloads, composite structures, cubesats, Design/Build/Fly aircraft, electric propulsion, exoplanets, jet engines, lunar crater mining, orbits and gravity, paper airplanes, paper helicopters, parachutes, Phoenix mars lander, radars, robotic space spheres, rockets, quadcopters, spacecraft dynamics, space helmets, space suits, straw rockets, trigonometry, and the wind tunnel.

Four volunteers made significant contributions: Yari Golden-Castano, Paula do Vale Pereira, Martina Stadler, and Joe Vornehm. They were honored at the Section's Honors and Awards Banquet on April 24. Contact the New England Section using AIAA Engage for more information.

2. Link to many photos

Here is the link to download lots of photos from the March 10 Science on Saturday posted by Todd Rider, the Coordinator for the MIT Museum’s Science on Saturday series:

http://www.everydayartistryphotography.com/client-gallery/science-saturday-march-2018/

His comments: The password is “beaver". . You can see from the kids' faces that it was a very big hit!

RETIRED?

Become active in AIAA to enjoy watching advances in our technology with your colleagues.

Contact your Section

3. Event Details and Safety Plan

3a - Best practices for volunteers & ground rules for participants (YGC)

3b -**Presentations**

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- Gliders of different types
- Wind tunnel demo
- String rockets
- Wrap-up
- Xbox Mars Rover Landing and Hidden Figures video until 11:30

3c -**Displays**

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3a. Best practices for volunteers & ground rules for participants (YGC)

Best practices for volunteers working with kids

- Know the event area, safety guidelines, and evacuation plan.
- Ensure kids do not group on the floor in front of the stage
- Pick up everything when leaving
- Let kids do as much as they can on their own, don't take things out of their hands unless asked.
- Don't touch kids, even in seemingly harmless ways (hugs and pats on the head can lead to trouble).
- Let kids know you want them to ask questions and make up a way to let them know when to be quiet.
- Never leave anything unsafe unattended, kids will touch it. They want to eat anything and will touch/take/stick fingers in anything they can.
- Expect and be able to handle strange and unexpected questions or statements ("I have a hamster named Blinky" when you asked about the inventor of the lightbulb).
- Above all, roll with the punches - kids can be an odd bunch.
- Be patient and willing to repeat yourself.

Ground Rules

- No running and no pushing.
- Let a volunteer know whenever you step away.
- Be mindful of electronics and demonstration supplies.
- Do not throw or purposefully break electronics or equipment.
- Listen actively and respect others when they are speaking.
- Ask questions and speak freely.
- Do not be afraid to respectfully challenge one another by asking questions, but refrain from personal attacks.
- Participate to the fullest of your ability – growth depends on the inclusion of every individual voice.

3b. Presentations

Introduction and Keynote

10:00: Dr Joseph Vornehm – Introduction
Col Andres Knoedler – Introduce Lt Col Tucker Hamilton
Lt Col Tucker Hamilton with videos

Safety Concerns and Mitigation:

Safety Concerns	Mitigation
None	N/A

Materials: None

Procedures: Presentations with videos

Other Practical Considerations: None

Gliders of different types

10:20 Northeastern University AIAA Student Branch – Harry Brodsky and team with audience participation

Safety Concerns and Mitigation:

Safety Concerns	Mitigation
None	N/A

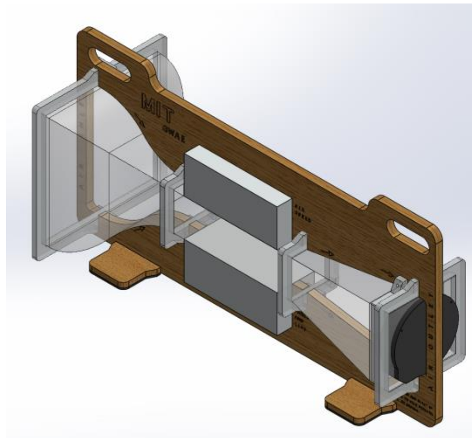
Materials: Balsa wood glider models, three lengths of string stretching across the stage and straws.

Procedures: Three models will be tested to illustrate the effects of aerodynamic drag and weight of performance. Each model will be attached to straws through which one end of a string is strung. An audience member will hold one end of the string next to the floor, another will hold it up high. The third on each glide-model team will hold the glider next to the high end. At a command, the gliders will be released simultaneously. The characteristics of the fastest will be discussed.

Other Practical Considerations: None

Wind tunnel demo

10:30: Paula do Vale Pereira and Cadence Payne- with audience participation



Requires 120V.
Dimensions are ~1m length, ~0.3m width and ~0.6m height.

Safety Concerns and Mitigation:

Safety Concerns	Mitigation
None	N/A

Materials: Acrylic, wood, electric fan, load cells, pressure sensor, Arduino, laptop

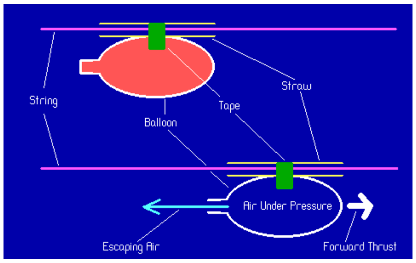
Procedures:

- Display the wind tunnel and explain how it works
- Display airfoils and explain how they generate lift
- Place different shapes and compare the lift between them

Other Practical Considerations: None

String rockets

10:35: Juan Salazar & MIT Rockets Team



Safety Concerns and Mitigation:

Safety Concerns	Mitigation
None	N/A

Materials: Balloons, straws, string

Procedures: Audience members will be invited up to inflate and launch balloons attached to string held at each end of the stage by other kids. This will illustrate how pressurized air can develop thrust.

Other Practical Considerations: None

Wrap-up

10:45: Joe – Describe tables in lobby, introduce Mars lander app and Hidden Figures, dismiss

Safety Concerns and Mitigation:

Safety Concerns	Mitigation
None	N/A

Materials: None

Procedures: Talk

Other Practical Considerations: None

Xbox Mars Rover Landing and Hidden Figures movie until 11:30

11:00 R. Daniel Golden-Castano

Safety Concerns and Mitigation:

Safety Concerns	Mitigation
None	N/A

Materials: Xbox with NASA Kinect Mars Rover Landing app running and Hidden Figures movie which have no safety implications.

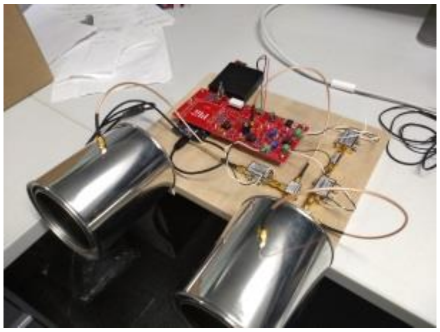
Procedures: Audience members will be invited up guide the cartoon lander with hand and body gestures.

Other Practical Considerations: None

3c. Displays

Table 1 MIT Radar Demonstration

POC: Sandeep Badrinath



This table-top radar was made during an IAP course at MIT, organized by MIT Lincoln Laboratory. It is a safe device to use, and works in the authorized power and frequency limits for amateur built devices. The link for the course is : https://llx-bwsix.mit.edu/courses/course-v1:MITLL+LLX01+Summer_2017/about

The radar can be used to estimate speed and distance to targets. We can show a demo of these two modes, along with a quick introduction to how radars work, and an outline of the components used.

Safety Concerns and Mitigation:

Safety Concerns	Mitigation
Emitted radiation	Operation approved by MIT Environmental Health and Safety office

Materials: Radar model, laptop to process the raw data obtained from the radar.

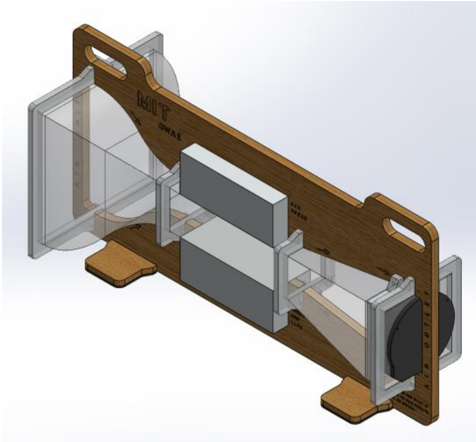
Procedures:

- Briefly describe the components used.
- Show how a radar works using a demo.
- Talk about real world applications of radar.

Other Practical Considerations: None

Table 2 Wind Tunnel Inside if Poor Weather

POC: Paula do Vale Pereira



Requires 120V.
Dimensions are ~1m length, ~0.3m width and ~0.6m height.

Safety Concerns and Mitigation:

Safety Concerns	Mitigation
None	N/A

Materials: Acrylic, wood, electric fan, load cells, pressure sensor, Arduino, laptop

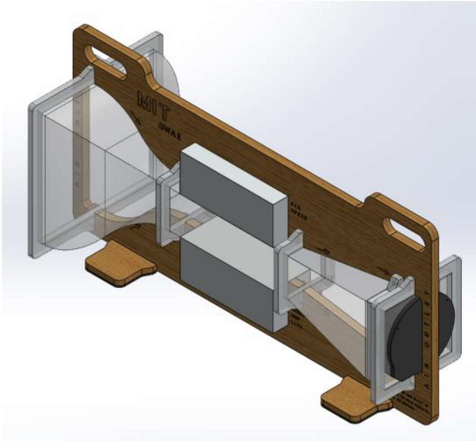
Procedures:

- Display the wind tunnel and explain how it works
- Display airfoils and explain how they generate lift
- Place different shapes and compare the lift between them

Other Practical Considerations: None

Table 2 Wind Tunnel Outside if Good Enough Weather

POC: Paula do Vale Pereira



Requires 120V.
Dimensions are ~1m length, ~0.3m width and ~0.6m height.

Safety Concerns and Mitigation:

Safety Concerns	Mitigation
Handling dry ice	Keep dry ice stored safely away from kids and handle with gloves when inserting into wind tunnel

Materials: Acrylic, wood, electric fan, load cells, pressure sensor, Arduino, laptop, 2 pounds of dry ice to exhibit flow

Procedures:

- Display the wind tunnel and explain how it works
- Display airfoils and explain how they generate lift
- Place different shapes and compare the lift between them

Other Practical Considerations: Requires table be moved outside with 120V electrical power from inside

Table 3 Jet Engine

POC: Hiroaki Endo

Safety Concerns and Mitigation:

Safety Concerns	Mitigation
Preventing injuries from rotating parts	1 - Place inlet cover which will not allow any object to enter the rotating parts of the turbine. 2 - Cover the turbine section with a nozzle for the same reason.
Preventing accidental ignition/fire	1 - Remove fuel, disconnect all supply plumbing and dry it out overnight to vent vapors, 2-Remove ignition plug

Materials: Jetcat P80, Battery, DC power source, link to Jetcat P80 http://www.tamjets.com/OSCnew/product_info.php?products_id=173

Procedures: Display jet engine parts & explain how they work. Spin Jetcat P80 by using electric motor (low speed).

Other Practical Considerations: Disable & disconnect fuel and ignition systems to eliminate any chance of ignition.

Table 4 UML DBF, CubeSat, Rocketry

POC: Samuel Johnson

UMass Lowell Display Table at Collings Foundation July 2017 with DBF

Safety Concerns and Mitigation:

Safety Concerns	Mitigation
None	N/A

Materials: Various

Procedures: The display table will show a Design/Build/Fly, DBF, model airplane, as was displayed at the Collings Foundation last July. The table will also have model rockets and simulated cubesats. There are no hazards.

Other Practical Considerations: None

Table 5 Paper Airplanes

POC: Yari Golden-Castano

Safety Concerns and Mitigation:

Safety Concerns	Mitigation
None	N/A

Materials:

-colorful construction paper

-markers

Procedures:

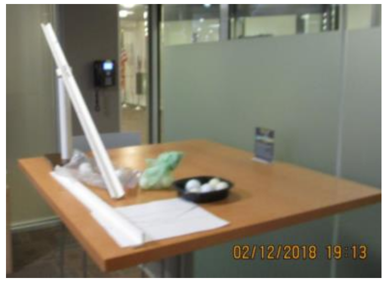
Write name and decorate, fold into shape. Fly outside

Other Practical Considerations:

Keeping kids from running.

Table 6 Moon Crater Water Mining Dynamics (Save the Ice House)

POC: John Wilkes



Safety Concerns and Mitigation:

Safety Concerns	Mitigation
None	N/A

Materials: Plastic V-shaped ramps simulating the sides and floor of a lunar crater, four 1" diameter steel ball bearings, 4 golf balls and four ping pong balls

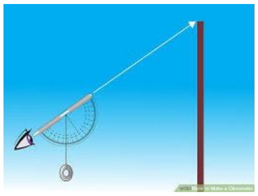
Procedures: Concept **–** understand the possible impact of a sphere of ice dislodged and rolling down onto a lunar ice-mining house on the floor of a crater. Understand the relative effect of lunar vs terrestrial gravity. Step 1 – roll a sphere from various heights into three others and see momentum transfer on last sphere (Newton's Balls without strings). See effect of height. Step 2 - Replace steel balls with ping pong balls representing effect of lunar gravity. Step 3 – compare results.

Details – the plastic ramps simulate 30 degree slope of Shackleton crater side to a depth of 1.4 kilometers below the lunar surface. Another ramp at the bottom will simulate the 3 kilometer flat run from the end of the slope to the center of the crater floor, which is where the ice house is. The activity uses either heavy golf balls or steel ball bearings and lighter ping pong balls. The lighter ones will be ~1/6th the mass of the larger ones, mimicking lunar gravity. The challenge is to damper the force imparted at impact by an "ice ball" that breaks loose and is descending the ramp by rearranging the 3 balls of the same size and weight placed on the flat V- ramp to protect the ice house. When the heavy balls are used by themselves, the descending ball does not save the ice house since the impact kinetic energy is imparted to the final blocking ball which is propelled toward the ice house. The ice house is mimicked by a black plastic container that is light enough to be dramatically knocked around by a golf ball or a ball bearing, but not a ping pong ball.

Other Practical Considerations: Keeping balls on the table.

Table 7 Trigonometric Measurement

POC: Yari Golden-Castano



Safety Concerns and Mitigation:

Safety Concerns	Mitigation
None	N/A

Materials:

- No. 2 wooden pencil with erasers
- String (Qty. ~50 ft.)
- Protractor

Procedures: Trigonometry Intro

Teach students how to use trigonometry to measure the angles of a right triangle if two side lengths are known. There may be no need for them to know EXACTLY how the tangent function works. They just need to know it exists and how to use it. Build a clinometer with the protractor, pencil and string.

Other Practical Considerations: none

Table 8 MIT Rocket Team - Parachutes

POC: Martina Stadler

Safety Concerns and Mitigation:

Safety Concerns	Mitigation
None	N/A

Materials:

4x MIT Rocket Team handmade parachutes, sample parachute fabric, Laptop running parachute sizing script

Procedures: MIT Rocket Team Members will explain why parachutes are used and how the team makes their own.

Other Practical Considerations: None

Table 9 Exoplanets:

POC: Yari Golden-Castano

Safety Concerns and Mitigation:

Safety Concerns	Mitigation
None	N/A

Materials: Small LED Flashlights, marbles, cups, pencils and paper

Procedures: kids work together in teams of 2-4 so one could roll the marble, one could observe the shadow and report it, one could time, etc. and then they could talk about what different sizes/speeds/planetary orbit properties would mean.

Other Practical Considerations: none

Table 10 MIT Space Systems Lab - CubeSats

POC: Martina Stadler

Safety Concerns and Mitigation:

Safety Concerns	Mitigation
None	N/A

Materials: SSL CubeSat Test Article

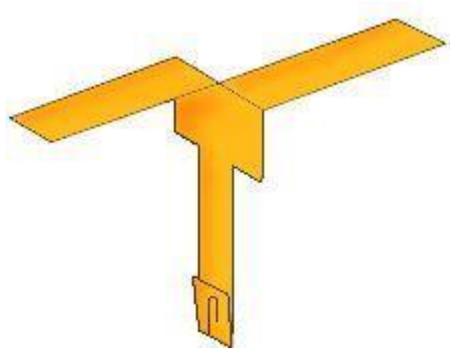
Procedures:

MIT Space Systems Laboratory (SSL) members will explain what CubeSats are, talk about why they are useful, and show students hardware to give them a physical intuition of a CubeSat's size.

Other Practical Considerations: None

Table 11 Paper Helicopters

POC: Lauren Trollinger (American Helicopter Society)



Safety Concerns and Mitigation:

Safety Concerns	Mitigation
Small kids using scissors can be dangerous. Papercuts.	Use 4” kid-friendly blunt-tip safety scissors! Help (or ask parents to help) kids make the cut. Have a medical first aid kit available for use at the event.
Overcrowding/Running	Make sure there are enough volunteers on hand to steer kids to proper place and maintain safety.

Materials:

-large paperclips
-colorful construction paper
-markers
-safety scissors

Procedures:

Cut out shape, write name and decorate, fold into shape, and add paper clips at base of shape. The helicopters are then tossed into the air and modified as desired.

Other Practical Considerations: Keeping kids from running.

Table 12 Apollo space suit mockup

POC: Paula do Vale Pereira

Safety Concerns and Mitigation:

Safety Concerns	Mitigation
None	N/A

Materials:

- A long sleeve synthetic overall with some space-related patches and
- A simple plastic helmet.

Procedures: Let the kids try them on and take some pictures.

Other Practical Considerations: None

Table 13 Spacecraft Dynamics

POC: Yari Golden-Castano

Safety Concerns and Mitigation:

Safety Concerns	Mitigation
Spinning wheel and rolling chair	Volunteers will monitor the demo at all time, no students will be left alone with the chair and wheel

Materials:

- Bicycle wheel with handles
- Spinning chair
- Model gyroscope

Procedures: In this activity, a spinning bicycle wheel resists efforts to tilt it and point the axle in a new direction. Students use the bicycle wheel like a giant gyroscope to explore angular momentum and torque. Students will sit on the chair and hold on to the bicycle wheel. There will be two volunteers assisting the student and explaining the concept. https://www.howtosmile.org/resource/smile-000-000-002-848

Other Practical Considerations: none

Table 14 Orbits Demo

POC: Yari Golden-Castano

Safety Concerns and Mitigation:

Safety Concerns	Mitigation
None	N/A

Materials:

- Fabric table
- Weights
- Marbles, ping-pong balls and ball bearings.

Procedures: In this demo, we will teach about orbits, including orbits of planets, LEO/MEO/GEO, and the galaxy. This demo includes showing how we orbit a black hole. We use a fabric sheet to demonstrate, with different weighted balls in the center we throw a ping pong ball around it, balls "orbit" a different number of times and in a different shape depending on the mass that is bending "spacetime (the grid)." To expand, we can talk about GPS, gravity, and gravitational lensing.

Other Practical Considerations: none

Table 15 Balloon Powered Phoenix Mars Lander

POC: Yari Golden-Castano

Safety Concerns and Mitigation:

Safety Concerns	Mitigation
None	N/A

Materials:

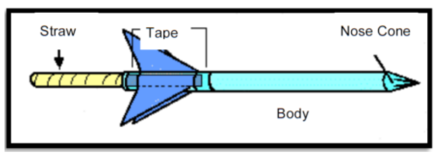
- Printout of lander to take home and a balloon to take home

Procedures: Volunteers will display landers and will provide the materials to take home and build at home.

Other Practical Considerations: none

Table 16 Straw Rockets

POC: Yari Golden-Castano



Safety Concerns and Mitigation:

Safety Concerns	Mitigation
Students blowing small paper rockets	Volunteers will remind students not to blow their rockets at people, to use caution and shoot at a target. Volunteers will supervise that students shoot their rockets at specific targets in the auditorium Students are blowing little paper rockets with a straw.
	Remember launch safety! Never point your rocket at a person. Your goal is to get to your target destination! Record the distance it travels on your Data Log.

Materials:

- Straws, pencils, construction paper, tape, safety scissors

Procedures: Students will build their small paper rockets using the pencil as a mold for size. Once the rocket is done students will exchange their pencil for a straw in the auditorium and shoot at a target to record their accuracy and distance traveled.

Other Practical Considerations: none

Table 17 Space Helmet Station

POC: Yari Golden-Castano

Photo from another event

Safety Concerns and Mitigation:

Safety Concerns	Mitigation
Scissors	All scissors will have the blunt point and will be attached to the table with string to keep them from wondering off.

Materials:

- Markers
- Poster board
- Arts and crafts
- Velcro

Procedures: Students will decorate their own pre-cut poster, which wraps around their head and attaches with Velcro. The poster fits loose around their head and has a wide opening for the face.

Other Practical Considerations: none

Table 18 MIT Space Systems Lab - Spheres

POC: Martina Stadler

Safety Concerns and Mitigation:

Safety Concerns	Mitigation
None	N/A

Materials:

- MIT Space Systems Laboratory (SSL) Spheres Test Article

Procedures:

Members of the SSL will discuss the Spheres project, talk about why it is useful, and show students a Spheres test article.

Other Practical Considerations: None

Table 19 MIT Rocket Team - Composite Structures

POC: Martina Stadler

Safety Concerns and Mitigation:

Safety Concerns	Mitigation
None	N/A

Materials:

- MIT Rocket Team custom-built fiberglass tube
- MIT Rocket Team custom-built carbon fiber fins

Procedures:

MIT Rocket Team members will talk about composite structures, why they are useful and how they are used, and show participants examples of composites.

Other Practical Considerations:

None

Table 20 MIT Rocket Team - Biomedical Payload

POC: Martina Stadler

Safety Concerns and Mitigation:

Safety Concerns	Mitigation
None	N/A

Materials:

- MIT Rocket Team 3D-printed model spine
- MIT Rocket Team force sensitive fabric

Procedures:

Students from MIT Rocket Team will talk about their payload for this year's Spaceport America Cup competition. The payload, a spine simulator, will allow the team to collect spine loading data to inform biological models of astronauts during launch. Students will talk about the importance of simulation in informing complex models.

Other Practical Considerations: **N**one

Table 21 MIT Robust Robotics Group - Quadcopter

POC: Martina Stadler

Safety Concerns and Mitigation:

Safety Concerns	Mitigation
None	N/A

Materials:

-MIT Robust Robotics Group Quadrotor

Procedures:

Students from the Robust Robotics Group will talk about quadrotor dynamics. Note: the quadrotor will be turned off for the duration of the event.

Other Practical Considerations:

None

Table 22 MIT Space Propulsion Lab - Electric Propulsion

POC: Martina Stadler

Safety Concerns and Mitigation:

Safety Concerns	Mitigation
None	N/A

Materials:

- MIT Space Propulsion Lab (SPL) Electrospray Thruster

Procedures:

Students from the SPL will talk about alternative thruster designs for space applications, and show their electrospray thruster design.

Other Practical Considerations:

None

Table 23 MIT Man Vehicle Lab

POC: Martina Stadler

Safety Concerns and Mitigation:

Safety Concerns	Mitigation
None	N/A

Materials:

- MIT Man Vehicle Lab Biosuit
-

Procedures:

Students from the Man Vehicle Lab will talk about the challenges of living in working in space, and will talk about new technology being developed to support human life in space, like the biosuit and in-situ resource utilization (ISRU).

Other Practical Considerations:
None

Table 24 MIT AIAA Airplane Handout

POC: Martina Stadler

Safety Concerns and Mitigation:

Safety Concerns	Mitigation
None	N/A

Materials:

- 150 AIAA Balsa Wood Gliders

Procedures:
Members of MIT AIAA will hand out balsa wood gliders for participants to take home.

Other Practical Considerations: None