Gateway To Space

ASEN 1400 / ASTR 2500

Class #4

Colorado Space Grant Consortium
Today:

- Announcements
- Next Time
- One Minute Report Questions
- BalloonSat Overview & RFPs
- Team Videos (if time)
Announcements:

- Pictures – More today
- Thank you letter – please sign
- HW #2 DUE, HW#3 Q?s 1 – 3 Assigned
- Shop Training & Other ITLL Training

Introductory Workshops

General

INTRODUCTION TO LABVIEW SOFTWARE
This workshop covers the basics of LabVIEW programming, including user interface, block diagram, data types and sub VIs. Also introduces the basics of data acquisition with LabVIEW, such as taking, displaying and saving data.
WHERE: Meet in the Brodia Lab Plaza (ITLL 2B10)
MAX ENROLLMENT = 15
CONTACT: Dan Goddard, 303-492-4056

Two-night Workshop
Monday, September 29th and Tuesday September 30th 5-8p
Register Now

INTRODUCTION TO ARDUINO MICROCONTROLLERS
Learn the basics of the Arduino UNO microcontroller board and development environment. Learn to interface your microcontroller board to various sensors and actuators, such as temperature sensors, light sensors, motors, and servos.
WHERE: Meet in the Brodia Lab Plaza (ITLL 2B10)
MAX ENROLLMENT = 15
CONTACT: Dan Goddard, 303-492-4056

Monday, September 15th 5-7p
Register Now

Monday, October 6th 5-7p
Register Now

SOLIDWORKS
Learn the basics of SolidWorks and model something that could be 3-D printed. Get creative and explore how you could solve an engineering problems through innovative design. This workshop is FREE!
WHERE: Meet in Brodia Lab Plaza (2B10)
CONTACT: Jacob.K.Schultz@colorado.edu

Tuesday, September 16th 5:30-8pm
Announcements:

- Best reason I can give as to why this class is rushed...
  - Because people say this class can’t be done in one semester
  - Because people say students can’t do it
Next Time...

Team Forming and Team Activity

HW #3 Questions 3 – 10 & Proposal Assigned

Please arrive early – Class will start promptly at 9:30
BalloonSat Overview

Class #4

Colorado Space Grant Consortium
Origins:

- Started at Space Grant June 2000
- Was a student at Space Grant 1990-1995
- Programs had advanced
- Hard for freshman students to get plugged in
- Sink or Swim
Origins:

What if students could get close to space?

- Met Edge of Space Sciences (EOSS) in Fall 1996
Origins:

- Promise of recovery and 100,000 feet
- Price was right
- Many launches every year
- Some of the same engineering challenges
Origins:

With the combination of these items, BalloonSat was born
The StratoShuttle-1 student balloon, an educational project by the Quest for Stars group, captured NASA’s shuttle Atlantis soaring into orbit as seen from 89,000 feet on July 8, 2011. Tweeted @questforstars: "Atlantis, GO at Throttle up!"
**BalloonSat:**

- BalloonSat is an excellent, low cost platform for “Walk” level student missions to the Edge of Space

- A BalloonSat weighing up to 9 kg can reach 30 km (100,000 feet)

- Students faced with many engineering challenges
  - Mach 1, -80 C, near vacuum, impact and burst

- No microgravity but BalloonSat can be recovered
**Balooning**

<table>
<thead>
<tr>
<th>Altitude</th>
<th>Pressure</th>
<th>Horizon</th>
<th>Sky Color*</th>
<th>Cosmic Rays**</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ground</td>
<td>1013 millibars</td>
<td>3 miles</td>
<td>Blue</td>
<td>4 counts/min All secondaries</td>
</tr>
<tr>
<td>85,000 feet</td>
<td>20 millibars</td>
<td>350 miles</td>
<td>Black</td>
<td>700 counts/ Min Primaries and Secondaries</td>
</tr>
<tr>
<td>300 miles</td>
<td>0 millibars</td>
<td>1500 miles</td>
<td>Black</td>
<td>? All Primaries</td>
</tr>
</tbody>
</table>

* Chapter Fourteen discusses the topic of sky color  
** Chapter Eight discusses the topic of cosmic rays
Ballooning

- Ballooning is inexpensive
  - Helium (~$800) - Now Hydrogen (~$30)
  - Balloon (~$300)

- You mostly control launch
Ballooning

When your balloon and payload ascend into the sky...

Every student knows, *their* experiment is going where no one - except astronauts - has ever gone before
BalloonSat Construction:

Aluminum Construction

Foam Core Construction
BalloonSat Construction:

- Velcro
- Silicon Adhesive and Hot Glue
- Aluminum Tape
- Insulation
- Venting
- Condensation
BalloonSats

- Easy to attach to balloon
- Easy to track and Recovery
- Fun for all
- You will build one this semester
What you will get:

- Batteries (some)
- Black Foam Insulation ¼ and ½ inch
- 3 half sheets
- Velcro & hot glue
- Aluminum tape
- Xacto knives
- Flight tube USA flag
- Coolers
- Multimeter & Wire
- Gateway Store
What you will get:
What you will get:

- Must fill out inventory sheet when you use the store
What you will get:
What your team supplies:

- Batteries (some)
- Mission
- Design
- Time & Effort - Build, Test, Document, Fly, Recovery, & Analyze
- Hardware order forms (HW #6)
Past Student Experiments:

- Atmospheric radiation levels
- Solar cell efficiency
- Atmospheric soundings
- Video imaging
- High altitude effects on roaches
- Digital sound recording of upper atmosphere
- Temperature studies

Use Past Team Reports
Launch:
- Sites typically in eastern Colorado
- Liftoff is 7:00 AM
- 90 minutes up, 45 minutes down
Launch: Supported by EOSS

- 3000 gram latex balloon
- Gaseous Hydrogen (~2 K bottles)
- Balloon filling system
- Flight string
- Radio Transceiver
- GPS
- Control Systems
- Parachute
- FAA notification
Introductions:
Introductions:
Introductions:
**Burst:**

- Altitude variable
- One of the most violent moments of the flight
- Mach I

Series of burst images
BalloonSats

- Interesting burst
ATOMIC BOMBS
PROJECT MAYHEM
Introductions
Launch Review:
Recovery:

HAZELTON — Joe Nelson of Hazelton made an interesting discovery in one of his fields recently while he was harvesting.

A silver box approximately 5 1/2 inches square with wires and bolts sticking out of it was laying among the vines in the field. It was near dark and difficult to see any details.

“My first thought was that it was a bomb,” Nelson said.

The next morning after having a closer look, Nelson could see a hole cut in one side of the box with a camera in it. There is also what appears to be an antenna on one side and a switch on another. A long bolt appears to be running through the contraption, sticking out 3 inches on each side.

The box looks to be made of foam board held together by foil and duct tape. Several stickers of badgers and American flags decorate the box.

In another nearby field, he found a similar contraption. This one was white with stickers saying USA1 and a second box was connected to it by a cable.

Nelson said that the boxes may have been part of a school science experiment and someone may want to retrieve the cameras from the boxes.

For more information, call Trena at 677-4042, extension 600.
Recovery:

- Begins after launch
- Can track real-time
- Recovery complete same day
BalloonSat Testing:

- Drop Test
- Cooler Test
- Subsystem Tests
- Functional Tests
- Mission Sim Tests
- Whip Test

DO NOT FOCUS ON STRUCTURAL TESTING ONLY
BalloonSat Testing:

Kick, Drop, Cool, Whip, and Fore!
Quick Lesson on the Atmosphere

Colorado Space Grant Consortium
Environments at 30 km:

- How high do commercial jets fly? ~10 km
- How high is the ozone layer? ~20 to 50 km
- What are the layers of the atmosphere?
The 4 Layers of the Atmosphere:

- Troposphere
- Stratosphere
- Mesosphere
- Thermosphere
Environments at 30 km:

- Troposphere
- Stratosphere
- Mesosphere
- Thermosphere
Capt. Joe W. Kittinger jumps from a balloon at 102,800 feet. Forgot to mention, he exceeded the speed of sound with his body.
Environments at 30 km:

Temperature varies in all directions as you climb through the different layers of the atmosphere.

Why?

Solar Radiation (UV, IR)
- Ozone Absorbs
- Surface Heats
- Convection
Environments at 30 km:

- Temperature can dip to -80°C
- Biggest killer of past missions
- Easy, repeatable science

Burst (30 km)  Landing

Launch ·

Coldest ·

Tropopause ·
Back to BalloonSats...
History and Results:
History and Results:

- Over 100 launches
- 18,500 students
- 98% recovery rate
- 90% recovered with some data
- 50% recovered with all expected data
- Papers have been written and presented
- More than 50% of students have continued with more research projects
History and Results:
History and Results:
Launch Review:
BalloonSats:

- BalloonSats are excellent way to do hands-on research
- Motivates you to go further
- See importance of your education
- Prepared to contribute to more complex projects
- Have the confidence to take the next step
Questions?

Colorado Space Grant Consortium
Request For Proposals
What is an RFP?

- There is a lot of money out there
- There are a lot of ideas
- **Request For Proposal** bring them together
- Most satellites were at one time an RFP
- Most of you will write or help write a proposal in your job
- Now is your time to practice
SEE

RFP

The Colorado Space Grant Consortium, The University of Colorado at Boulder Department of Aerospace Engineering Sciences, and the Edge of Space Sciences present

BalloonSat Missions to the Edge of Space

Request For Proposal
#RFP 1406F13

Fall 2013 Announcement

Proposal Due No Later Than:
DATE: September 30, 2013
TIME: 8:00 AM
To Recap RFP:

- Final weight shall not exceed 1,100 grams
- Shall image the Earth or the Balloon during flight, record internal and external temperature, humidity and pressure levels, and g forces in x, y, and z directions
- Must have one additional experiment and one additional sensor (minimum)
- Must follow all the guidelines while writing proposal
- Why and How – this is your plan and foundation for project
- Using screen shots…
So...

- Take the ideas you came up with individually during the HW#2

- Start with these in your team and expand them during HW #3

- But…Keep It Simple Stupid (KISS Principle)

- Start now!

- You are writing a proposal not a request for proposal

- Proposals Due September 22, 2014 (18 days)
- Launch is November 15, 2014 (72 days)
Presentation:

Presentation Templates

- On Class Website

- Final presentation should cover same items in final report

- CoDRs are before Proposals are due this year

- Quick Look Presentation (Post Launch)

- Final Presentations before Final Report
**Final Written Report:**

**Design Document Template**

- You will write your team’s final report throughout the semester with our Design Document revisions

- 1st Draft of DD Rev D is due at Expo

- Final draft is due after final presentations to allow incorporation of action items from Expo, presentations
Team Video (Optional):

- Must be less than 3 minutes
- Must be turned in at Expo
- Must be “presentable” to the public
- Extra, extra, extra credit if it goes viral (more than 100,000 hits)
Drawings:
Functional Block Diagrams
So...

- Get started now (Due in 18 days)
- Teams next class (Due in 13 days)
- Be opened minded about your team and how ideas fit into the team’s ideas
Questions?

Colorado Space Grant Consortium
One Minute Report Questions:

“The function of education is to teach one to think intensively and to think critically. Intelligence plus character - that is the goal of true education.”

Martin Luther King, Jr.
Fall 2006
Team Video