Gateway To Space

ASEN 1400
My Name is...
\[
\frac{\partial^2 \varphi}{\partial x^2} + \frac{\partial^2 \varphi}{\partial y^2} + \frac{\partial^2 \varphi}{\partial z^2} = 0
\]

\[
\sum_{k=1}^{n} k^2 = \frac{n(n+1)(2n+1)}{6}
\]

\[
\frac{d}{dx} f(x) = \lim_{\Delta \to 0} \frac{f(x + \Delta) - f(x)}{\Delta}
\]

\[
\cos x = \sum_{n=0}^{\infty} \frac{(-1)^n x^{2n}}{(2n)!}
\]

\[
\int \tan(ax) \, dx = -\frac{1}{a} \ln |\cos(ax)| + c
\]

\[
\int u \frac{dv}{dx} \, dx = uv - \int \frac{du}{dx} v \, dx
\]

\[
\lim_{x \to c} \frac{f(x)}{g(x)} = \lim_{x \to c} \frac{f'(x)}{g'(x)}
\]

\[
\lim_{x \to \infty} \tan^{-1}(x) = -\frac{\pi}{2}
\]
PID Control Law

- Proportional, Integral, Derivative (PID)
  - Used to control single axis

  - One PID controller for each axis

\[
\omega_{err} \rightarrow K_d \rightarrow \text{Rate Gain}
\]

\[
\theta_{err} \rightarrow K_p \rightarrow \text{Att Gain}
\]

\[
\theta_{err} \rightarrow K_i \rightarrow \text{Int Att Gain}
\]

\[
\omega_{err} = \text{rate error} \\
\theta_{err} = \text{attitude error} \\
\theta_{ierr} = \text{integrated attitude error}
\]
PID Control Law Response Times

Zero Rate Gain = No Damping
Small Rate Gain = Light Damping
Large Rate Gain = Heavy Damping
"If you're really successful at bullshitting, it means you're not hanging around enough people smarter than you."

Neil DeGrasse Tyson
November 2000 University of Colorado at Boulder

...Word!
Dream to Space
Gateway To Space

ASEN 1400

Class #1

Colorado Space Grant Consortium
How was the first day?
How was the second day?
Today

- Lots of stuff about the class
- What to expect from this course
- Format for this course
- “How to get an A”
- Introductions
- Pictures

First Day Checklist
So you know what you heard
Class Size
Who’s Out There?
Who’s Out There?
Space?
Space Clip
What this class takes...
Wordle from Comments 2011 Class:
Wordle from Comments Fall 2014 Class:

LEARNED WORK MET PROJECT LOT

EXPECTED TEAM WORKING

EXPERIENCE

GOOD HARD FEEL EVEN

EVERYTHING LEARNING HELP

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Wordle from Comments Spring 2015 Class:
What to expect...
What to Expect?

- What you imagine this class will be like...
What to Expect?

- What it is like...
What to Expect?

- What it is like…
What to Expect?

- What it is like...
What to Expect?

- What it is like...
What to Expect?

- What it is like…
Speaking of History…

- What was it like…
What to Expect?

- 19th time teaching this course

- I have a unique teaching style

- I teach like I wish I had been taught

- Sense of humor
What to expect from this class:

- If you are not here because you want to be here, then leave…

- If you are here because you think this will be easier than GEEN 1400 (or some other class), then leave…

- If you are a slacker, then leave…

- But if you want to work hard and achieve something great…

  then please stay
The Class:

**Learn** the basics of atmospheric and space sciences, space exploration, spacecraft design, rocketry, and orbits.
The Class:

Hear about the current research in space through lectures from industry
The Class:

Launch a mini-satellite on a high altitude balloon that is designed and built by you and a team of students.
The Class:
The Class:
The Class:

- Interactive
- Interesting
- Applicable
- Fun
Team Video:

Team Video Fall 2012
Syllabus:

11 - Lecture
10 - Guest
11 - Teams
07 - Reviews
09 - Extra
24 - Attention
<table>
<thead>
<tr>
<th>Class #</th>
<th>Date</th>
<th>Day</th>
<th>DTL</th>
<th>Topics</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>08-25-15</td>
<td>T</td>
<td>74</td>
<td>Class Introduction and Pictures (So starts the rollercoaster)</td>
</tr>
<tr>
<td>2</td>
<td>08-27-15</td>
<td>R</td>
<td>72</td>
<td>Spacecraft Overview – (Compressed)</td>
</tr>
<tr>
<td>3</td>
<td>09-01-15</td>
<td>T</td>
<td>67</td>
<td>BalloonSat Overview + Request for Proposals: Functional Block Diagrams, Design Documents</td>
</tr>
<tr>
<td>4</td>
<td>09-03-15</td>
<td>R</td>
<td>65</td>
<td>HANDS-ON: Team Forming + Team Activity</td>
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<td>--------&gt; PROPOSAL Assigned (18 days) &lt;--------</td>
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<tr>
<td>5</td>
<td>09-08-15</td>
<td>T</td>
<td>60</td>
<td>HANDS-ON: Soldering 101 (Build and Blink)</td>
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<td>&lt;Arduino's distributed to teams today for HW 04&gt;</td>
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<tr>
<td>6</td>
<td>09-10-15</td>
<td>R</td>
<td>58</td>
<td>HANDS-ON: Arduino – Part I (Type and Blink):</td>
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<tr>
<td>7</td>
<td>09-15-15</td>
<td>T</td>
<td>53</td>
<td>HANDS-ON: Arduino – Part II (Analog Sensors):</td>
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<td></td>
<td>All team members report for beginning of class</td>
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<tr>
<td>x1</td>
<td>09-15-15</td>
<td>T</td>
<td>53</td>
<td>REVIEWS: Conceptual Design Review (CoDR)</td>
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<tr>
<td></td>
<td>6 – 8 PM</td>
<td></td>
<td></td>
<td>&lt;5 minute presentations &amp; 5 minutes of Q/A&gt;</td>
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<tr>
<td>8</td>
<td>09-17-15</td>
<td>R</td>
<td>51</td>
<td>HANDS-ON: Arduino – Part III (More Sensors):</td>
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<td>All team members report for beginning of class</td>
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<td>x2</td>
<td>09-17-15</td>
<td>R</td>
<td>51</td>
<td>HANDS-ON: Arduino – Part IV (Memory):</td>
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<tr>
<td></td>
<td>6 – 9 PM</td>
<td></td>
<td></td>
<td>Team representatives required to attend</td>
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<tr>
<td>x3</td>
<td>09-21-15</td>
<td>M</td>
<td>47</td>
<td>PROPOSALS DUE 8:00 AM</td>
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<tr>
<td>No.</td>
<td>Date</td>
<td>Day</td>
<td>Time</td>
<td>Guest Lecture Title</td>
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<td>---------------------------------------------------------</td>
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<tr>
<td>9</td>
<td>09-22-15</td>
<td>T</td>
<td>46</td>
<td>Guest Lecture – “Satellite Tool Kit”</td>
</tr>
<tr>
<td>10</td>
<td>09-24-15</td>
<td>R</td>
<td>44</td>
<td>Requirements Flow Down Process</td>
</tr>
<tr>
<td>12</td>
<td>10-01-15</td>
<td>R</td>
<td>37</td>
<td>Guest Lecture – “Systems Engineering”</td>
</tr>
<tr>
<td>13</td>
<td>10-06-15</td>
<td>T</td>
<td>32</td>
<td>Guest Lecture – “Spacecraft Structures”</td>
</tr>
<tr>
<td>14</td>
<td>10-08-15</td>
<td>R</td>
<td>30</td>
<td>HANDS-ON: In-Class Team Time – <em>Bring hardware and questions</em></td>
</tr>
<tr>
<td>15</td>
<td>10-08-15</td>
<td>R</td>
<td>30</td>
<td>REVIEWS: Preliminary Design Review (PDR)</td>
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<td><em>(&lt;6 minute presentations &amp; 4 minute of Q/A&gt;</em></td>
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<tr>
<td>16</td>
<td>10-13-15</td>
<td>T</td>
<td>25</td>
<td>Rocket History</td>
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<tr>
<td>17</td>
<td>10-15-15</td>
<td>R</td>
<td>23</td>
<td>Launch Vehicles</td>
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<tr>
<td>18</td>
<td>10-20-15</td>
<td>T</td>
<td>18</td>
<td>Guest Lecture – “Spacecraft Thermal Analysis”</td>
</tr>
<tr>
<td>19</td>
<td>10-22-15</td>
<td>R</td>
<td>16</td>
<td>Orbits and Mission Design – Part I</td>
</tr>
<tr>
<td>19</td>
<td>10-27-15</td>
<td>T</td>
<td>11</td>
<td>Orbits and Mission Design – Part II</td>
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HANDS-ON: In-Class Team Time – *Bring hardware Chris will be inspecting payloads*
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<th>Type</th>
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<tbody>
<tr>
<td>20</td>
<td>10-29-15</td>
<td>R</td>
<td>09</td>
<td>HANDS-ON - In-Class Mission Simulation Test <em>(ON for the whole class)</em> If Time = Spider</td>
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<tr>
<td>21</td>
<td>11-03-15</td>
<td>T</td>
<td>04</td>
<td>REVIEWS: Launch Readiness Review (LRR)</td>
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<tr>
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<td><em>&lt;4 minute presentations &amp; 4 minutes of Q/A&gt;</em></td>
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<tr>
<td>22</td>
<td>11-05-15</td>
<td>R</td>
<td>02</td>
<td>Launch Logistics</td>
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<tr>
<td>23</td>
<td>11-06-15</td>
<td>F</td>
<td>01</td>
<td>Final BalloonSat Weigh-in and TURN IN</td>
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<td><em>By appointment 8:00 AM to 2:00 PM @ Chris's Office DLC 270A</em></td>
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<tr>
<td>24</td>
<td>11-07-15</td>
<td>SAT</td>
<td>00</td>
<td>Launch Day @ 6:50 AM @ Windsor, Colorado</td>
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<td><em>(Leave Boulder at 4:45 AM!)</em></td>
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<td>25</td>
<td>11-10-15</td>
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<td>+3</td>
<td>Guest Lecture – <em>“Spacecraft Attitude Determination and Control”</em></td>
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<td>+ Launch Recap and Report and Data Analysis Guidance</td>
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<tr>
<td>26</td>
<td>11-12-15</td>
<td>R</td>
<td>+5</td>
<td>REVIEWs: Quick Look Post Launch Presentation</td>
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<td>[WEB]</td>
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<td><em>(Pre-recorded and sent to Chris by 9:30 AM)</em></td>
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<tr>
<td>27</td>
<td>11-17-15</td>
<td>T</td>
<td>+3</td>
<td>Guest Lecture – <em>“Have You Been To Mars?”</em></td>
</tr>
<tr>
<td>28</td>
<td>11-19-15</td>
<td>R</td>
<td>+5</td>
<td>Guest Lecture – <em>“Spacecraft Propulsion”</em></td>
</tr>
<tr>
<td></td>
<td>11-24-15</td>
<td>T-R</td>
<td>18</td>
<td>Fall Break – NO CLASSES – Fall Break</td>
</tr>
<tr>
<td></td>
<td>11-26-15</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>29</td>
<td>12-01-15</td>
<td>T</td>
<td>+10</td>
<td>Guest Lecture – <em>“Spacecraft Power” and Career Advice</em></td>
</tr>
<tr>
<td>30</td>
<td>12-03-15</td>
<td>R</td>
<td>+12</td>
<td>Guest Lecture – <em>“The Next Big Thing in Space”</em></td>
</tr>
<tr>
<td>31</td>
<td>12-05-15</td>
<td>SAT</td>
<td>+14</td>
<td>REVIEWs: ITLL Design Expo <em>(9:00 AM – 4:00 PM)</em></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td><em>(Open to the general public from 12:30 to 3:00 PM)</em></td>
</tr>
<tr>
<td>32</td>
<td>12-08-15</td>
<td>T</td>
<td>+17</td>
<td>Space Grant Opportunities, Class Survey, and Team Videos</td>
</tr>
<tr>
<td>33</td>
<td>12-08-15</td>
<td>T</td>
<td>+17</td>
<td>REVIEWs: Final Presentations</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td><em>&lt;8 minute presentations &amp; 7 minutes of Q/A&gt;</em></td>
</tr>
<tr>
<td>34</td>
<td>12-10-15</td>
<td>R</td>
<td>+19</td>
<td>Final Class – Review and Discussion + Final Team Evaluations</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td><em>Bring all hardware</em></td>
</tr>
<tr>
<td>35</td>
<td>12-15-15</td>
<td>T</td>
<td>+23</td>
<td>REVIEWs: Community Service Activity Presentations + Extra Credit Final Exam <em>(time permitting)</em></td>
</tr>
</tbody>
</table>
NOTES: All “DUE” items are due electronically via email at Prof.Koehler@gmail.com by class time unless otherwise stated above. Items submitted after class begins or past the specified time, will be late and subject to grade penalty. Files must be emailable or brought to Chris on USB driver before time due.

All Subject lines of each email submitted for this class must follow the naming convention below:
Homework = “HW XX Lastname Firstinitial” Example = HW 01 Armstrong N (Attachments shall be in MS Word)
Team Documents = “DD rev Team Number” Example = DD C Team 04 (Attachments shall be in MS Word)
Team Presentations = “Review Team Number” Example = CDR Team 04 (Attachments shall be in MS PowerPoint)
Failure to use this naming convention will result in your email being deleted by a SPAM filter and may result in no credit or late penalties.

1 Minute Reports are DUE each day at the end of class. Please use your assigned number and printed form for proper credit. Attendance will be taken during each lecture. It is your responsibility to find and sign the attendance sheet before the end of class. If you need anything, please send an email with the word “HELP” in the subject. Email will be routed to the top of my email inbox.

<table>
<thead>
<tr>
<th>Individual Points/Grade Percentage</th>
<th>Team Points/Grade Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>10% Attendance (30) &amp; 1 Minute Reports (30)</td>
<td>10% Team Proposal</td>
</tr>
<tr>
<td>15% Homework 1-8,10 (10%) + 9 (5%)</td>
<td>13% Team Presentations (4)</td>
</tr>
<tr>
<td>05% Spatial Visualization Test (Must pass to get 5%)</td>
<td>10% Team Design Document (2 Revs)</td>
</tr>
<tr>
<td>05% Community Service and Presentation</td>
<td>02% Design Expo</td>
</tr>
<tr>
<td>15% Individual Contributions &amp; Participation on Team</td>
<td>15% Final Presentation and Final Report</td>
</tr>
<tr>
<td>50% Subtotal (You)</td>
<td>50% Subtotal (Team)</td>
</tr>
</tbody>
</table>

50% + 50% = 100%
How to get an A?
How to get an A:

“Everyone starts out with an A”

You have to try really hard to get anything lower than C-

Not in the business of giving bad grades…

…But you get the grade you earn

Please, Please, Don’t Cheat
Spring 2006 – Spring 2015 Grades

617 Students
How to get an A:

Grades are based on a normal 100 point scale

No curve

Team project and participation are based on your team evaluation and instructor evaluation

Feedback may be slow
How to get an A:

Graders – Leina, Amber and Gabriel

- Leina and Amber took class in Fall 2014
- Gabriel took the class in Spring 2013 at CCA

- They will each play an active role in your teams this semester
How to get an A:

Graders – Leina, Amber and Gabriel
How to get an A

Graders – Leina, Amber and Gabriel
How to get an A
Leina, Amber and Gabriel
How to get an A

Graders – Leina, Amber and Gabriel
How to get an A

Graders – Leina, Amber and Gabriel
How to get an A

Graders – Leina, Amber and Gabriel
How to get an A:

Graders – Leina, Amber and Gabriel
## How to get an A:

### Grade Breakdown

<table>
<thead>
<tr>
<th>Individual Points/Grade Percentage</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
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<td>10%</td>
</tr>
<tr>
<td>Homework 1-8,10 (10%) + 9 (5%)</td>
<td>15%</td>
</tr>
<tr>
<td>Spatial Visualization Test (Must pass to get 5%)</td>
<td>05%</td>
</tr>
<tr>
<td>Community Service and Presentation</td>
<td>05%</td>
</tr>
<tr>
<td>Individual Contributions &amp; Participation on Team</td>
<td>15%</td>
</tr>
<tr>
<td>Subtotal (You)</td>
<td>50%</td>
</tr>
</tbody>
</table>
### How to get an A:

#### Grade Breakdown

<table>
<thead>
<tr>
<th>Team Points</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>Team Proposal</td>
<td>10%</td>
</tr>
<tr>
<td>Team Presentations (4)</td>
<td>13%</td>
</tr>
<tr>
<td>Team Design Documents (2 Revs)</td>
<td>10%</td>
</tr>
<tr>
<td>Design Expo</td>
<td>02%</td>
</tr>
<tr>
<td>Final Presentation and Final Report</td>
<td>15%</td>
</tr>
<tr>
<td>Subtotal (TEAM)</td>
<td>50%</td>
</tr>
</tbody>
</table>
How to get an A:

Grade Breakdown

50% You + 50% Team = 100%
Homework
Homework:

Submit via email

- Subject should be in this format
  “HW XX Lastname Firstinitial”

- Send all items to Prof.Koehler@gmail.com

- Get from Website

First Homework is…
ASEN 1400 - Fall 2015

Taught as part of the Colorado Space Grant student experience and funded by the Department of Aerospace Engineering Sciences at the University of Colorado at Boulder.
The Book(s)
Miscellaneous:

Book(s) for course

- Typical engineering book cost $100, $90, $80, $70

This Book…
- $13.11
- Rocket Boys
  Homer Hickam

Also…Set aside $25 for batteries and dry ice
Miscellaneous:

Book(s) for course

This Book...
- $9.00
- The Martian
- Andy Weir

Also…Set aside $25 for batteries
Attendance & 1 Minute Report
Attendance:

- Your responsibility to sign the attendance sheet every class

- Don’t sign for friends

- Sick, stay away but send email

- Gone for other reasons, must get approved before event, not after

- Be on-time

- Plan on being here for the full class (75 minutes)
1 Minute Reports:

- Everyone has a unique number

- Use your uniquely numbered sheet each class

- Turn in at end of class

- Must be this format and not your own “I forget my forms” paper

Please Print/Write clearly

- I read each of them clearly

- Great feedback as the class goes forward
1 Minute Report:

Name: 
Date: 
Lecture Title: 

1. Key points of today’s lecture?

2. What wasn’t clear and/or what questions do you wish you had asked?

3. What personal contributions have you made to your team this week?

4. What grade would you give today’s lecture?

5. Other comments, concerns, or suggestions?
Community Service Activity
Community Service:

- Everyone must do a community service activity

- Not something you are doing for any other class/club/organization (i.e. NEW)

- Preferred if it is related to this class, your college major, or your interest in space

- Activity must last a minimum of 2 hours

- Form is on the class website and must be approved before completed
Community Service:

- Assigned 08-25-15
- Approval Due 10-22-15
- Completed 12-15-15
- Form Submit 12-15-15
- Presentation Due 12-15-15 @ 10 AM

60 second presentation that summarizes your service project by using the template on the website. Presentations will be given at the Final Exam.
Community Service Approval (must be completed and signed before activity)

Description of planned activity:

Proposed date and location of activity: ___________________ Date ___________________ Location

Approved by ___________________ on ___________________

(Chris Koehler)
Community Service Completion
Description of how the actual activity went:

Actual date and location of activity:

Number of those affected through your activity?

Point of Contact of the activity:

Point of Contact signature:

Point of Contact email and/or phone number:

Signature of student performing the activity:

Attach picture(s) of you doing the actual activity:
Community Service:
Community Service
Spatial Visualization Test
Spatial Visualization Testing

- Everyone must take test and pass to get 5%

- Due by September 3, 2015

- Workshops if you don’t pass plus a chance to retake
**Guest Speakers:**

- Be attentive and present
- Applaud
- Thank you letters
- Ask questions

**Colorado Space Grant Consortium**
Providing Colorado students with experiences in space to prepare them for NASA’s future space programs.

[Website](http://spacegrant.colorado.edu)

**Lead Institution:**

University of Colorado
520 UCB, Boulder, CO 80309
303.492.3141

**Affiliate Institutions:**

- Adams State University
  Alamosa
- Aims Community College
  Greeley
- Arapahoe Community College
  Littleton
- Colorado Mesa University
  Grand Junction
- Colorado School of Mines
  Golden
- Colorado State University
  Fort Collins
- Colorado State University – Pueblo
- Colorado State University – Pueblo Community College
  Pueblo
- Colorado State University – Pueblo Community College
  Pueblo
- Colorado State University – Ramsdell
- Colorado State University – Red Rocks Community College
  Lakewood
- Colorado State University – Space Foundation
  Colorado Springs
- Colorado State University – Trinidad State College
  Trinidad
- Colorado State University – University of Northern Colorado
  Greeley
- Colorado State University – Western State Colorado University
  Gunnison

April 23, 2015

Dr. James Stuart
1092 West Alder Street
Loveland, CO 80537-1846
303.492.3141

On behalf of the Colorado Space Grant Consortium and the University of Colorado at Boulder, we would like to express our appreciation to you for speaking to our class, Gateway to Space, on April 23, 2015. Your discussion on the Future of Space was very interesting and inspiring.

The goal of the class is to teach these future engineers and scientists about the opportunities in space and give them real-world experience in the classroom. We appreciate you sharing your expertise and knowledge with them.

Thank you for taking the time to make a difference.

Sincerely,

Chris Koehler
Director, Colorado Space Grant Consortium
koehler@colorado.edu
303-492-4750
Miscellaneous
Miscellaneous:

- Respectful class participation
  - Phones, laptops, noises, footprint (stuff), etc.

- Notes – Take them

- Communications via email and this class

- Office hours 10:45 – 11:45 T & Th and by appointment

- I am busy but always approachable

- Where to Find Me… DLC 270A
Questions?
Introductions
Who is this Guy?
SPACE: 1999

http://youtu.be/w4-A__lZrEA
- Who has not seen Star Wars, Episode IV (1977)?
What Experience Do You Have?

Intern at Ball
summer of 1991

Worked with
Bob Poley

Worked on
RADARSAT
Who is this Guy?

Graduated from CU in December 1992 with B.S. in Aerospace Engineering

Graduated from CU in December 1994 with M.S. in Mechanical Engineering
What Did You Do After College?

Worked at Lockheed Martin from March 1995 until May 2000
What Did You Do At Martin?

- Classified satellite
- 1,000 people on program
- Youngest
- Reaction Control System
  Mechanical Design Lead
- Design done in IDEAS
- Released over 100 engineering drawings

- Supervised manufacture, assembly, integration and test for 5 satellite builds
- Last two years, Mechanical Design Lead for the Antenna systems
What Did You Do At Martin?

- Also worked on Stardust and Genesis

- Worked with many different disciplines and people
Why Did You Leave?

- Many reasons

1. Coming back here was a great opportunity

2. Pictures on the wall

3. Mentor

4. Change
Vision:

Providing a diverse group of Colorado students with experiences in space to prepare them for our Nation’s future space programs

COSGC = Workforce Development
RocketSat IV:
- Highest greenhouse gas measurement
- The tubing is vacated at apogee
- Air is forced into the tube, compresses, and remains in the order that it was sampled
- Sample is analyzed using laser analyzer after the flight
Who is this Guy?
Who is this Guy?

I love space...

And with the help of students...
- 10 large satellites
- 8 small satellites
- 196 rocket payloads
- 1090 BalloonSats
Who is this Guy?

I love to laugh

DEATH
The world’s leading cause of death
Who is this Guy?

I love to laugh
Who is this Guy?

I do crazy things
Who is this Guy?

I love to read
Who is this Guy?

I brew Kombucha

How the contents develop during the course of the fermentation process is very clearly seen in the results of Dr. Jürgen Reiss’s investigations. (From Deutsche Lebensmittelrundschau (German Food Review), 83rd year, No.9, 1987, with kind permission of the publisher and author.)

Substances contained in Kombucha made from black tea:

- lactic acid
- gluconic acid
- acetic acid
- ethanol
- glucose
- pH value
Who is this Guy?

I love to play video games.
Who is this Guy?

I love to play guitar
Why Did You Leave?

Al Worden, Apollo 15
Harrison Schmitt, Apollo 17
Why Did You Leave?
### Who is this Guy?

<table>
<thead>
<tr>
<th>Number</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>45</td>
<td>My age</td>
</tr>
<tr>
<td>52</td>
<td>The age I feel</td>
</tr>
<tr>
<td>7</td>
<td>Hours I get to sleep a night</td>
</tr>
<tr>
<td>40</td>
<td>Hours I get to sleep a week</td>
</tr>
<tr>
<td>55</td>
<td>Average number hours I work a week</td>
</tr>
<tr>
<td>15</td>
<td>Hours per week I am paid to teach this course</td>
</tr>
<tr>
<td>20</td>
<td>Average hours per week I actually spend on class</td>
</tr>
<tr>
<td>19</td>
<td>Times I have taught this course</td>
</tr>
<tr>
<td>134</td>
<td>Emails I get each day</td>
</tr>
<tr>
<td>15</td>
<td>Emails I respond to each day</td>
</tr>
<tr>
<td>1</td>
<td>Me</td>
</tr>
<tr>
<td>64</td>
<td>You</td>
</tr>
</tbody>
</table>
So why are you here?
Why You Are Here:

- You want to get a good job after college
- Good School
- Good Grades
- Good Experience
- This course and Space Grant gets you all three
- Unique point in your life
Space in Colorado:

3rd largest aerospace economy

169,810 employed at over 400 companies with $3.2 billion in payroll

3rd in the nation with $1.8 billion in NASA contracts
Final Word

You’ll Never...
Next Time:

Spacecraft Overview
Pictures?