Gateway To Space

ASEN 1400

Class #1

Colorado Space Grant Consortium
How was the first day?
How is your day now?
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?
Space?
What this class takes...
Wordle from Comments 2011 Class:
Wordle from Comments 2013 Class:
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 to Expect?

- 24th time teaching this course (picture from 2000)

- 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:

- Interactive
- Interesting
- Applicable
- Fun
Syllabus:

11 - Lecture
06 - Guest
11 - Teams
08 - Reviews
06 - Extra
18 - 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>01-16-18</td>
<td>T</td>
<td>81</td>
<td>Class Introduction and Pictures (So starts the rollercoaster)</td>
</tr>
<tr>
<td>2</td>
<td>01-18-18</td>
<td>R</td>
<td>79</td>
<td>Spacecraft Overview – (Compressed)</td>
</tr>
<tr>
<td>3</td>
<td>01-23-18</td>
<td>T</td>
<td>74</td>
<td><strong>BalloonSat Overview + Request for Proposals:</strong> Functional Block Diagrams, Design Documents</td>
</tr>
<tr>
<td>4</td>
<td>01-25-18</td>
<td>R</td>
<td>72</td>
<td><strong>HANDS-ON: Team Forming + Team Activity</strong></td>
</tr>
<tr>
<td></td>
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<td></td>
<td><strong>PROPOSAL Assigned (17 days)</strong></td>
</tr>
<tr>
<td>5</td>
<td>01-30-18</td>
<td>T</td>
<td>67</td>
<td><strong>HANDS-ON: Soldering 101 (Build and Blink)</strong></td>
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<tr>
<td></td>
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<td></td>
<td></td>
<td>&lt;Arduino’s distributed to teams today for HW 04&gt;</td>
</tr>
<tr>
<td>6</td>
<td>02-01-18</td>
<td>R</td>
<td>65</td>
<td><strong>HANDS-ON: Team Inclusive Activity</strong></td>
</tr>
<tr>
<td>7</td>
<td>02-06-18</td>
<td>T</td>
<td>60</td>
<td>REVIEWS: Conceptual Design Review (CoDR)</td>
</tr>
<tr>
<td></td>
<td>9:20 Start</td>
<td></td>
<td></td>
<td>&lt;5 minute presentations &amp; 5 minutes of Q/A&gt;</td>
</tr>
<tr>
<td>8</td>
<td>02-08-18</td>
<td>R</td>
<td>58</td>
<td><strong>HANDS-ON: Arduino – Part I (Type and Blink):</strong></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>All team members report for beginning of class</td>
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<tr>
<td>x1</td>
<td>02-08-18</td>
<td>R</td>
<td>58</td>
<td><strong>HANDS-ON: Arduino Deep Dive (Sensors/SD Card):</strong></td>
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<tr>
<td></td>
<td>6 – 9 PM</td>
<td></td>
<td></td>
<td>All team members present for first 75 minutes</td>
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<tr>
<td>x2</td>
<td>02-10-18</td>
<td>SUN</td>
<td>53</td>
<td><strong>PROPOSALS DUE 12:00 PM</strong></td>
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<tr>
<td>9</td>
<td>02-13-18</td>
<td>T</td>
<td>53</td>
<td>Guest Lecture – “Solar System Exploration Missions”</td>
</tr>
<tr>
<td>10</td>
<td>02-15-18</td>
<td>R</td>
<td>51</td>
<td><strong>HANDS-ON: In-Class Team Time + Hardware Distribution</strong></td>
</tr>
<tr>
<td></td>
<td>9:00 Start</td>
<td></td>
<td></td>
<td>&gt;&gt;&gt; Authority To Proceed (ATP) with Chris &lt;&lt;&lt;</td>
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<td>Week</td>
<td>Date</td>
<td>Day</td>
<td>Time</td>
<td>Lecture/Activity</td>
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<tr>
<td>11</td>
<td>02-20-18</td>
<td>T</td>
<td>46</td>
<td>Requirements Flow Down Process + MUIRA (HASP) and RS-12 Student Teams</td>
</tr>
<tr>
<td>12</td>
<td>02-22-18</td>
<td>R</td>
<td>44</td>
<td>Guest Lecture – “Systems Engineering”</td>
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<tr>
<td>13</td>
<td>02-27-18</td>
<td>T</td>
<td>39</td>
<td>Guest Lecture – “Spacecraft Structures”</td>
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<tr>
<td>14</td>
<td>03-01-18</td>
<td>R</td>
<td>37</td>
<td>HANDS-ON: In-Class Team Time – Bring hardware Chris will be inspecting payloads</td>
</tr>
<tr>
<td>15</td>
<td>03-06-18</td>
<td>T</td>
<td>32</td>
<td>REVIEWS: Preliminary Design Review (PDR) &lt;6 minute presentations &amp; 3 minute of Q/A&gt;</td>
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<tr>
<td>16</td>
<td>03-08-18</td>
<td>R</td>
<td>30</td>
<td>Rocket History (Best Lecture in the History of Lectures)</td>
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<tr>
<td>17</td>
<td>03-13-18</td>
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<td>25</td>
<td>HANDS-ON: In-Class Team Time – Bring hardware Chris will be inspecting payloads</td>
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<tr>
<td>18</td>
<td>03-15-18</td>
<td>R</td>
<td>23</td>
<td>Launch Vehicles</td>
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<td>19</td>
<td>03-20-18</td>
<td>T</td>
<td>18</td>
<td>HANDS-ON: In-Class Team Time – Bring hardware Chris will be inspecting payloads</td>
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<tr>
<td>20</td>
<td>03-22-18</td>
<td>R</td>
<td>16</td>
<td>HANDS-ON - In-Class Mission Simulation Test (ON for the whole class) If Time = Spider</td>
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<tr>
<td>03-27-18</td>
<td>T-R</td>
<td>11</td>
<td>Spring Break – NO CLASSES – Spring Break</td>
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<tr>
<td>03-29-18</td>
<td>T-R</td>
<td>09</td>
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<tr>
<td>Date</td>
<td>Time</td>
<td>Day</td>
<td>Time</td>
<td>Event</td>
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<tr>
<td>04-03-18</td>
<td>9:05</td>
<td>T</td>
<td>04</td>
<td>REVIEW: Launch Readiness Review (LRR)</td>
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<td>&lt;4 minute presentations &amp; 4 minutes of Q/A&gt;</td>
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<tr>
<td>04-05-18</td>
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<td>R</td>
<td>02</td>
<td>Launch Logistics</td>
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<td><strong>Final BalloonSat Weigh-in and TURN IN</strong></td>
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<td></td>
<td>By appointment 8:00 AM to 2:00 PM @ Chris’s Office DLC 270A</td>
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<tr>
<td>04-06-18</td>
<td>04</td>
<td>F</td>
<td>01</td>
<td>Launch Day @ 6:50 AM @ Windsor, Colorado</td>
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<td></td>
<td>AM - 4 PM</td>
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<td></td>
<td><em>(Leave Boulder at 4:45 AM!)</em></td>
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<tr>
<td>04-10-18</td>
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<td>T</td>
<td>+03</td>
<td>Launch Recap and Report and Data Analysis Guidance</td>
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<tr>
<td>04-12-18</td>
<td></td>
<td>R</td>
<td>+05</td>
<td>REVIEW: Quick Look Post Launch Presentation</td>
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<tr>
<td>04-17-18</td>
<td></td>
<td>T</td>
<td>+10</td>
<td>Orbits and Mission Design</td>
</tr>
<tr>
<td>04-19-18</td>
<td></td>
<td>R</td>
<td>+12</td>
<td><strong>Guest Lecture – “Spacecraft Attitude Determination and Control”</strong></td>
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<tr>
<td>04-24-18</td>
<td></td>
<td>T</td>
<td>+17</td>
<td>Guest Lecture – The Orion Spacecraft and Career Advice</td>
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<tr>
<td>04-26-18</td>
<td></td>
<td>R</td>
<td>+19</td>
<td>Guest Lecture – “The Next Big Thing in Space”</td>
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<tr>
<td>04-28-18</td>
<td>08</td>
<td>SAT</td>
<td>+22</td>
<td>REVIEW: ITLL Design Expo (8:00 AM – 1:00 PM)</td>
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<td></td>
<td>AM – 1 PM</td>
<td></td>
<td></td>
<td>Open to the general public from 10:30 to 12:00 PM</td>
</tr>
<tr>
<td>05-01-18</td>
<td></td>
<td>T</td>
<td>+25</td>
<td>Space Grant Opportunities, Class Survey, and Team Videos</td>
</tr>
<tr>
<td></td>
<td>05-01-18</td>
<td>06</td>
<td>+25</td>
<td>REVIEW: Final Presentations</td>
</tr>
<tr>
<td></td>
<td>6 – 9 PM</td>
<td></td>
<td></td>
<td>&lt;8 minute presentations &amp; 7 minutes of Q/A&gt;</td>
</tr>
<tr>
<td>05-03-18</td>
<td></td>
<td>R</td>
<td>+27</td>
<td>Final Class – Review and Discussion + Final Team Evaluations</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Bring all hardware</td>
</tr>
<tr>
<td>05-07-18</td>
<td>04:30</td>
<td>WED</td>
<td>+33</td>
<td>REVIEW: Community Service Activity Presentations</td>
</tr>
<tr>
<td></td>
<td>7 PM</td>
<td></td>
<td></td>
<td>+ Extra Credit Final Exam (time permitting)</td>
</tr>
</tbody>
</table>
Syllabus:

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 be 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 – Fall 2017 Grades
937 Students

The histogram represents the distribution of grades for 937 students from Spring 2006 to Fall 2017. The x-axis shows the grade ranges, and the y-axis shows the count of students. The grades are represented by the letter grades, with F being the lowest and A being the highest. The histogram shows a peak in the B grade range, indicating that it was the most common grade received by the students during this period.
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
## How to get an A:

### Grade Breakdown

<table>
<thead>
<tr>
<th>Individual Points/Grade Percentage</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>10%</td>
<td>Attendance (30) &amp; 1 Minute Reports (30)</td>
</tr>
<tr>
<td>15%</td>
<td>Homework 1-8,10 (10%) + 9 (5%)</td>
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<tr>
<td>05%</td>
<td>Spatial Visualization Test (Must pass to get 5%)</td>
</tr>
<tr>
<td>05%</td>
<td>Community Service and Presentation</td>
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<tr>
<td>15%</td>
<td>Individual Contributions &amp; Participation on Team</td>
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<tr>
<td>50%</td>
<td>Subtotal (You)</td>
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</tbody>
</table>
How to get an A:

Grade Breakdown

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

Grade Breakdown

50% You + 50% Team = 100%
How to get an A:

Graders – Alex, Tristan, and Amber

- Alex took the class in Fall 2013
- Tristan took the class in Fall 2017
- Amber took the class in Fall 2014
- They will each play an active role in your teams this semester (Password for Mailing List)
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 - Spring 2018

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…
- $10.11
- Rocket Boys
  Homer Hickam

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

Book(s) for course

This Book…
- $9.79
- Apollo 13 (Lost Moon)
- James Lovell and Jeffrey Kluger

Also…Set aside $25 for batteries and dry ice
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 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?
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

- I read each of them clearly

- Great feedback as the class goes forward

Please Print/Write clearly
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 Today
- Approval Due 03-20-18
- Completed 05-07-18
- Form Submit 05-07-18
- Presentation Due 05-07-18 @ 12 PM

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:

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:
Community Service
Spatial Visualization Testing

- Everyone must take test and pass to get 5%

- Due by this 01/22

- Workshops if you don’t pass plus a chance to retake
What would this look like from the bottom?
Foam Core Example
Why do we like spatial visualization?

1. Most significant predictor of success in engineering
2. It’s learnable!
Purdue Spatial Visualization Test: Rotations (PSVT:R)
Purdue Spatial Visualization Test: Rotations (PSVT:R)

• 30 question multiple choice in 30 minutes
• Score > 20 = passing
• Score < 20 = required to attend SV workshops
• 5% of semester grade given after passing PSVT:R

<table>
<thead>
<tr>
<th>Block A</th>
<th>Week 1</th>
<th>Week 2</th>
<th>Week 3</th>
<th>Week 4</th>
<th>Required Session</th>
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<tbody>
<tr>
<td></td>
<td>1/29 &amp; 2/4</td>
<td>2/5 &amp; 2/11</td>
<td>2/12 &amp; 2/18</td>
<td>2/19 &amp; 2/25</td>
<td>Mondays, 5-7pm, ITLL 150</td>
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<td>Orthographic Views</td>
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<td>Isometric Drawing</td>
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<td>1D &amp; 2D Rotations</td>
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<td>Review + <strong>TEST</strong></td>
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<tr>
<th>Block B</th>
<th>Week 5</th>
<th>Week 6</th>
<th>Week 7</th>
<th>Week 8</th>
<th>Makeup Session</th>
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<tr>
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<td>2/26 &amp; 3/4</td>
<td>3/5 &amp; 3/11</td>
<td>3/12 &amp; 3/18</td>
<td>3/19</td>
<td>Sundays, 5-7pm ITLL 150</td>
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<td>Orthographic Views</td>
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<td>Review + <strong>TEST</strong></td>
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</tbody>
</table>

Inclines and Curves
Write a Rule
Time Trials
Review + **TEST**

Inclines and Curves
Write a Rule
Time Trials
--
Spatial Visualization Test:

- Everyone Required to take test by JAN 22 at 5 PM

- Pass 5%  Fail 0%

- If you fail, you will be requested by the college to attend workshops starting next week so they are looking at your results

- After workshops, you will be able to retake test and still get 5%
Spatial Visualization Test:

- I took it

- Only have 30 minutes

- It was a mind bending experience but fun

- My score was 26 out of 30

- My advice…Use your hand
Spatial Visualization Test:

- Log into TBD
Spatial Visualization Test:

GEEN 1400 - Spatial Visualization (Fall 2014)

Quiz

Note: It is recommended that you save your response as you complete each question.

Information

This test consists of 30 questions designed to see how well you can visualize the rotation of three-dimensional objects. Shown in figure 1 is an example of the type of question included in this test.

Figure 1

IS ROTATED TO

AS

IS ROTATED TO

A B C D E

You are to:
Spatial Visualization Test:

- You must click **SAVE** after each question or no credit
Guest Speakers
Guest Speakers:

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

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

- Notes – Take them


- Communications via email and this class

- Put HELP in subject if you want me to read your email
Miscellaneous:

- **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?
Why Did You Leave?
Al Worden, Apollo 15
Why Did You Leave?

Harrison Schmitt, Apollo 17
Why Did You Leave?

Buzz Aldrin, Apollo 11
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?

- 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
Students Statewide:
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
Start Here…
Weaknesses:
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?

I love space...

And with the help of students...
- 10 large satellites
- 8 small satellites
- 308 rocket payloads
- 1150 BalloonSats
SPACE MINOR

Open to all undergraduate students at the University of Colorado Boulder. Pathway to Space (ASEN 1969) is the kickoff class for the Space Minor.

Enroll now!

www.colorado.edu/spaceminor

PATHWAY TO SPACE

ASEN1969 - PATHWAY TO SPACE

COURSE AVAILABLE TO ALL SPACE MINOR STUDENTS!
TO ENROLL IN THE MINOR, VISIT:
COLORADO.EDU/SPACEMINOR
OPEN TO ALL UNDERGRADUATES

COLORADO.EDU/PATHWAYTOSPACE
Who is this Guy?
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 love to read
Who is this Guy?

I still love Legos
Who is this Guy?

I still love Legos
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
- gluonic acid
- acetic acid
- ethanol
- glucose
- pH value
Who is this Guy?

I love to play guitar
Who is this Guy?

47  My age
55  The age I feel
7   Hours I get to sleep a night
55  Average number hours I work a week
15  Hours per week I am paid to teach this course
20  Average hours per week I actually spend on class
24  Times I have taught this course
180 Emails I get each day
15  Emails I respond to each day
1   Me
64  You
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?