Gateway To Space

ASEN 1400/ASTR 2500
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

\[ \omega_{err} \rightarrow K_d \]

- One PID controller for each axis

\[ \omega_{err} = \text{rate error} \]
\[ \theta_{err} = \text{attitude error} \]
\[ \theta_{ierr} = \text{integrated attitude error} \]
"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!
Balloon

Parachute, GPS

Radio & Camera

Beer Cooler
Dream to Space
Incoming Transmission from Kennedy Space Center...
Please Stand By...
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?
Space?
What this class takes...
Wordle from Comments 2011 Class:
Wordle from Comments 2012 Class:
Wordle from Comments 2013 Class:
Wordle from Comments Fall 2014 Class:
Wordle from Comments Spring 2015 Class:
Wordle from Comments Fall 2015 Class:

- work
- engineering
- learned
- semester
- satellite
- project
- expected
- BalloonSat
- expected
- payload
- professional
- data
- engineering
- projects
- data
- professional
- Koehler
- really
- lot
- one
- actually
- first
- expect
- exceeded
- thought
- thing
- build
- year
- engineering
- presentations
- technical
- knew
- going
- knew
- part
- little
- help
- still
- future
- times
- building
- different
- given
- Yes
- worked
- documents
- end
- something
- like course
- now
- college
- professor
- overall
- idea
- group
- feel
- near
- even
- knowledge
- ever
- rewarding
- Gateway
- people
- meet
- definitely
- get
- fun
- just
- every
- just
- got
- amount
- space
- think
- hard
- able
- believe
- everything
- though
- better
- beginning
- launch
- difficult
- fact
- coming
- program
- guest
- real
- students
- lectures
- writing
- grades
- never
- sense
- taking
- best
- day
- hard
- take
- end
- professional
- learning
- way
- projects
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 is was like…
What to Expect?

- 21st 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.

Earth to Mars:

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

Past Student Experiments:

- Ocean Surface Currents
- Transpolar Mesosphere
The Class:

Hear about the current research in space through lectures from industry
Launch a mini-satellite on a high altitude balloon that is designed and built by you and a team of students.
The Class:  
- Interactive  
- Interesting  
- Applicable  
- Fun
Space Minor Clip Recording
\begin{align*}
\omega_{\text{err}} &= \text{rate error} \\
\theta_{\text{err}} &= \text{attitude error} \\
\theta_{i\text{err}} &= \text{integrated attitude error}
\end{align*}
Syllabus:

12 - Lecture
07 - Guest
11 - Teams
07 - Reviews
07 - 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>08-23-16</td>
<td>T</td>
<td>81</td>
<td>Class Introduction and Pictures (So starts the rollercoaster)</td>
</tr>
<tr>
<td>2</td>
<td>08-25-16</td>
<td>R</td>
<td>79</td>
<td>Spacecraft Overview – (Compressed)</td>
</tr>
<tr>
<td>3</td>
<td>08-30-16</td>
<td>T</td>
<td>74</td>
<td>BalloonSat Overview + Request for Proposals: Functional Block Diagrams, Design Documents</td>
</tr>
<tr>
<td>4</td>
<td>09-01-16</td>
<td>R</td>
<td>72</td>
<td>HANDS-ON: Team Forming + Team Activity</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td><strong>PROPOSAL Assigned (18 days)</strong></td>
</tr>
<tr>
<td>5</td>
<td>09-06-16</td>
<td>T</td>
<td>67</td>
<td>HANDS-ON: Soldering 101 (Build and Blink)</td>
</tr>
<tr>
<td></td>
<td>9:20 Start</td>
<td></td>
<td></td>
<td>&lt;Arduino's distributed to teams today for HW 04&gt;</td>
</tr>
<tr>
<td>6</td>
<td>09-08-16</td>
<td>R</td>
<td>65</td>
<td>HANDS-ON: Arduino – Part I (Type and Blink):</td>
</tr>
<tr>
<td></td>
<td>9:20 Start</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>7</td>
<td>09-13-16</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>09-15-16</td>
<td>R</td>
<td>58</td>
<td>HANDS-ON: Arduino – Part II (Analog Sensors):</td>
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<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>All team members report for beginning of class</td>
</tr>
<tr>
<td>x1</td>
<td>09-19-16</td>
<td>M</td>
<td>54</td>
<td>PROPOSALS DUE 8:00 AM</td>
</tr>
<tr>
<td>Date</td>
<td>Time</td>
<td>Day</td>
<td>Room</td>
<td>Topic</td>
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<tr>
<td>09-20-16</td>
<td>09-20-16</td>
<td>T</td>
<td>53</td>
<td>HANDS-ON: Arduino – Part III (More Sensors): 10-20</td>
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<tr>
<td></td>
<td>09-20-16</td>
<td>T</td>
<td>53</td>
<td>All team members report for beginning of class</td>
</tr>
<tr>
<td></td>
<td>09-22-16</td>
<td>R</td>
<td>51</td>
<td>Requirements Flow Down Process + HELIOS V Team</td>
</tr>
<tr>
<td>09-22-16</td>
<td>R 09-23-16</td>
<td>F</td>
<td>50</td>
<td>&gt;&gt;&gt;&gt; Authority To Proceed (ATP) by appointment with Chris &lt;&lt;&lt;</td>
</tr>
<tr>
<td>09-27-16</td>
<td>T 09-22-16</td>
<td>T</td>
<td>46</td>
<td>Guest Lecture – “Solar System Exploration Missions”</td>
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<tr>
<td>09-29-16</td>
<td>R 09-22-16</td>
<td>R</td>
<td>44</td>
<td>Guest Lecture – “Systems Engineering”</td>
</tr>
<tr>
<td>10-04-16</td>
<td>T 10-04-16</td>
<td>T</td>
<td>39</td>
<td>Guest Lecture – “Spacecraft Structures”</td>
</tr>
<tr>
<td>10-06-16</td>
<td>R 10-06-16</td>
<td>R</td>
<td>37</td>
<td>REVIEWS: Preliminary Design Review (PDR)</td>
</tr>
<tr>
<td></td>
<td>9-05 Start</td>
<td></td>
<td></td>
<td>&lt;6 minute presentations &amp; 3 minute of Q/A&gt;</td>
</tr>
<tr>
<td>10-11-16</td>
<td>T 10-11-16</td>
<td>T</td>
<td>32</td>
<td>Rocket History</td>
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<tr>
<td>10-13-16</td>
<td>R 10-13-16</td>
<td>R</td>
<td>30</td>
<td>Launch Vehicles</td>
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<tr>
<td>10-20-16</td>
<td>R 10-20-16</td>
<td>R</td>
<td>23</td>
<td>Guest Lecture – “Spacecraft Propulsion”</td>
</tr>
<tr>
<td>10-27-16</td>
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<td>&gt;&gt;&gt;&gt; Authority To Proceed (ATP) by appointment with Chris &lt;&lt;&lt;</td>
</tr>
<tr>
<td>Week</td>
<td>Date</td>
<td>Day</td>
<td>Time</td>
<td>Activity</td>
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<td>18</td>
<td>10-20-16</td>
<td>R</td>
<td>23</td>
<td>Guest Lecture – “Spacecraft Propulsion”</td>
</tr>
<tr>
<td>19</td>
<td>10-25-16</td>
<td>T</td>
<td>18</td>
<td>Guest Lecture – “Spacecraft Thermal Analysis”</td>
</tr>
<tr>
<td>20</td>
<td>10-27-16</td>
<td>R</td>
<td>16</td>
<td>HANDS-ON: In-Class Team Time – Bring hardware Chris will be inspecting payloads</td>
</tr>
<tr>
<td>21</td>
<td>11-01-16</td>
<td>T</td>
<td>11</td>
<td>TBD</td>
</tr>
<tr>
<td>22</td>
<td>11-03-16</td>
<td>R</td>
<td>09</td>
<td>HANDS-ON - In-Class Mission Simulation Test (ON for the whole class) If Time = Spider</td>
</tr>
<tr>
<td>23</td>
<td>11-08-16</td>
<td>T</td>
<td>04</td>
<td>REVIEWS: Launch Readiness Review (LRR) &lt;4 minute presentations &amp; 4 minutes of Q/A&gt;</td>
</tr>
<tr>
<td></td>
<td>11-08-16</td>
<td></td>
<td></td>
<td>9:05 Start</td>
</tr>
<tr>
<td>24</td>
<td>11-10-16</td>
<td>R</td>
<td>02</td>
<td>Launch Logistics</td>
</tr>
<tr>
<td>23</td>
<td>11-11-16</td>
<td>F</td>
<td>01</td>
<td>Final BalloonSat Weigh-in and TURN IN By appointment 8:00 AM to 2:00 PM @ Chris’s Office DLC 270A</td>
</tr>
<tr>
<td>23</td>
<td>11-12-16</td>
<td>SAT</td>
<td>00</td>
<td>Launch Day @ 6:50 AM @ Windsor, Colorado (Leave Boulder at 4:45 AM!)</td>
</tr>
<tr>
<td></td>
<td>11-12-16</td>
<td></td>
<td></td>
<td>8:00 AM – 4 PM</td>
</tr>
<tr>
<td>23</td>
<td>11-15-16</td>
<td>T</td>
<td>+03</td>
<td>Launch Recap and Report and Data Analysis Guidance</td>
</tr>
<tr>
<td>24</td>
<td>11-17-16</td>
<td>R</td>
<td>+05</td>
<td>REVIEWS: Quick Look Post Launch Presentation</td>
</tr>
<tr>
<td>Day</td>
<td>Date</td>
<td>T-R</td>
<td>Time</td>
<td>Activity</td>
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<td>--------------------------------------------------------------------------</td>
</tr>
<tr>
<td>27</td>
<td>11-29-16</td>
<td>T</td>
<td>+17</td>
<td>Guest Lecture – The Orion Spacecraft and Career Advice</td>
</tr>
<tr>
<td>28</td>
<td>12-01-16</td>
<td>R</td>
<td>+19</td>
<td>Guest Lecture – “The Next Big Thing in Space”</td>
</tr>
<tr>
<td>x6</td>
<td>12-03-16</td>
<td>SAT</td>
<td>+21</td>
<td>REVIEWS: ITLL Design Expo (8:00 AM – 1:00 PM)</td>
</tr>
<tr>
<td></td>
<td>8 AM – 1 PM</td>
<td></td>
<td></td>
<td><em>Open to the general public from 10:30 to 12:00 PM</em></td>
</tr>
<tr>
<td>29</td>
<td>12-06-16</td>
<td>T</td>
<td>+24</td>
<td>Space Grant Opportunities, Class Survey, and Team Videos</td>
</tr>
<tr>
<td>x7</td>
<td>12-06-16</td>
<td>T</td>
<td>+24</td>
<td>REVIEWS: 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>30</td>
<td>12-08-16</td>
<td>R</td>
<td>+26</td>
<td>Final Class – Review and Discussion + Final Team Evaluations</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td><a href="https://example.com">Bring all hardware</a></td>
</tr>
<tr>
<td>31</td>
<td>12-11-16</td>
<td>SUN</td>
<td>+29</td>
<td>REVIEWS: Community Service Activity Presentations + Extra Credit Final Exam</td>
</tr>
<tr>
<td></td>
<td>4:30 – 7 PM</td>
<td></td>
<td></td>
<td>(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 – Spring 2016 Grades
743 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
How to get an A:

Grade Breakdown

<table>
<thead>
<tr>
<th>Individual Points/Grade Percentage</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>Attendance (30) &amp; 1 Minute Reports (30)</td>
<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></th>
</tr>
</thead>
<tbody>
<tr>
<td>10%</td>
<td>Team Proposal</td>
</tr>
<tr>
<td>13%</td>
<td>Team Presentations (4)</td>
</tr>
<tr>
<td>10%</td>
<td>Team Design Documents (2 Revs)</td>
</tr>
<tr>
<td>02%</td>
<td>Design Expo</td>
</tr>
<tr>
<td>15%</td>
<td>Final Presentation and Final Report</td>
</tr>
<tr>
<td>50%</td>
<td>Subtotal (TEAM)</td>
</tr>
</tbody>
</table>
How to get an A:

Grade Breakdown

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

Graders – Amber, Olagappan, and Amanda

- Amber took the class in Fall 2014
- Olagappan took the class in Spring 2015
- Amanda took the class in Fall 2015
- They will each play an active role in your teams this semester
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…
GATEWAY TO SPACE

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...
- $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:

- 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: 10-20-16
- Completed: 12-11-16
- Form Submit: 12-11-16
- Presentation Due: 12-11-16 @ 4 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:

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 Friday (8/26)

- 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>Session A</th>
<th>Session B</th>
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<td>Orthographic Views</td>
<td>Orthographic Views</td>
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<td></td>
<td>1D &amp; 2D Rotations</td>
<td>1D &amp; 2D Rotations</td>
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<td></td>
<td>Review + <strong>TEST</strong></td>
<td>Review + <strong>TEST</strong></td>
</tr>
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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>Session A</th>
<th>Session B</th>
</tr>
</thead>
<tbody>
<tr>
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<td></td>
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<td></td>
<td>Write a Rule</td>
<td>--</td>
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<td></td>
<td></td>
<td></td>
<td>Time Trials</td>
<td>--</td>
</tr>
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<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Review + <strong>TEST</strong></td>
<td>--</td>
</tr>
</tbody>
</table>

*makeup sessions on Sundays 4-6pm in ITLL 150*
Spatial Visualization Test:

- Everyone Required to take test by 8/26 at 3:00 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 learn.colorado.edu
Spatial Visualization Test:

- Log into learn.colorado.edu
Spatial Visualization Test:

- Log into learn.colorado.edu
Spatial Visualization Test:

GEEN 1400 - Spatial Visualization (Fall 2014)

Time Limit: 0:30:00   Time Left: 0:30:00   Christopher J Koehler: Attempt 2

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
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

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

http://spacegrant.colorado.edu

Lead Institution:
University of Colorado
Silt Unit, Boulder, CO 80309
303-492-3141

Affiliate Institutions:
Arapahoe Community College
Arapahoe Community College
Colorado Mesa University
Grand Junction
Colorado School of Mines
Golden
Colorado State University
Fort Collins
Colorado State University – Pueblo
Community College of Aurora
Community College of Denver
Fort Lewis College
Metropolitan State University
Denver
Otero Junior College
La Junta
Pikes Peak Community College
Sijoms
Pueblo Community College
Pueblo
Red Rocks Community College
Lakewood
Space Foundation
Colorado Springs
Triton College
Northwestern College
University of Colorado
Colorado Springs
University of Northern Colorado
Greensburg
Western State Colorado University
 Gunnison

April 23, 2015
Dr. James Stuart
1082 West Alder Street
Louisville, CO 80027-1046
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
University of Colorado at Boulder
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

- 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
- **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
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?

I love space…

And with the help of students…
- 10 large satellites
- 8 small satellites
- 267 rocket payloads
- 1120 BalloonSats
Who is this Guy?

I love to laugh

DEATH
The world’s leading cause of death
I love to read

Who is this Guy?
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 Reise’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
Why Did You Leave?
Why Did You Leave?
<table>
<thead>
<tr>
<th>Number</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>46</td>
<td>My age</td>
</tr>
<tr>
<td>50</td>
<td>The age I feel</td>
</tr>
<tr>
<td>7</td>
<td>Hours I get to sleep a night</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>20</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?