Teaching Undergraduates to Build Spacecraft During The Covid-19 Lockdown

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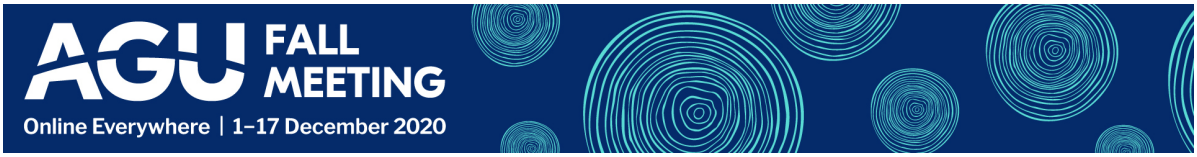
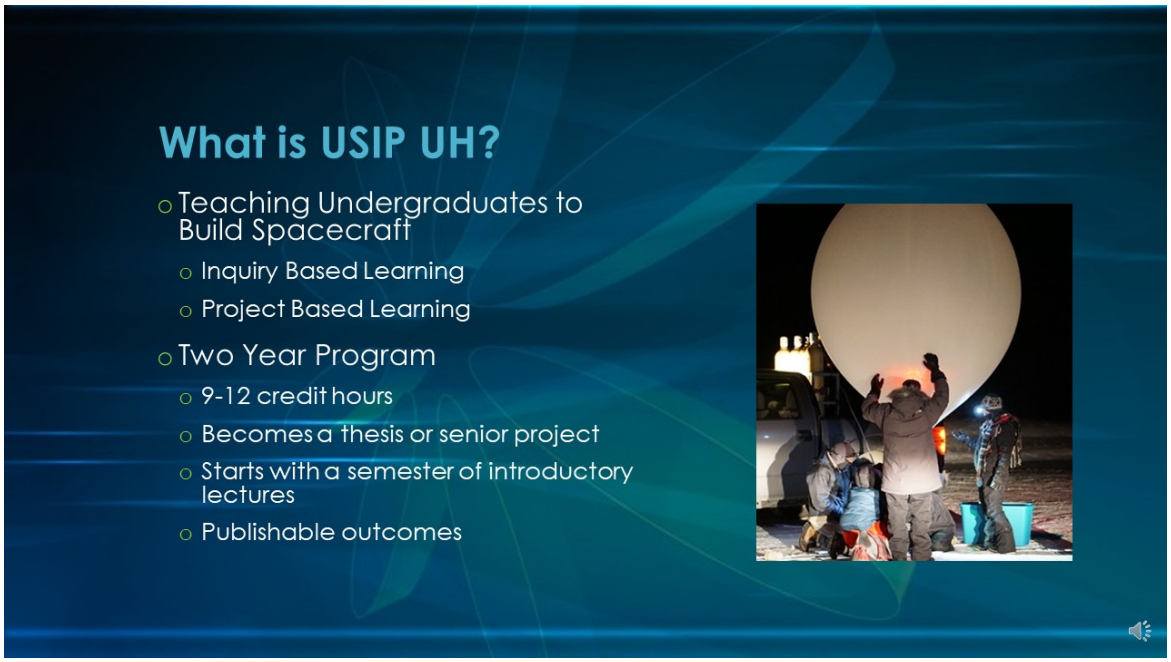
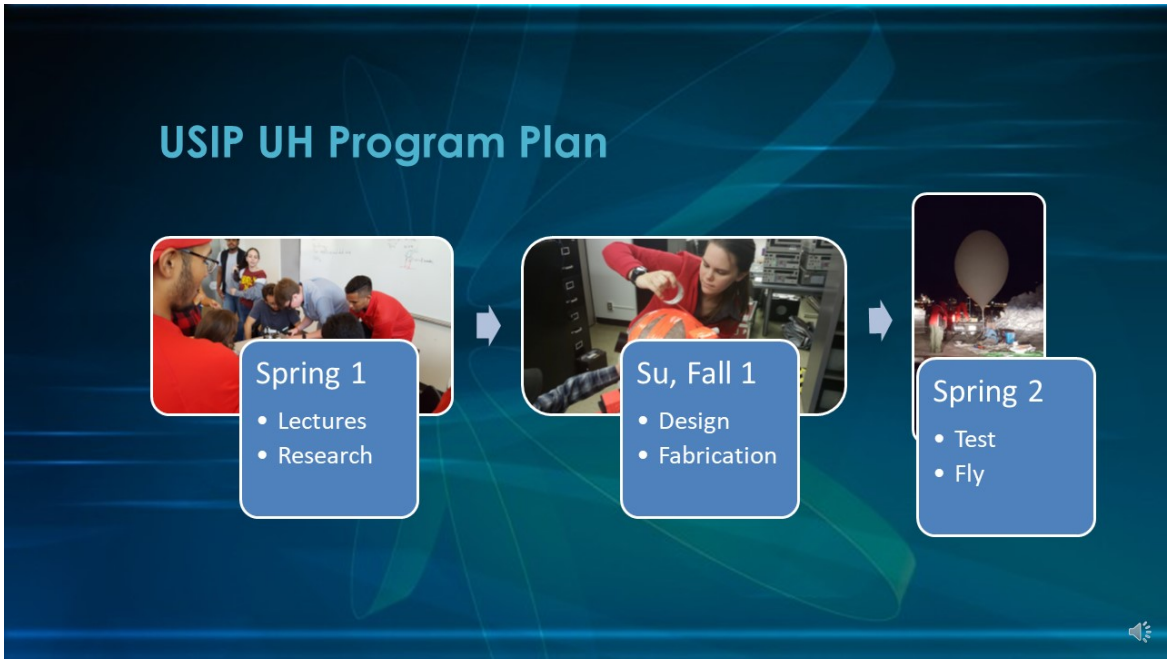
PRESENTED AT:



THE USIP PROJECT (1)

Undergraduate Student Instrument Project (USIP)




USIP UH Program Plan
Spring 1
• Lectures
• Research
Su, Fall 1
• Design
• Fabrication
Spring 2
• Test
• Fly


Demographics
WHO ARE THE STUDENTS?

Demographics

USIP I

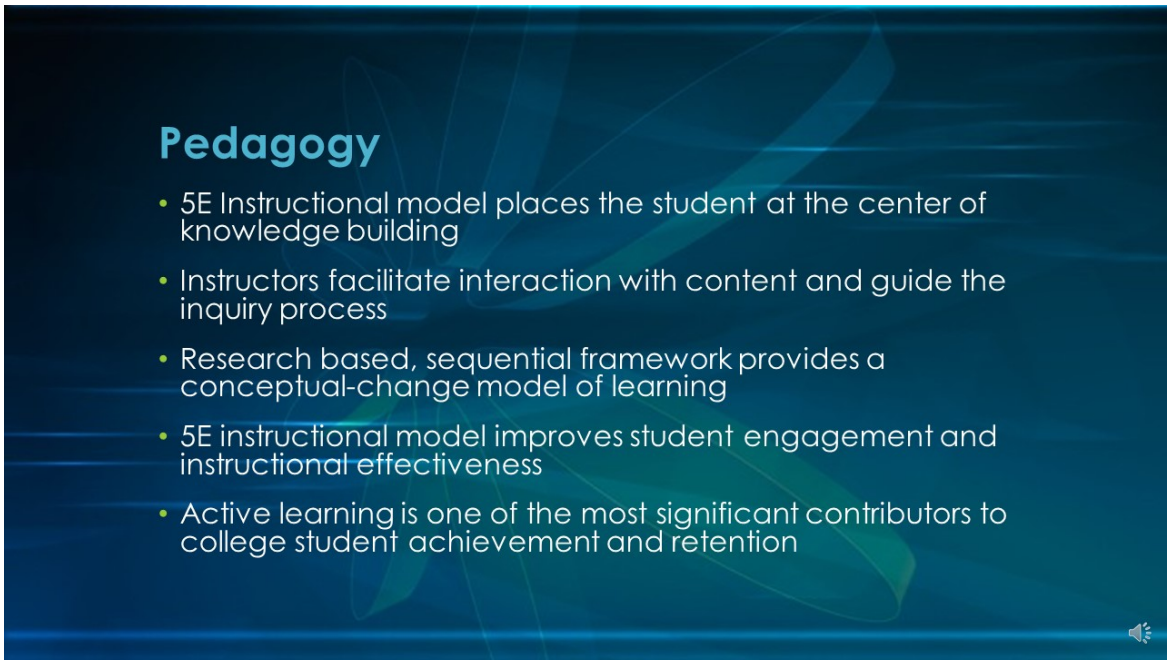
USIP II

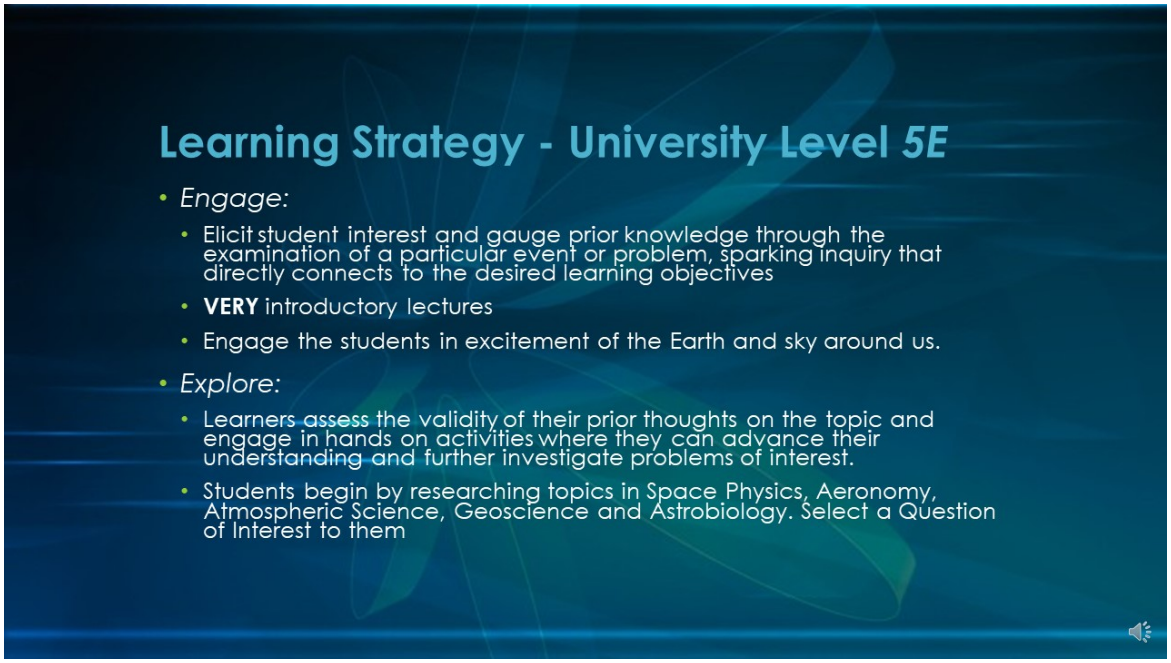
DEMOGRAPHICS

- 39 UH & 7 TAMU Completed 2012-2019, 23 Enrolled
- 12 different Majors
- Freshman, Sophomores, Juniors, and Seniors
- Ages range from 17 – 31
- 12 different ethnicities
- 10 different languages

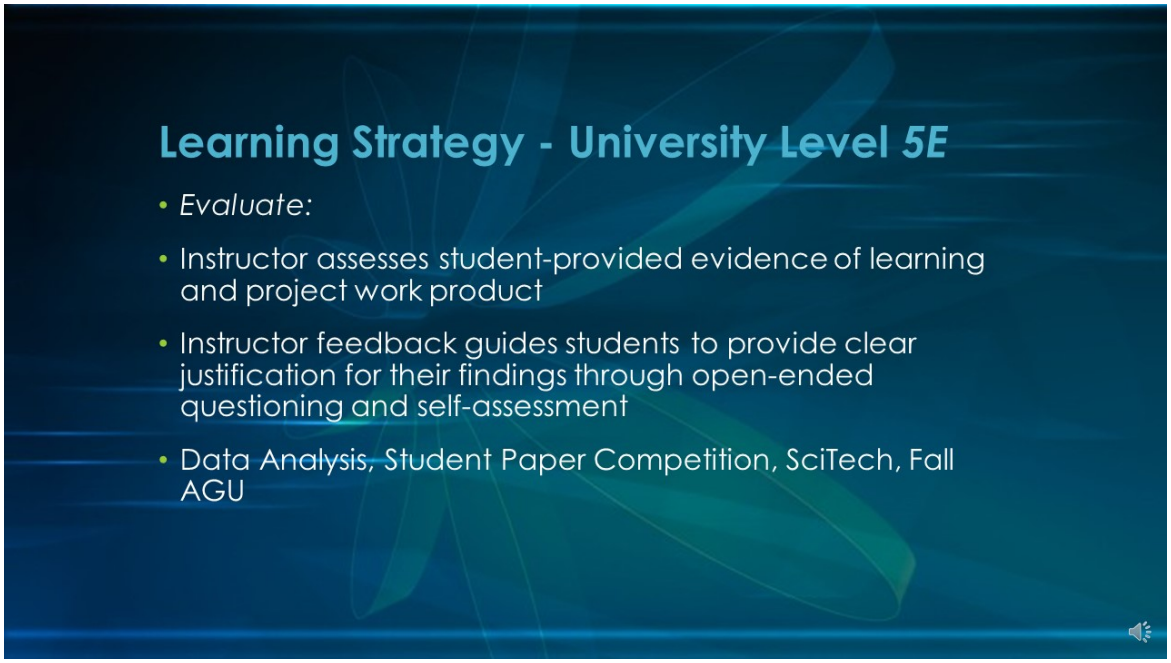
PEDAGOGICAL APPROACH (2)

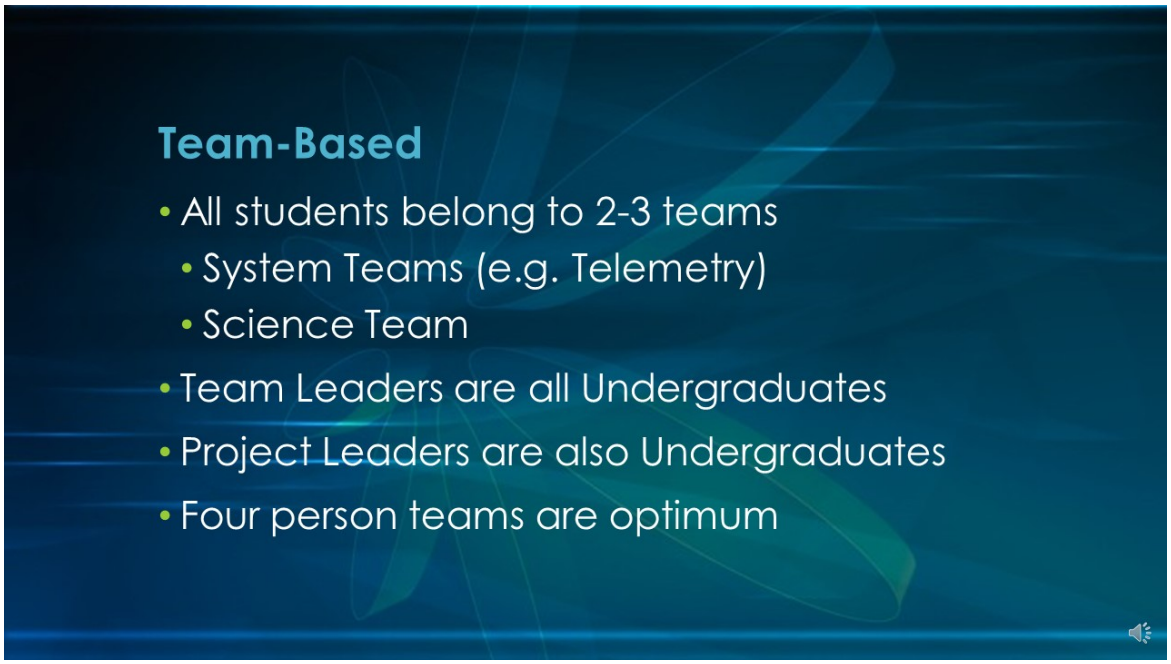
How Do We Teach This Project?




Learning Strategy - University Level 5E
Engage:
Elicit student interest and gauge prior knowledge through the examination of a particular event or problem, sparking inquiry that directly connects to the desired learning objectives
VERY introductory lectures
Engage the students in excitement of the Earth and sky around us.
Explore:
Learners assess the validity of their prior thoughts on the topic and engage in hands on activities where they can advance their understanding and further investigate problems of interest.
Students begin by researching topics in Space Physics, Aeronomy, Atmospheric Science, Geoscience and Astrobiology. Select a Question of Interest to them


Learning Strategy - University Level 5E
Explain:
Full explanations of the scientific content, where students connect concepts through the acquisition of associated vocabulary and science and engineering practices
Form Teams. Design Experiment to Address Question
Extend:
Students are challenged to apply concepts learned to new or unique scientific problems. Instruction focusses on presenting students with a novel challenge that requires them to apply and extend the concepts mastered in prior phases
Build, Test, Calibrate, Fly


Learning Strategy - University Level 5E
• Evaluate:
• Instructor assesses student-provided evidence of learning and project work product
• Instructor feedback guides students to provide clear justification for their findings through open-ended questioning and self-assessment
• Data Analysis, Student Paper Competition, SciTech, Fall AGU


Team-Based
• All students belong to 2-3 teams
• System Teams (e.g. Telemetry)
• Science Team
• Team Leaders are all Undergraduates
• Project Leaders are also Undergraduates
• Four person teams are optimum

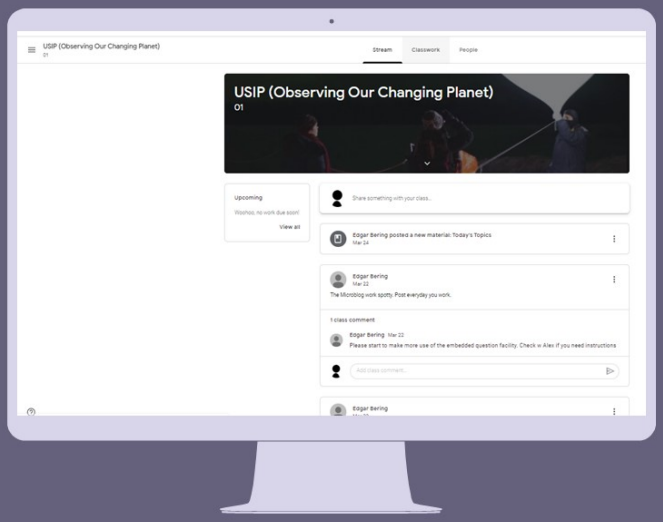
TOOLS AND METHODS (3)

How Do We Organize the Work?

USIP project

The precondition: An ongoing place to store data from different students for many years and that can be used by new students in a consistent and secure way. Additionally, the platform should provide tools for ongoing collaboration, revisions, storage and a tool to request immediate feedback from fellow researchers.

Google Class was used to meet this need



Tools Used For USIP Project.

Google Class

A space where resources, students and announcements can be contained for easy access.

Equipped with **Calendar**, **Drive**, and **Collaboration tools.**

Smartsheet

Create Gantt Charts and other tools you can share with all your team members across the world.

Collaboration Tools

Google **Docs**, **Slides**, **Forms**, **Sheets, Drawing** and **Smartsheet** help make working in teams convenient. **OpenOffice** and **MS Office** are also used in this project.

MS Teams

Planned use- One stop service for online teaching, presentations, team meetings and recording.

Google Drive

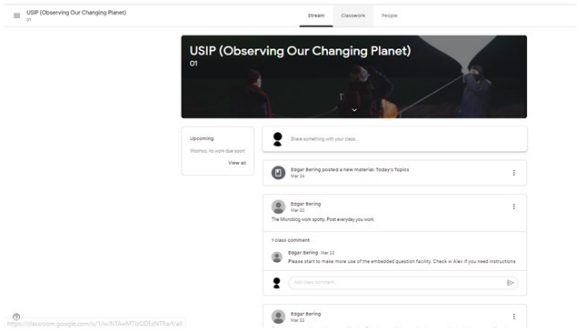
.Unlimited storage of data for student use on this project. Stores data in one place and share. Two Drive accounts are synced. Project is also synched with the Physics Server, Ra.

USIP Google Classroom

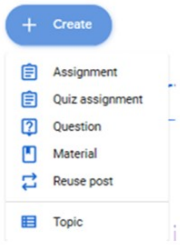
How it is used in the project

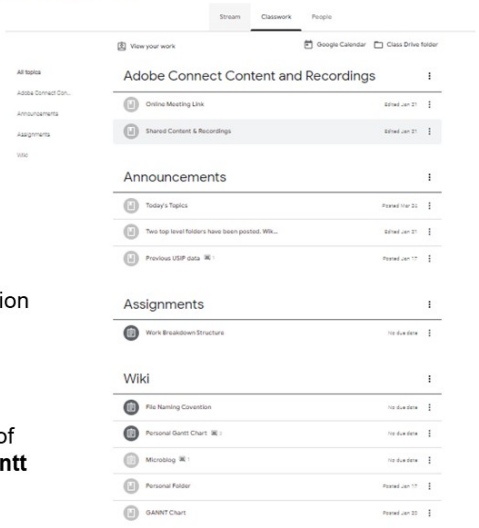
Google Classroom is used an access point for all the tools being used in the classroom.

The goal for the USIP group was to have **one** place that the students could visit and access all the tools being used in the project easily.



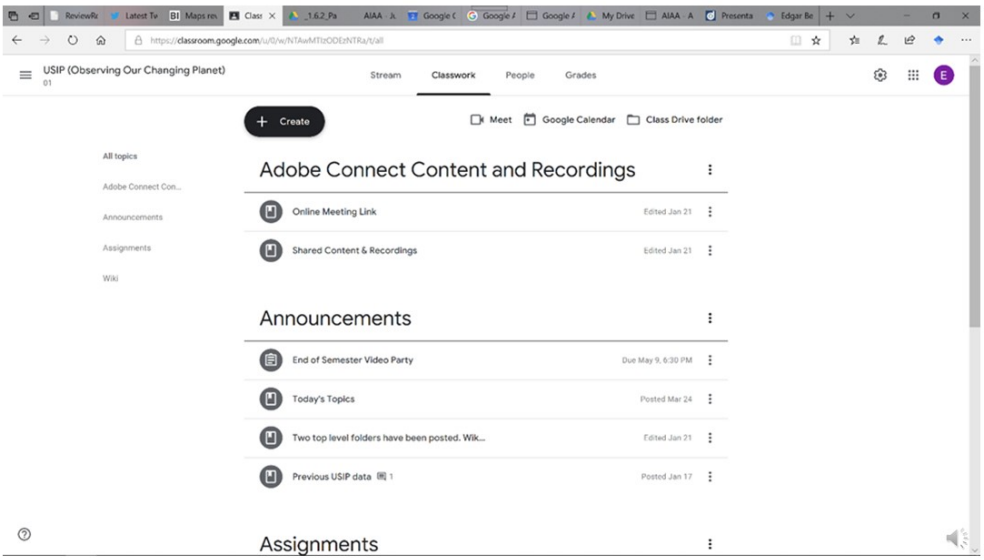
Classroom Structure



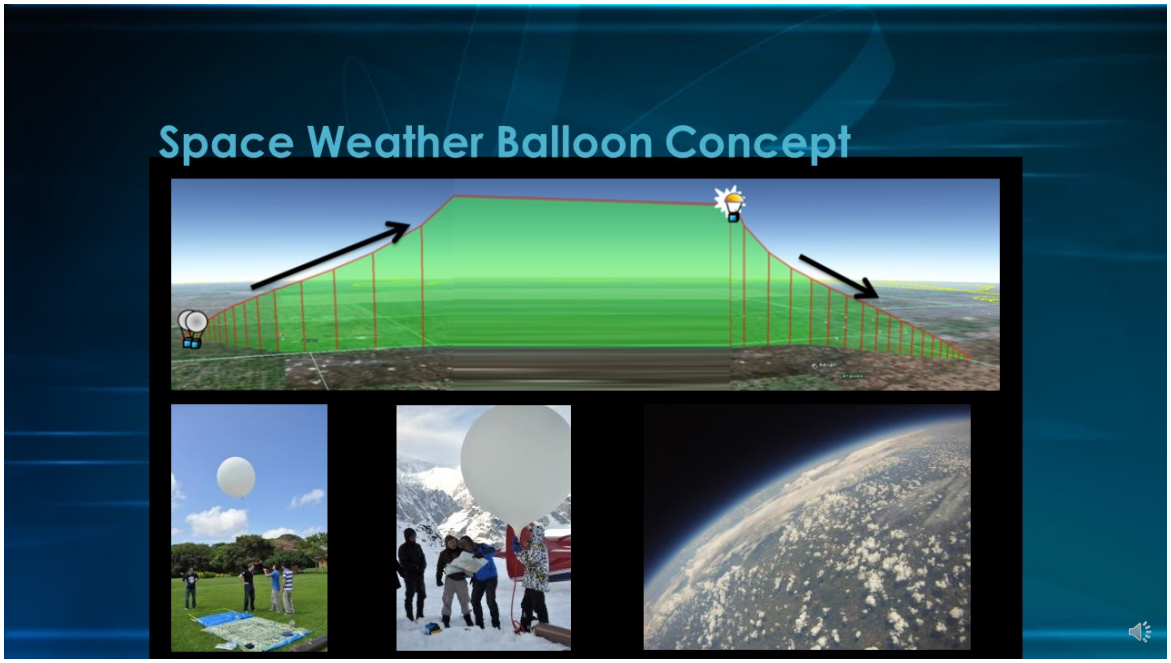


Work is separated into topics for easy organization and features the **Class lectures, Announcements/ Resources**, **Assignments** and the **Wiki** (which is the main collaboration point of the project. It contains student **Microblogs**, **Gantt Charts, Personal Folders** and **Data File Structures**)

Classroom Structure, II

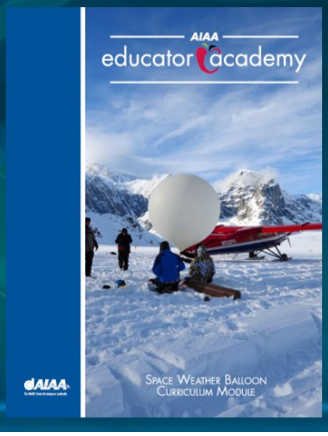



Operations
HOW DO WE DO THIS?


Space Weather Balloon Concept

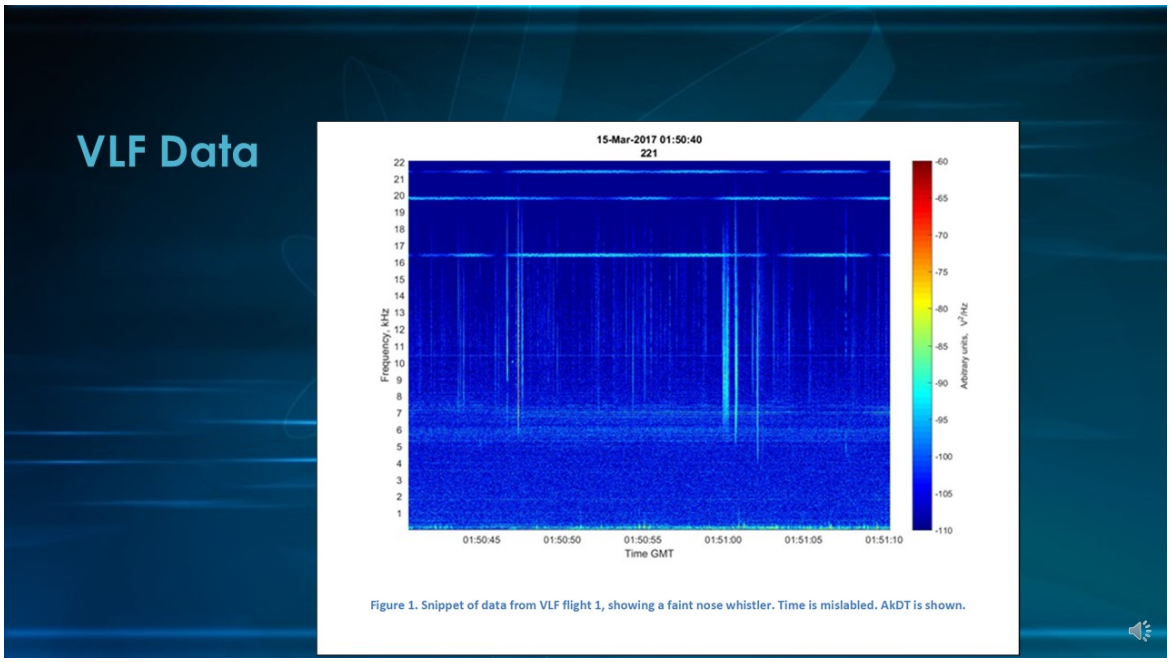
Curriculum Module

- Contains a 12 week lesson unit plan for the classroom to prepare for
  - Planning, Launch/Recovery
  - Experiment ideas
  - List of supplies



CAPTURE THE EXPERIENCE (4)

Share the Joy



Airglow Data

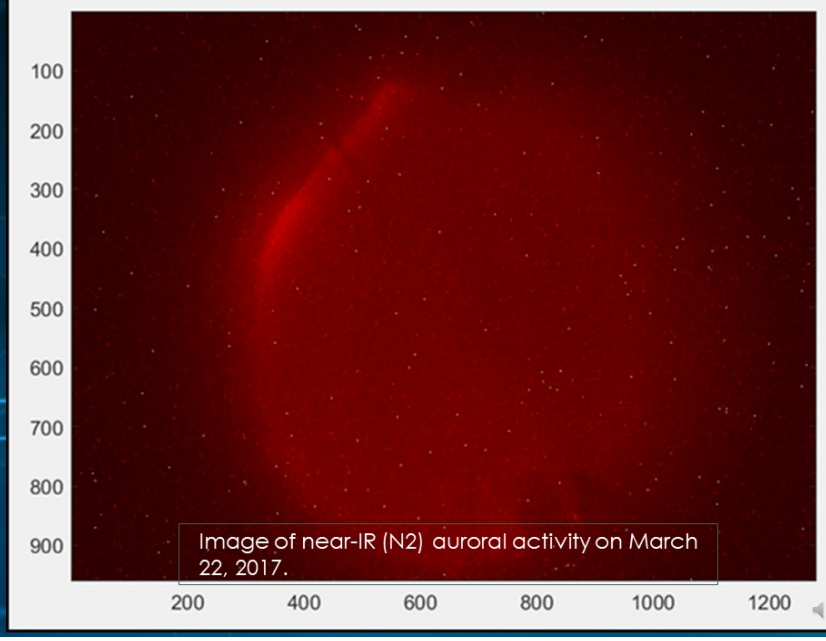
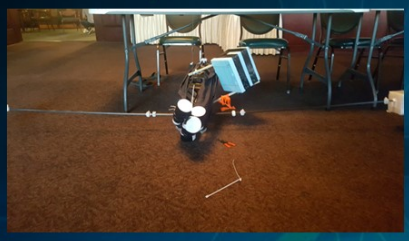


Image of near-IR (N2) auroral activity on March 22, 2017.

Spectroscope



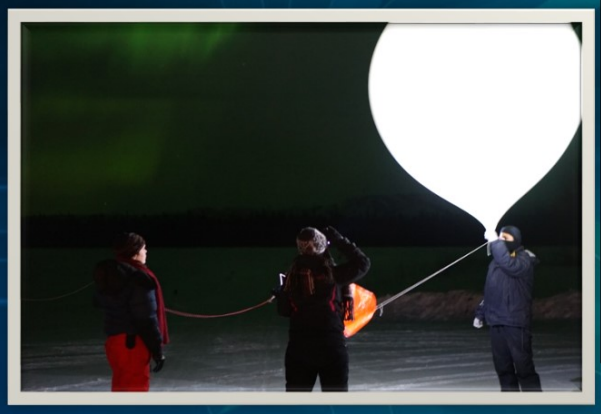
Star Tracker

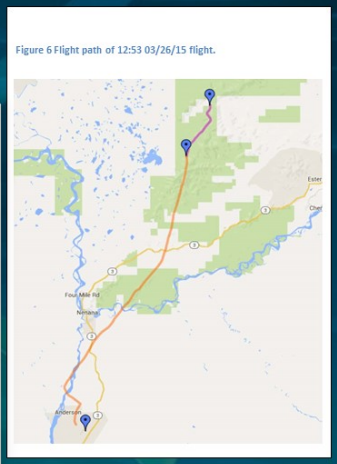
Ozonesonde

Field Experiences

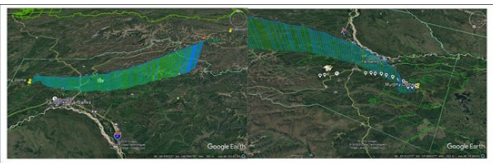
UP, UP AND AWAY

USIP I Alaska Flight Path (typical)





USIP II Alaska Flight Paths



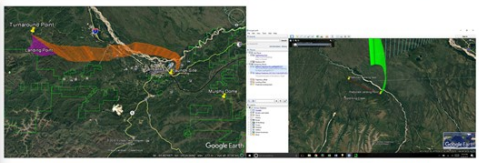


Figure 1. Flight paths of 10:45 03/17/15 (upper left); 11:50 3/20/2017 (upper right); 4:28 3/25/2017 (lower left).

Figure 2. Predicted end points of unrecovered flight 1, 02:56 3/13/2017 (lower right).

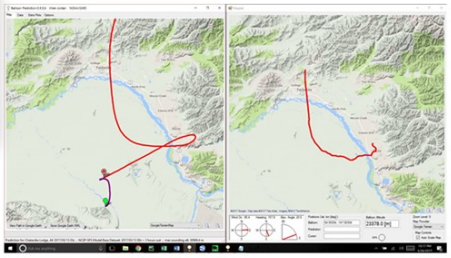


Figure 3. Predicted vs actual flight path, trace gasses flight.

USIP II Sweden Flight Paths

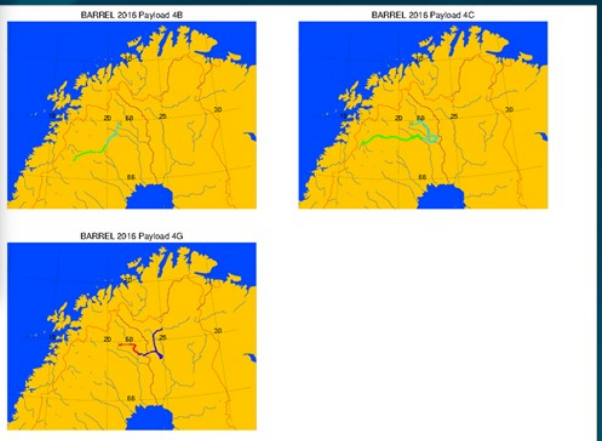
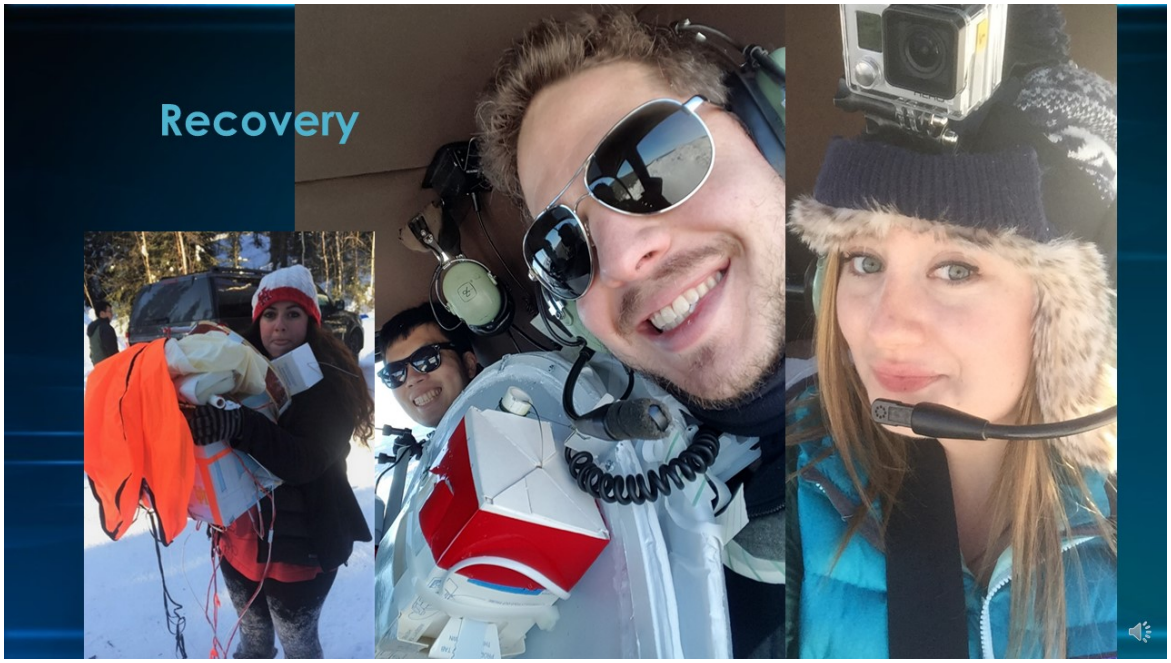
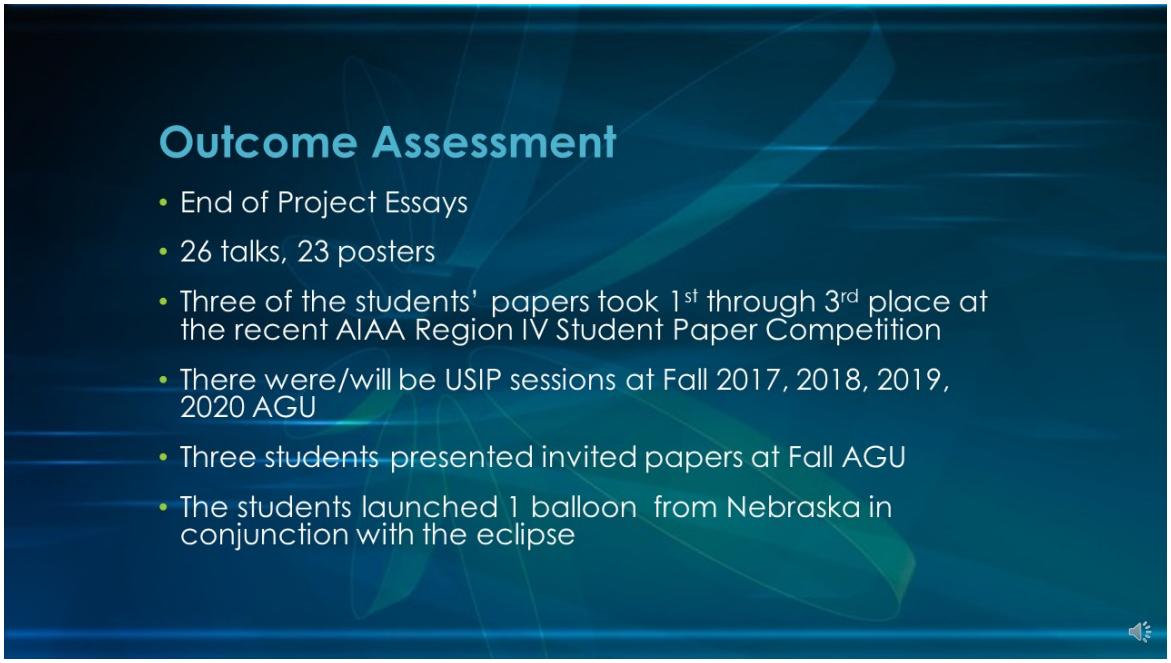


Figure 1. Maps of the three Barrel 4 flight tracks for the USIP UH piggy back flights. Change of track color indicates change of day.


Recovery

ASSESS THE OUTCOME (5)

Celebrate Acheivement


Outcome Assessment
• End of Project Essays
• 26 talks, 23 posters
• Three of the students' papers took 1st through 3rd place at the recent AIAA Region IV Student Paper Competition
• There were/will be USIP sessions at Fall 2017, 2018, 2019, 2020 AGU
• Three students presented invited papers at Fall AGU
• The students launched 1 balloon from Nebraska in conjunction with the eclipse

AUTHOR INFORMATION

University of Houston

ABSTRACT

The Undergraduate Student Instrumentation Project (USIP) was a NASA program to engage undergraduate students in rigorous scientific research, for the purposes of innovation and developing the next generation of professionals in space research. The program is student led and executed from initial ideation of research objectives to the design and deployment of scientific payloads. The University of Houston was selected twice to participate in the USIP programs. The first program (USIP_UH I) ran from 2013 to 2016. USIP_UH II ran from 2016 to 2019. USIP_UH I (USIP_UH II) at the University of Houston was composed of eight (seven) research teams developing six (seven), distinct, balloon-based scientific instruments. This project was a for-credit course two years in duration. The program has been so successful in terms of improved student career outcomes the University has decided to continue the project with purely local funding. The pandemic has produced a substantial instructional challenge since this project is a lab class! The virtual classroom that we designed to meet this need provides tools for ongoing collaboration, revisions, storage, project planning, systems engineering, and a tool to request immediate feedback from faculty and fellow researchers. Additionally, the classroom provides an ongoing place to store data from different students for many years. New students can use this continuity in a consistent and secure way. We also provided tools for conferencing and communication. A combination of several tools were selected and customized to meet this need. These tools include Google Classroom, Microsoft Teams, Slack, Git, Groupme, and Zoom.