Laboratory for Atmospheric and Space Physics
University of Colorado **Boulder**

Additional logo area (NASA, SwRI, etc)

Making Connections in Astronomical Science

Based upon ideas from a Framework for K-12 Science Education

Erin Wood

Next Generation Science Standards
Science Practices

- Developing and using models
- Analyzing and interpreting data
- Constructing explanations
- Engaging in argument from evidence

Do students understand the importance of models?

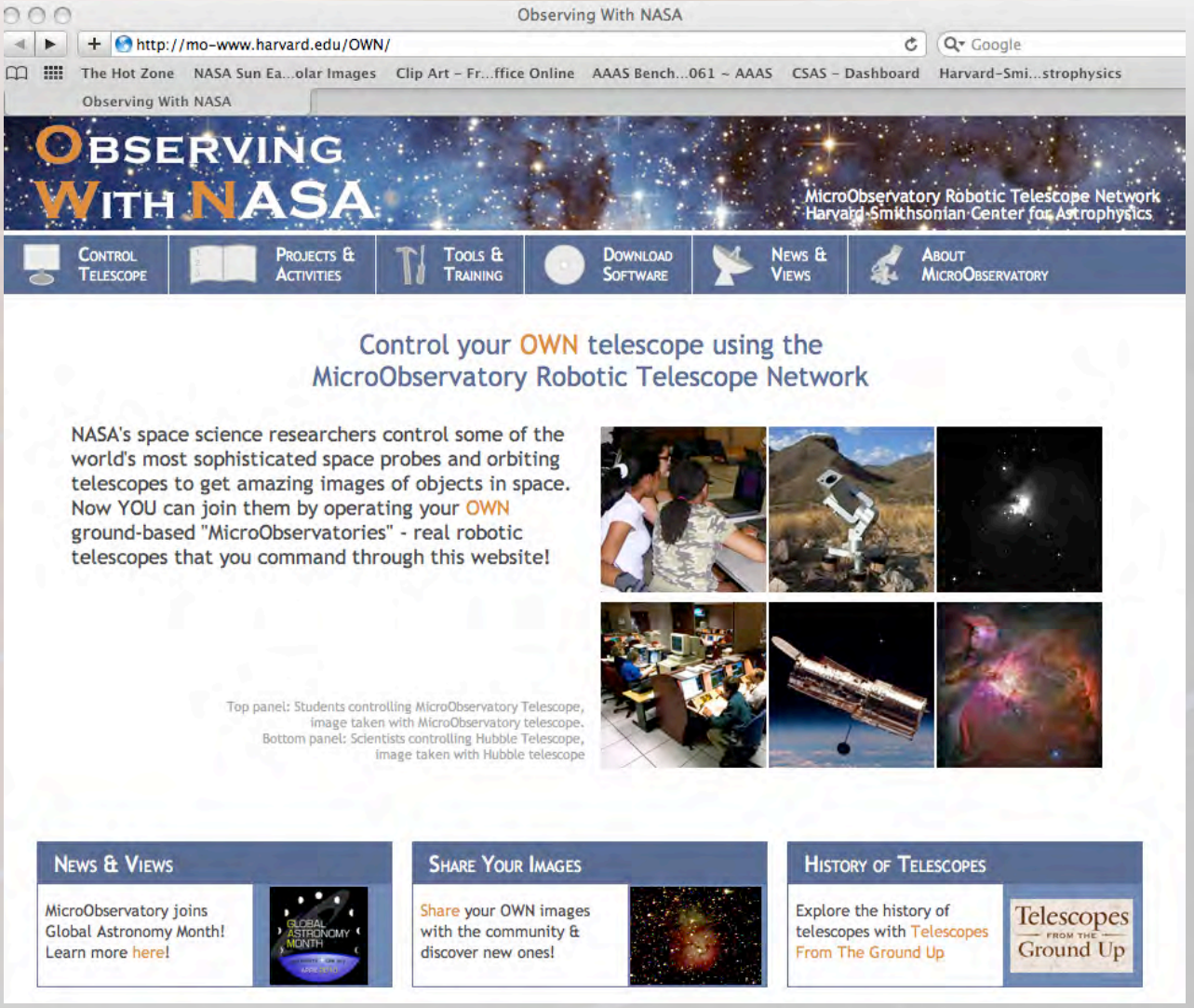
What types of models do you use in the classroom?

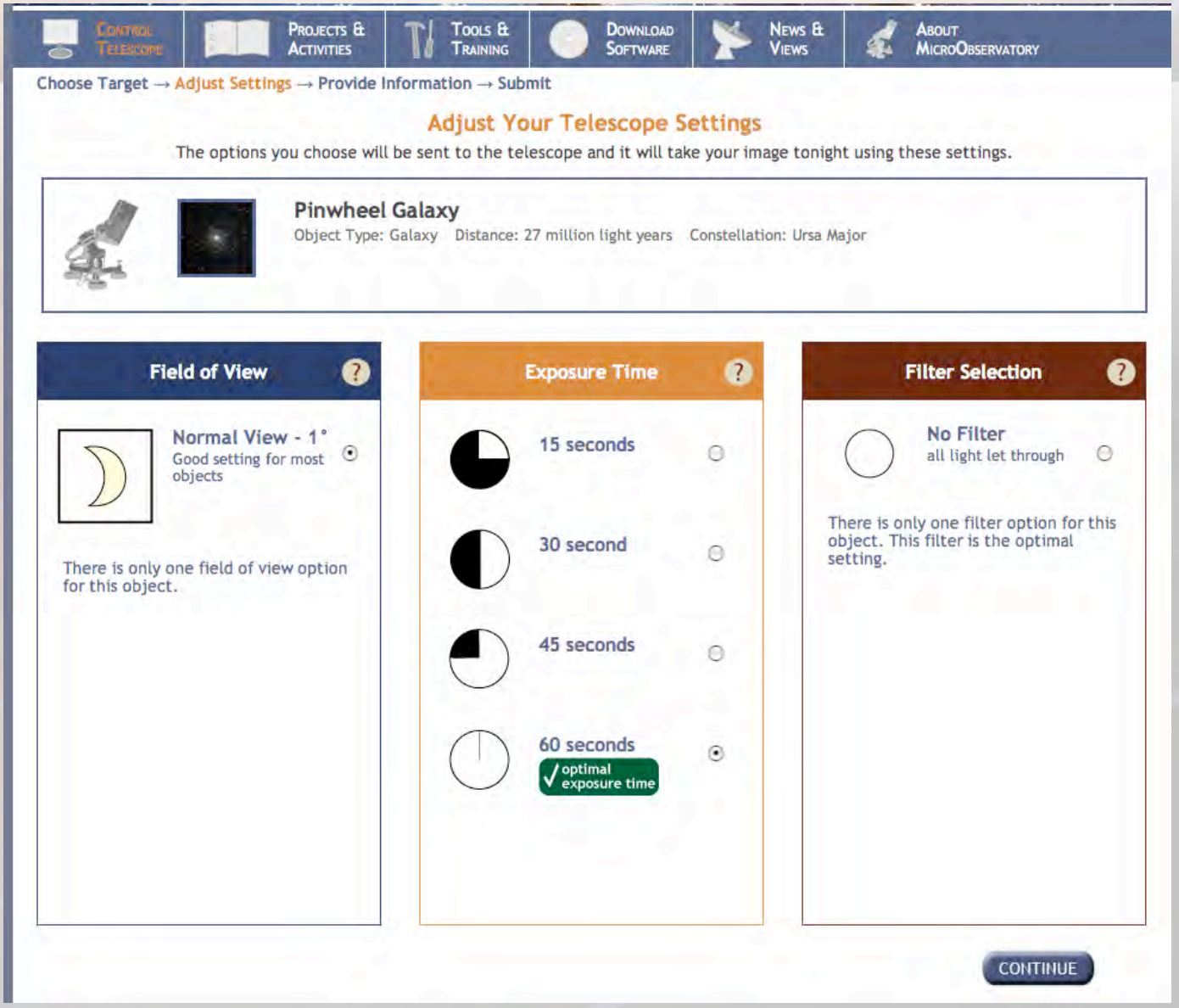
Analyzing and Interpreting Data: Types of real data for your class

- Raw
- Pre-processed for the class
- Citizen science (pre-packaged)
- Authentic classroom exploration

Why is authentic data powerful?

Resources for Classroom Friendly Data Observing with NASA




Control Telescope
Projects & Activities
Tools & Training
Download Software
News & Views
About MicroObservatory
Choose Target → Adjust Settings → Provide Information → Submit
Adjust Your Telescope Settings
The options you choose will be sent to the telescope and it will take your image tonight using these settings.
Pinwheel Galaxy
Object Type: Galaxy Distance: 27 million light years Constellation: Ursa Major
Field of View
Normal View - 1°
Good setting for most objects
There is only one field of view option for this object.
Exposure Time
15 seconds
30 second
45 seconds
60 seconds
optimal exposure time
Filter Selection
No Filter
all light let through
There is only one filter option for this object. This filter is the optimal setting.
CONTINUE

Choose Target → Adjust Settings → Provide Information → Submit

Your request for a telescope image has been submitted!

Here are your settings that will be used by the telescope to take an image tonight:

Target: Pinwheel Galaxy

Object Type: Galaxy Distance: 27 million light years Constellation: Ursa Major

Field of View: normal Exposure Time: 60 Seconds Filter Selection: none

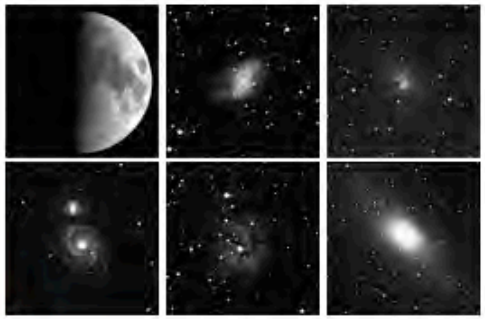
Your email address: erin.wood@lasp.colorado.edu

Tomorrow or the next day you will receive an email notification from MicroObservatorySupport@cfa.harvard.edu with a link to download your image.

Keep your fingers crossed for clear skies!

What's next?

- To see recently-taken images, visit the MicroObservatory Image Directory
- To take more images, go to Control Telescope
- To find things to do with your images, explore Projects & Activities
- Compare your OWN images to NASA's Great Observatories - Hubble - Chandra - Spitzer
- Give us your feedback on your MicroObservatory experience



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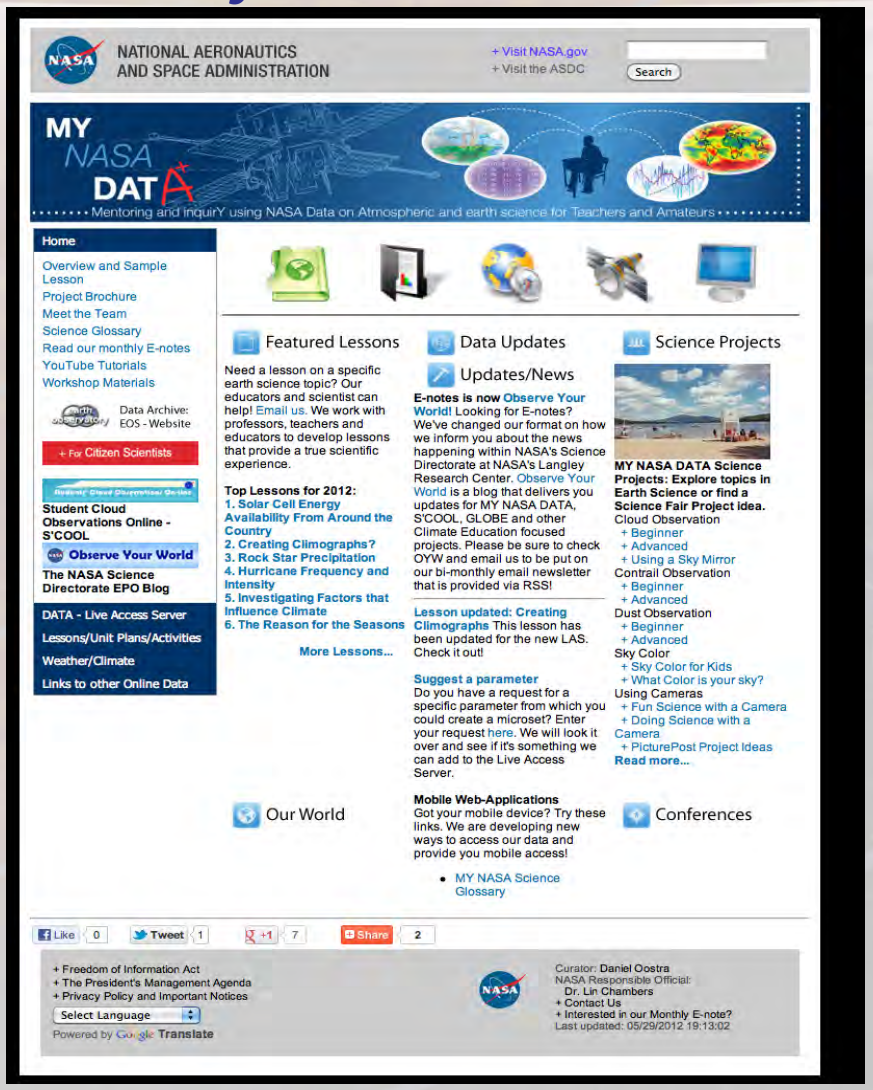
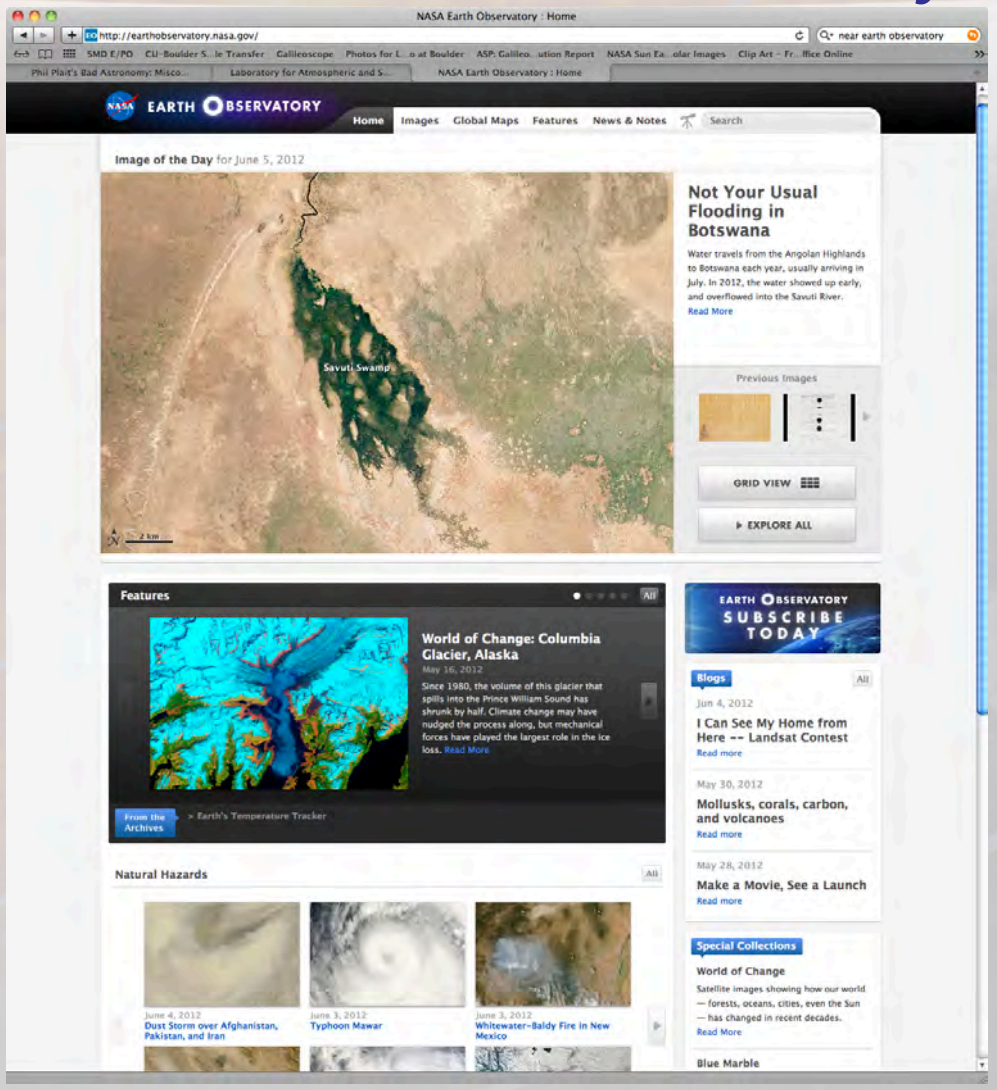
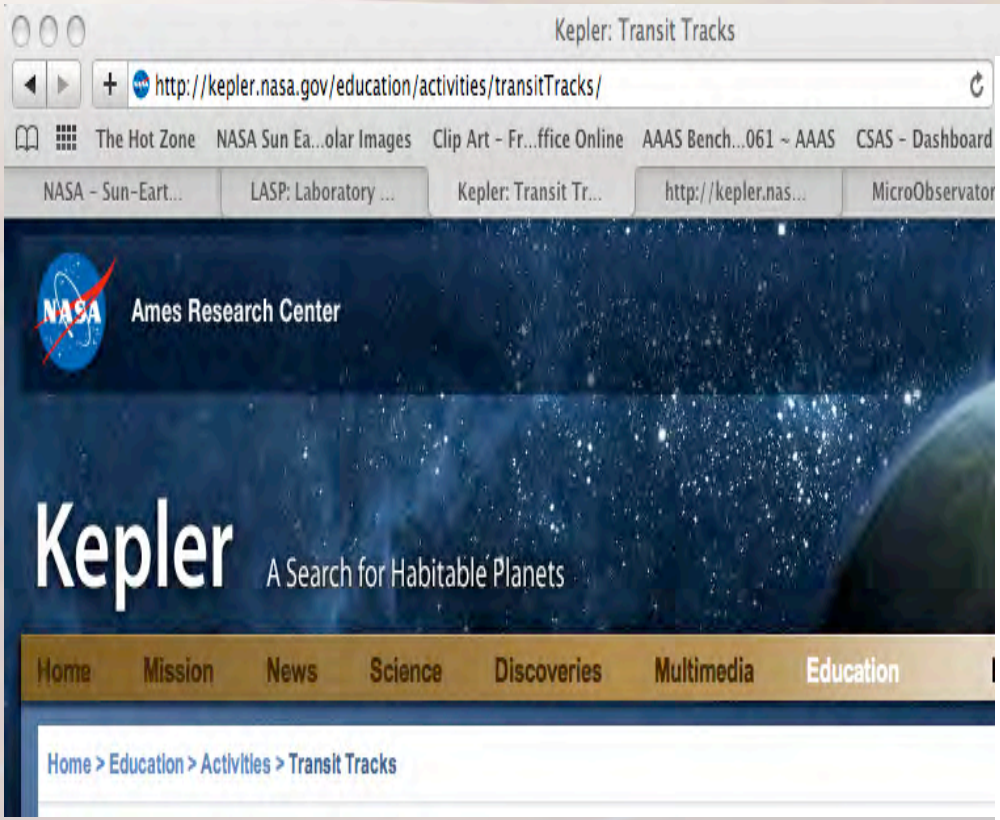
Resources for Classroom Friendly Data MyNASAdata

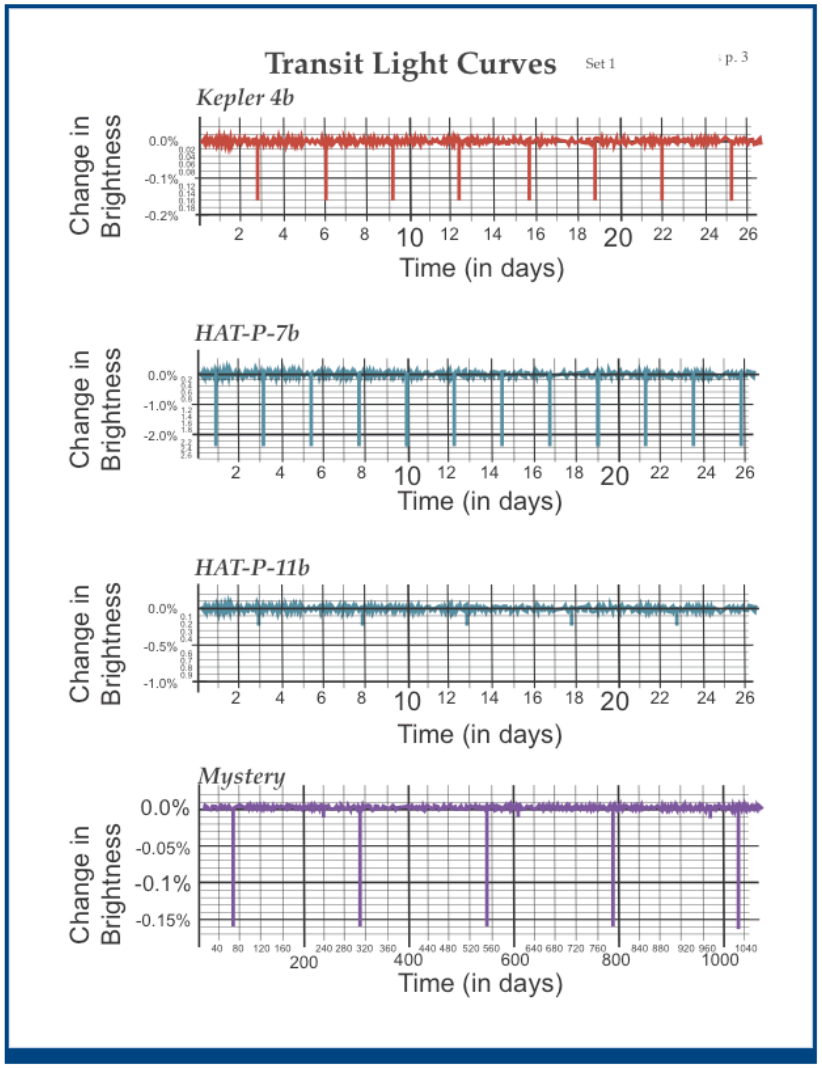


Resources for Classroom Friendly Data
NASA Earth Observatory



Resources for Classroom Friendly Data
Pre-packaged data: Missions





Pre-Packaged Data: Institutes

Laboratory for Atmospheric and Space Physics

http://lasp.colorado.edu/home/education/K-12/project-spectra/

SMD E/PO | CU-Boulder S...le Transfer | Galileoscope | Photos for L...o at Boulder | ASP: Galileo...ution Report | NASA Sun Ea...olar Images | Cli

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LASP — Laboratory for Atmospheric and Space Physics

About | Science | Engineering | Mission Operations & Data Systems | Education

Education

- K-12
  - Space Weather Compendium
  - Climate Change Compendium
  - Dancing Lights
  - Project Spectra!
  - Space Science Teachers Summit
  - Outer Planets
  - The Sunspot Newsletter
  - Interactive Lessons
  - Additional Programming
- Research Experiences for Undergraduates
- Engineering for Success
- MAVEN mission E/PO
- CCLDAS E/PO
- Media/Journalist Professional Development
- Workshops
- Personnel

Project Spectra!

Current Update

"Project Spectra!" is a NASA Approved Product and is being developed with NASA funding. We will offer teacher professional development workshops in 2011; please contact us at epomail@lasp.colorado.edu for more information.

The goal of "Project Spectra!" is to advance knowledge of Solar System exploration by providing students with actual spectroscopic data in an accessible format. (Courtesy LASP)

Introduction

"Project Spectra!" is a science and engineering program for 6th - 12th grade students, focusing on how light is used to explore the Solar System. "Project Spectra!" emphasizes hands-on activities, like building a spectrograph, as well as the use of real data to solve scientific questions.

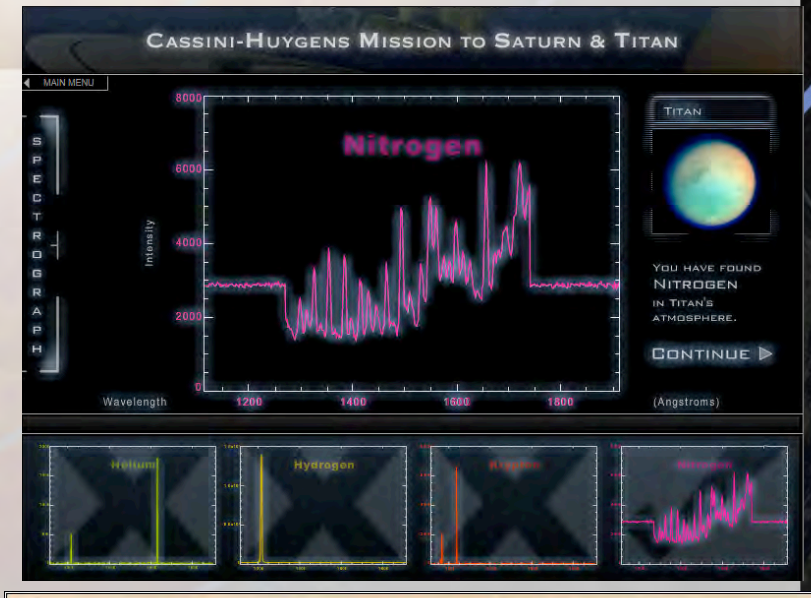
Here, you will find lessons for middle school students that can also be easily adapted for high school students or modified for elementary school students. Each lesson has a front page listing national standards in science and mathematics, prior knowledge students need for the lesson, materials, and time to complete the lesson. We have also provided tables listing national standards the lessons conform to, and a scope and sequence. We have included fun and informational links to explore the nature of light and spectroscopy further.

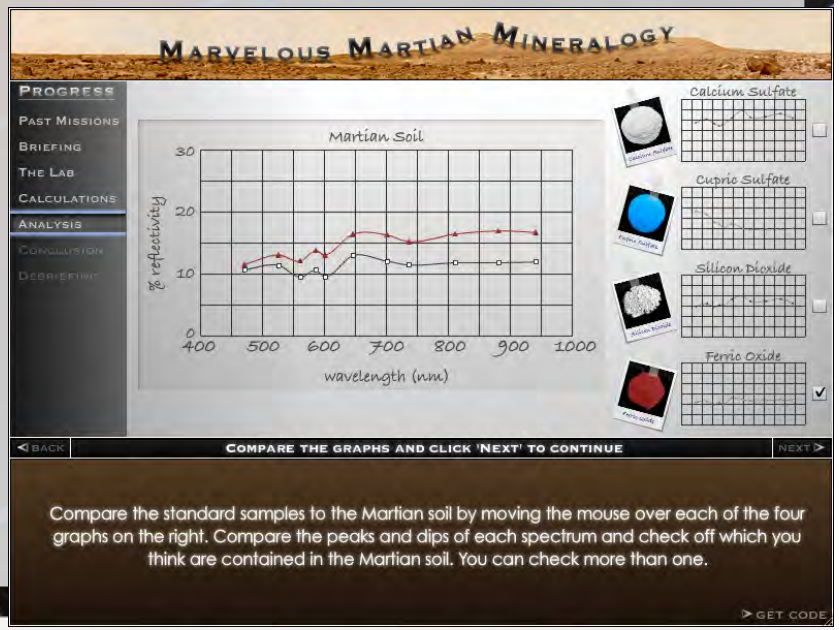
What is a Data Story?

A data story is an inquiry driven, standards-based lesson using real data from actual spacecraft! Each data story is a cogent, well-bounded story of solar system exploration that is accessible to students.

Activities

- Scope and Sequence (102 KB PDF)
- Standards (119 KB PDF)





LASP

If students engage in authentic science using real data will they…

- Construct explanations?
- Engage in argument using evidence?

Are there differences between a student driven investigation and learning that occurs in a pre-packaged lesson?

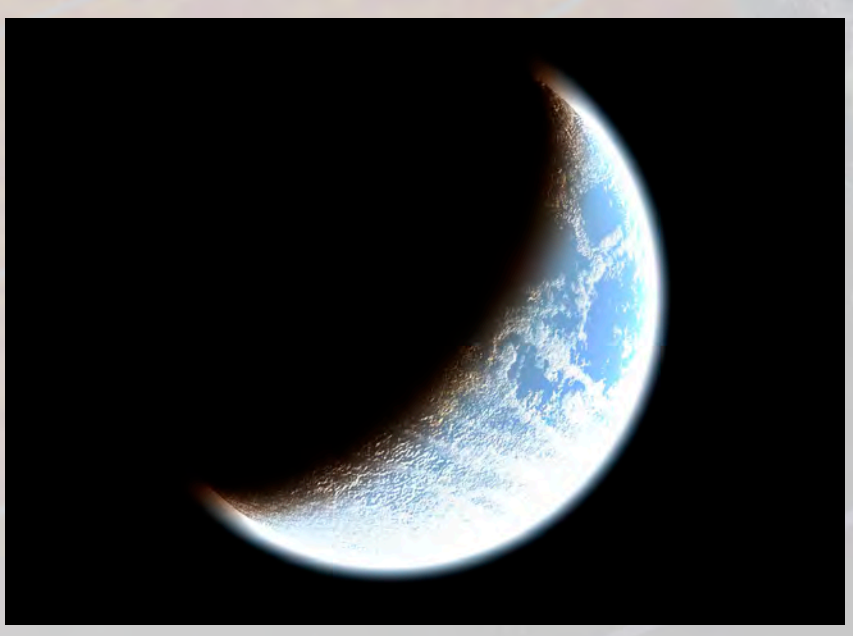
Help students construct explanations of observations/ engage in arguments using data. Start simple!

- Phases of the moon
- Seasons
- Solar cycle
- Planetary motions
- Much much much more…

Do your students walk in the door with pre/ misconceptions? How do you probe for this?

Next Generation Science Standards: Crosscutting Concepts

- Patterns
- Cause and Effect: Mechanisms and Explanation
- Systems and System Models

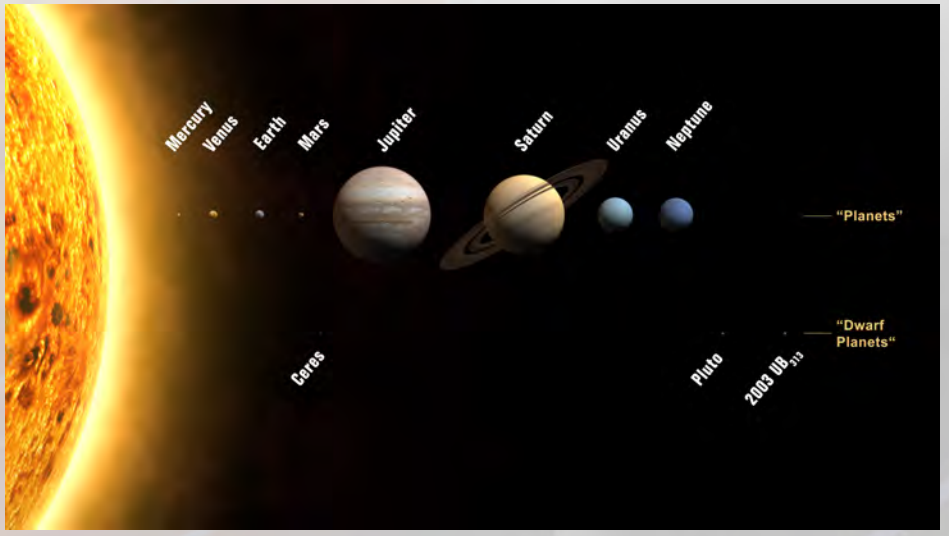


Click to add image credit info

No "march of the solar system" when discussing patterns

Earth is one body in our solar system. Are we alone?

- Weather systems
- Cycles
- Seasons
- Geology



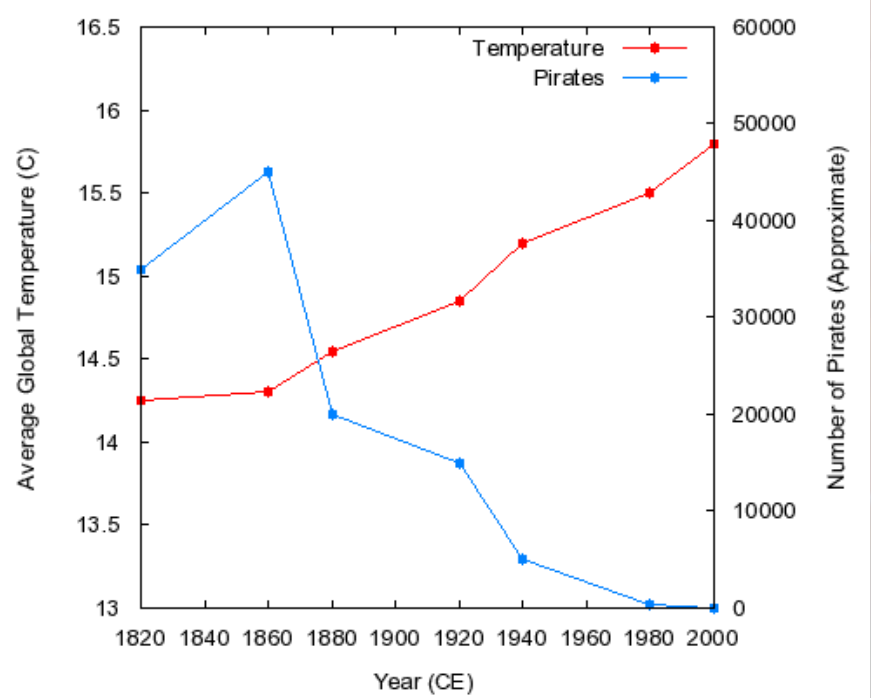
Seeing the Bigger Picture

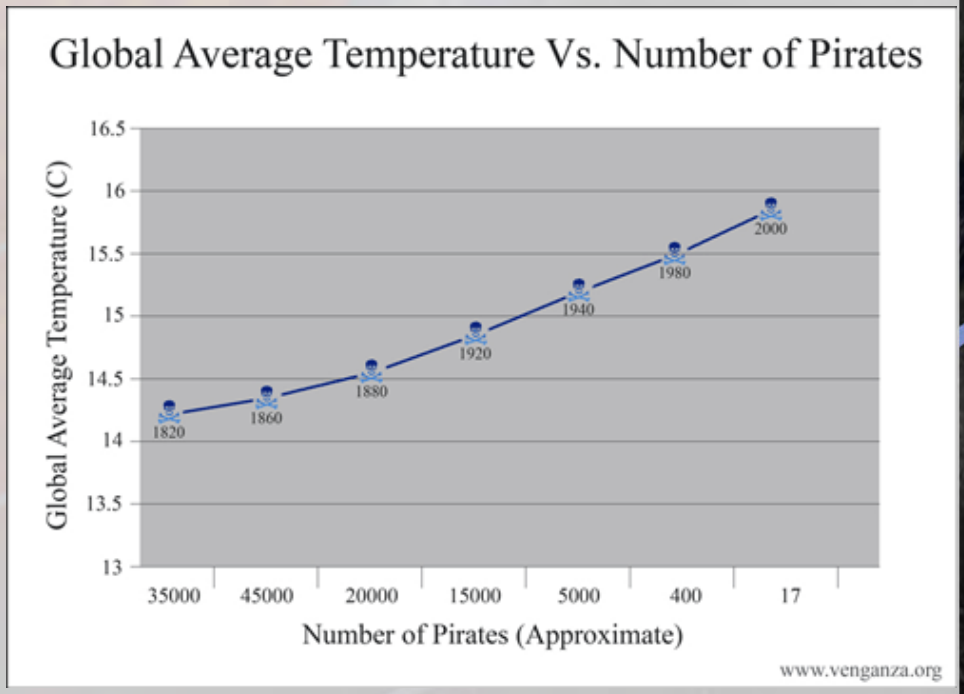
- How the Sun affects climate
- How the Sun influences wind/weather
- How the planets orbit the Sun (and how that effects temperature)
- How the Sun is one “middle of the road” star out of 100 billion stars in our galaxy and 100 billion galaxies
- How we are one planet, potentially out of billions, orbiting other stars

What patterns do you use in your current teaching practice that you could tie to astronomy?

Cause and effect: Mechanisms and Explanation

- Can students identify causation v. correlation?





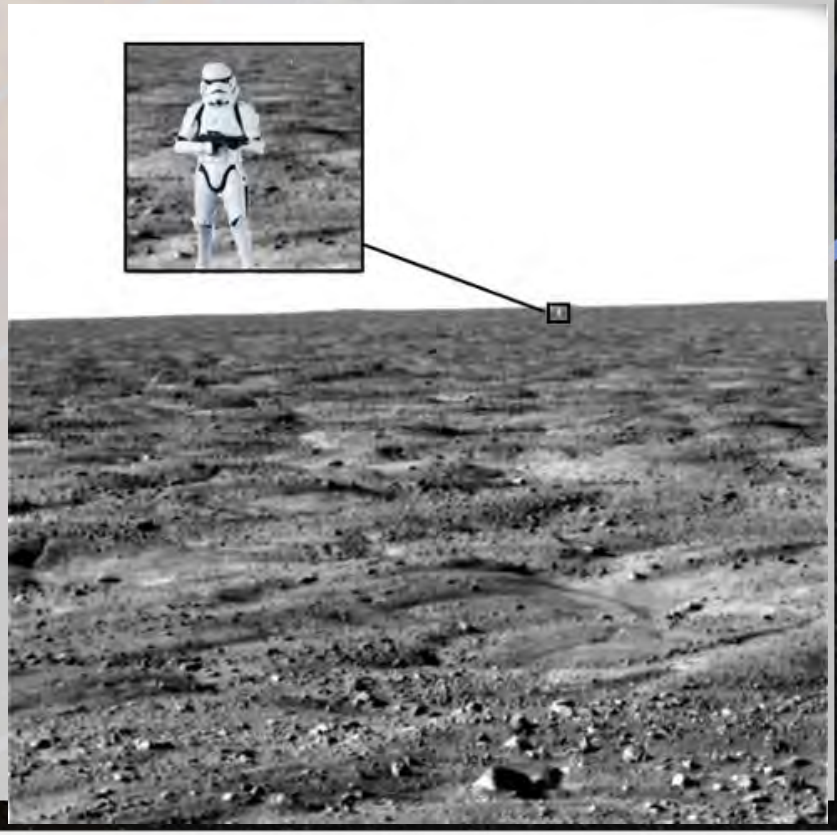
Note: Church of the Flying Spaghetti Monster's definition of pirate designates resent pirate activity as "pseudo piracy"

Can students evaluate scientific evidence? Can they think critically?

Think of Examples of Media/public/conspiracy -Induced Misunderstandings…And ways to combat these misunderstandings.

Think-Pair-Share

- 1 minute to think
- 1 minute to write
- 2 minutes to discuss with a neighbor



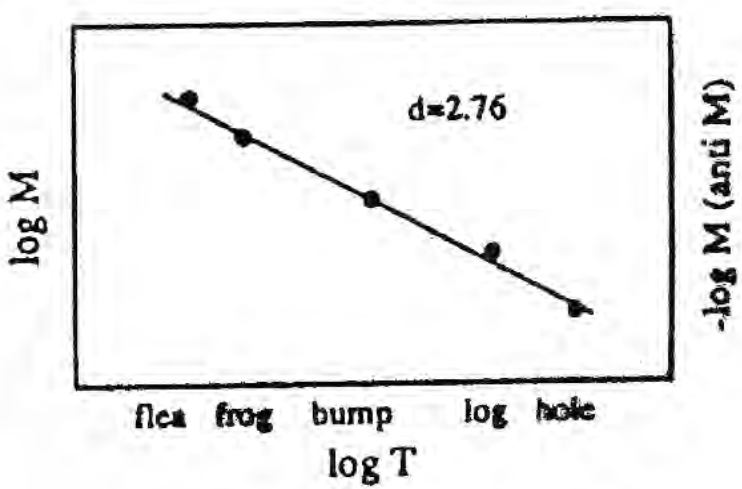
Can Students Make Sense of Data?

T22B-1P 1330h POSTER

Fractal Analysis of Deep Sea Topography

Marc Spiegelman and Chris Scholz (Lamont-Doherty Geological Observatory, Palisades, NY 10964; 914-359-2900)

Recent high resolution mapping of deep-sea topography shows clearly that there's a hole in the bottom of the sea. To repeat, there's a hole in the bottom of the sea. There's a hole—there's a hole—there's a hole in the bottom of the sea. Moreover, more careful analysis indicates that there is a multitude of scale lengths in the bathymetric data. For instance, there's a log in the hole in the bottom of the sea. There's a bump on the log in the hole in the bottom of the sea. There's a frog on the bump on the log in the hole in the bottom of the sea. And there's a flea on a frog on a bump on a log in a hole in the bottom of the sea. There's a flea—there's a frog—there's a hole in the bottom of the sea. Figure 1 shows the 5 orders of magnitude inherent in the data plotted in log-log space and indicates a fractal dimension $d = 2.76$. Plotting in log-frog space gives $d = 2.5$. No attempt has been made to understand this result.



LASP

Systems v. System models: How we observe the unobservable, predict, and explain

- Trace back through Mars history?
- Predict climate change?
- Understand the physics of the upper atmosphere?
- Understand Earth's radiation belts?
- Model motions of a star?
- Predict what's happening beneath the photosphere of the Sun?

What teaching techniques do you use to explain how models support observations?

And finally… It must be engaging. What are ways we can accomplish this?

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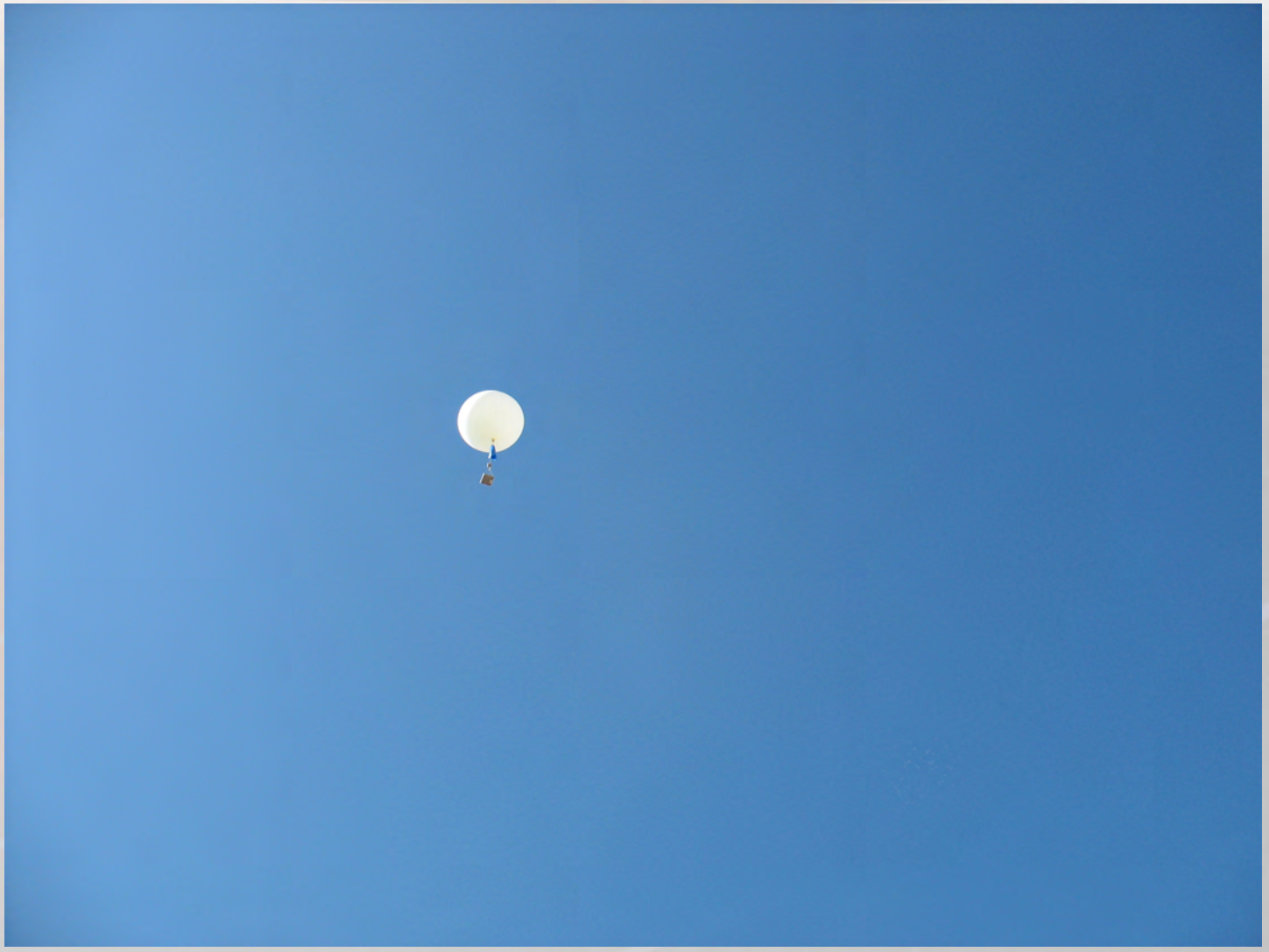

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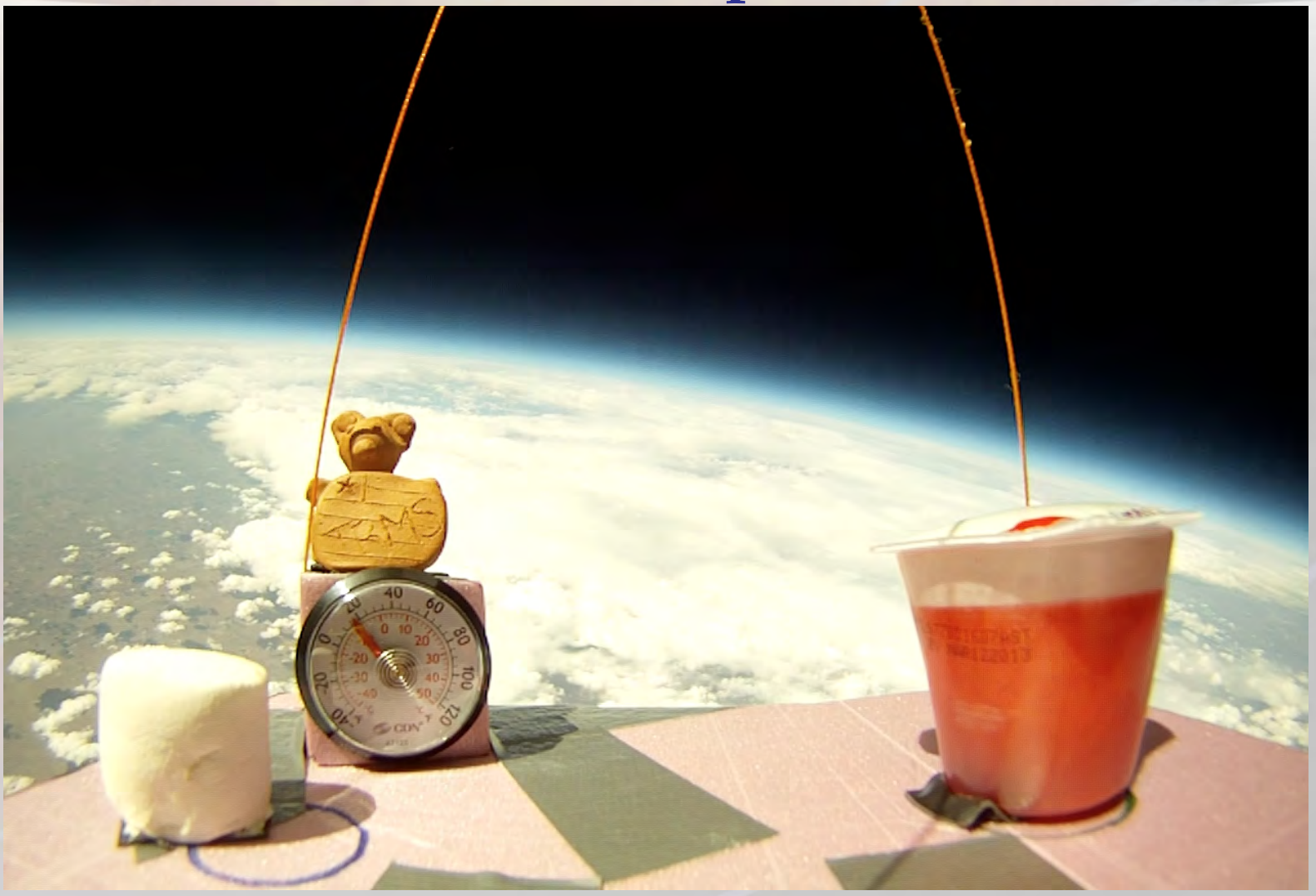

Final thoughts?