LUNAR University Network for Astrophysics
Education and Public Out

Doug Duncan and Matt Benjamin

Get students to understand the science

Get the public to support it!

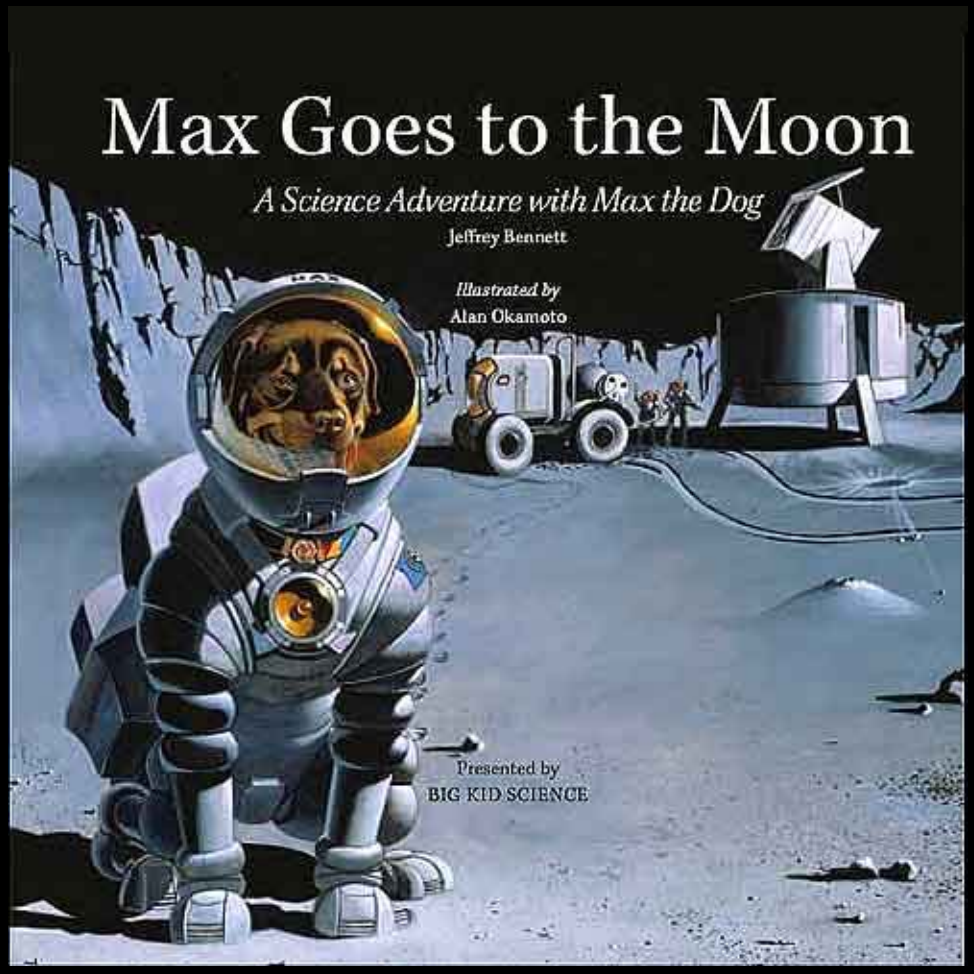
LUNAR

EPO Goals for LUNAR

Write and Produce 2 Planetarium Shows:

- One for adults, one for children
- Teacher (k-12)workshops
- Robotics Competition (conceived by Joe Lazio at the Naval Research Lab and supported by NLSI)
- Graduate Student Seminar (led by Burns, Horanyi, and Bottke)

Education and Public Outreach



- **Planetarium Program**

  Max Goes to the Moon

Based on the award winning children's book by Jeff Bennett

Fiske programs are distributed for free, used by many small and mid-sized planetariums

Only US planetarium that routinely produces bilingual shows

Education and Public Outreach

If we call on you to interview, say yes!

- **Adult Planetarium Program**

  "Cosmic Dawn"

Our programs cost only 3% of what New York costs to produce

We don't have Jody Foster or Tom Hanks narrate

We have Andrew Hamilton, Fran Bagenal, or Jack Burns

Ours last twice as long and have more science in them

Graduate Student Seminar co-led by

The Center for Lunar Origin and Evolution (CLOE) led by Bill Bottke ,
The Colorado Center for Lunar Dust and Atmospheric Studies (CCLDAS) led by Mihaly Horanyi
and
the Lunar University Network for Astrophysics Research (LUNAR) led by Jack Burns

Jan 12: Astrophysics: Overview of Astrophysics from the Moon - Jack Burns

Jan 19: Astrophysics: Lunar Laser Ranging - Jordan Mirocha

Jan 26: Astrophysics: Evolution of the 21-cm Signal Throughout Cosmic History - Dr. Geraint Harker

Feb 2: Astrophysics: Science with a Low-Frequency Array - Anthony Smith

Feb 9: Science of the Moon: Bombardment History of the Moon - Bill Bottke

Feb 16: Science of the Moon: Lunar Mare Volcanism - Elizabeth Frank

Feb 23: Astrophysics: Heliophysics & Low Frequency Emissions from the Sun -

Mar 2: Science on the Moon: Observations of the Lunar Horizon Glow - Mihaly

Mar 9: Science of the Moon: Ancient Lunar Crust - Michelle Hopkins

Mar 16: Science of the Moon: Lunar Interior - Seth Jacobson

Mar 23: Spring Break - No class!

Mar 30: Science on the Moon: Photometric Studies of Light Scattering above the lunar terminator from Apollo solar corona photography - Addie Dove

Apr 6: Science of the Moon: The Poles of the Moon - Robert Citron

Apr 13: Science on the Moon: Simulations of the lunar wake - Andrew Poppe

Apr 20: Science on the Moon: Experimental levitation of dust grains in a plasma sheath - Mike Chaffin

Apr 27: Science on the Moon: Experiments on dust transport in plasma to investigate the origin of the lunar horizon glow - Dr. Xu Wang

All lectures available over Adobe Connect!

Teacher Workshops

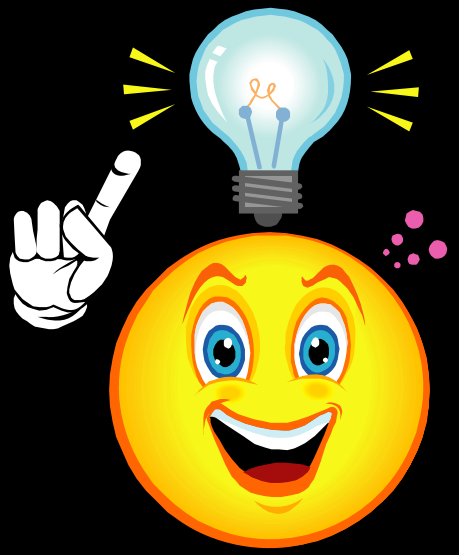
At CU we base our teaching on extensive research in how people learn science.

This is a $8M, 10 year, >15 person effort so far…

Traditional Model of Education

Individual ← **Instruction via transmission** **Content**

It is the ***students*** who must be actively engaged and thinking to learn!



Applets such as http://PHet.colorado.edu

We now know the subjects students will find difficult before they enter class!

So we tailor the curriculum to focus on difficult subjects.

e.g. expansion demo…

MAKE YOUR OWN DOPPLER BALL

Components

Components listed are the ones we used, similar ones can be substituted. Descriptions below are from the labels found at Radio Shack.

- **Piezo Buzzer** **OR** **Piezo Buzzer**

CAT. No. 273-068
Archer brand
User-selectable pulsing or constant tone (use the constant tone connection)
4-28 volts DC, 2.8 kHz

Cat No. 273-060B
Radio Shack brand
3-28 volts DC, 3.5 kHz

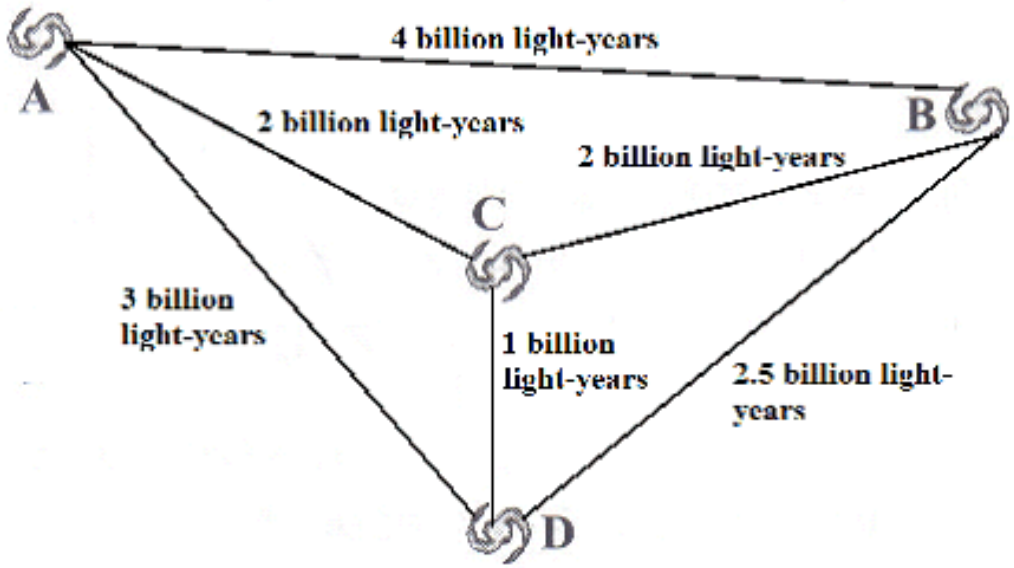
This buzzer is not quite as loud as first one listed, but would be loud enough to work well in a contained classroom situation. The other buzzer is REALLY loud, and works well in crowded museum galleries.

+ Whiffle Ball. 9V battery. Switch.

Hubble's Law

Consider the small section of the universe containing four galaxies (A-D), shown in Figure 1 below. The distances between each galaxy are also shown.

Figure 1



1) Imagine that this section of the universe doubles in size over time due to the expansion of the universe. Draw what the above section of the universe would look like after it doubles in size. Be sure to identify the new distances between the galaxies.

3) Two students are discussing their answers to Question 2:

Student 1: *All of the distances doubled, so all of the distances increased by the same amount. There is no one galaxy who's distance from Galaxy A increased the most.*

Student 2: *You're right that all the distances double in size, but I don't agree that they all increase by the same number of light-years. Since Galaxy B was the farthest away from Galaxy A initially, its distance will increase by the greatest number of light-years when this section of the universe doubles in size.*

Do you agree or disagree with either or both of the students? Explain your reasoning.

Robotics competition…