**1 session 1 MONDAY July 25, 2011**

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**Why are we here?**

Upgrade lunar program

Lunar data

Astronomy clubs

CEUs certificates

Moon interior/seismic

Lunar geology

Learn from each other

Student lunar research project

Observing the Moon

Moon maps/topo

Moon’s gravity interactions with Earth

Hands-on

Pedagogy / techniques

Summer experience

Applications to chem. And physics

Activity

**Balls/flashlight**

#1

basketball 22 ft from tennis ball

can rotate sphere HALF BLACKENED

--activity to start the students thinking about the topic

(using vocabulary, learning from others

limitations of activity)

**Correcting misconceptions**

We have been to the Moon

The Moon does not shine—it reflects sunlight: Moon NOT a STAR

Does not have atmosphere ? production of V. small amount of outgassing from sunlight on surface material

Not formed at same time as Earth

No werewolves

Phases are not about Earth’s shadows (dark part of the Moon = night on the Moon)

Moon’s rotation—same side faces us—need activities to visualize this. (Students are spatially challenged)

Moon does have gravity—1/6 Earth

All sides of the Moon are illuminated (Dark side not always the same side)

Moon is not a planet

Moon orbits in elliptical path (not circular with changing speed)

Moon inclined at 5o Not a misconception rather they don’t know it . . .

Craters are not the same age—there is on-going crater formation

Use terms far side/near side

 Or Night/Day on Moon

Confusion of words rotation and revolution

Rotate T for turn (inside axis) SHORTER period, revolve O for orbit (outside axis) LONG time period

Solar system/galaxy/universe DIFFERENT-not the same . . .

**CRATERING ACTIVITY**:

Bring in new information about Moon observation

Mini RF using radar images—shadow regions as well as below the surface Using UV—beyond the visible spectrum

Use detergent with whitening agent which glows in UV light

Extra materials in the flour to investigate more

(using a different light source to generate more conclusion)

compare visible light data to UV data

Impact crater allows us to see below the surface

UV reveals hidden data

Can pick up water signature below the surface of the Moon

(remove the impactor and take pictures again)

UV activity allows you to see beyond the obvious

Overlay images—both visible and UV . . .

Analogy to mini RF, which uses RADAR

Rays, rim, crater, ejector blanket—see peak in center—model does not do the latter

Asteroid is larger than the impact—melts and rebounds in reality—not seen in model

Crest bouncing back up

Terraces in the crater

Activity measure amount of impactor protruding then the whole ball to get the crater depth

Etc.

Variables you can measure

Different masses

Different volumes

Different heights

Movie and SLOW it down . . .

If use irregular shape (rubber stopper—it will alter the shape of the crater—this doesn’t happen in real life).

In real life the impactor disappears/is vaporized

\*\*\*SPLAT:

Get them to predict the diameter of the splat . . .

Water balloons—and pavement

Width of water balloon—throw on ground

Creates puddle and rays

Measure the continuous puddle (not rays)

Wet area 10-20 times diameter of the original balloon

Splat does not crater—modeling

Impactor disappears—this is like the real one where the impactor is vaporized

(cotton balls with paint for secondary cratering drop every 10 seconds—and two regions and one continuing other stop—the one with fewer craters is younger—Moon more highly cratered therefore older

Earth younger surface but Earth features covered up by weathering, plants, ocean, etc.

Yucatan crater discovered because of discontinuous geology)

Crater in ocean—but the impactor wasn’t destroyed because of the water—but the water caused the crater . . .

And cratering with yogurt and steel balls

**Lunar Landform Activity p.m. Monday 7/25/11**

Remote sensing with mini-RF (Miniature Radio Frequency)

SAR synthetic radio aperture

Sees permanently shaded craters

Possibility of water ice in these shaded areas (from asteroids)

Students may not use the right vocabulary—this activity reinforces the vocab

Transmits for a few minutes as it travels over the N and S poles

Then transmits back to Earth when Lunar Reconnaissance Orbiter is in sight of Earth

1. Lunar landform identification
	1. From photos from Apollo = remote sensing

To learn as much as we can

Why—costly and dangerous to send a manned mission immediately

Incorporate the vocabulary into the studies . . .

Difficult for an astronaut to have a sense of scale—how deep a crater is

What do they know already—what the images are

 Student sheet . . .

Identify the part numbered—see the Landform Information sheet that describe the feature

Complete—

1. highlands
2. maria
3. ray
4. multi-ringed basin
5. highlands
6. maria
7. rille
8. impact crater –rille came BEFORE the crater—the rille is smoothed by the cratering
9. central crater uplift
10. rille
11. terraced crater walls
12. “ “
13. uplift crater
14. lava flow
15. wrinkle ridge
16. dome
17. rille
18. ray/crater ejecta
19. terraced crater wall
20. central crater uplift

Helps to see direction of sunlight FIRST. Get students to identify the source direction of the sunlight.

Where would you land a vehicle? Near what landform? Why?

1. **What is that you see?—Radar part i**

Used UV earlier

Different types of spectra

Use diffraction grating on overhead projector (from Science First)

Roscoe theater color gels

($6 per sheet-see tab 2)

Moon mineralogy mapper TAB 3 in binder)

What do you see looking through blue filter?

 Over blue darker slightly, over red 🡪 black

Look at spectrum (rainbow) through the black gel paper

 Red and orange go black

 Still see green

Look at spectrum (rainbow) through the red gel paper

 See red and the orange has gone red

Look at spectrum (rainbow) through the green gel paper

 See green and a little yellow before the orange

Superimpose all and shut out ALL color

(active astronomy “Listening to light”

Solar cell with crocodile clicks attached

1. **How radar can see**

Radar part ii

Spectra from red and blue stars—different—pick up in the wavelengths res

Use a reflective spectrum

 Rocks may have more than one region

 Black no reflection

 White a lot of reflection

M3 reflective spectra of Moon

260 colors from different regions of the Moon that give a “fingerprint” of the geology of the Moon. Fingerprints patterns identify the person

Spectra from the rock identify the different rocks.

Take more than one spectrum from each rock.

Moon team given 3 different lunar rocks

Reflectance spectrometer

LPI free (except shipping) with rock samples)

Turn on see 1 (too much light) need to hold it against something.

LEDs emit different light colors

Blue puts on the blue and hold it down . . . do each in turn including the IR (but you don’t see and “color”)

Hold against paper to get the “dark voltage #”

Get a base line with a spectrum of white paper (three sheets thick)

Write the #s down for each color

Device flat on rock and press colors in turn

Subtract the base line #

# changes . . . slows down—but take the first highest # you get consistently

Let as little external light through into

Graph brightness vs wavelength

Can you identify the rocks (minerals) you find on the Moon?

One difficult . . .

# from color-coded map from section 3 in binder /

1. Anorthosite

Most moon rock Large crystals forming on the surface—formed on inside Highlands on Moon

Why are they high--

2. Basalt Large crystals forming on the surface—formed on inside low plains on Moon

Basalt on surface have fewer craters so appears younger

Rhyolite from explosive volcanoes (like a granite but crystal size may vary)—heavily cratered--last

Big dark areas are basalt

Green rocks with olivine-dunite

3. Activity imagine dunite in deep craters --deepest and most dense

Brian:

**“Student attention span = age in MINUTES**

Bear that in mind with your lesson

Include multimedia in your presentations

If they are off task—what is the trade off?

Get the students to buy into the class working “rules”