Name:_____ Points:___/10

SMITH - EARTH SPACE - 2nd PERIOD - OFF-SITE LEARNING PACKET DAY 6

Chapter 9 The Earthlike Planets
Lesson Six – The Moon Part One

Lesson Objectives

- **define the bellwork vocabulary (anorthosite, basalt, vesicular)** with 100% accuracy
- **define the two areas of the moon** with 100% accuracy
- **list the two main types of moon rocks and where they are found** with 100% accuracy

Chapter 9 Lesson 6

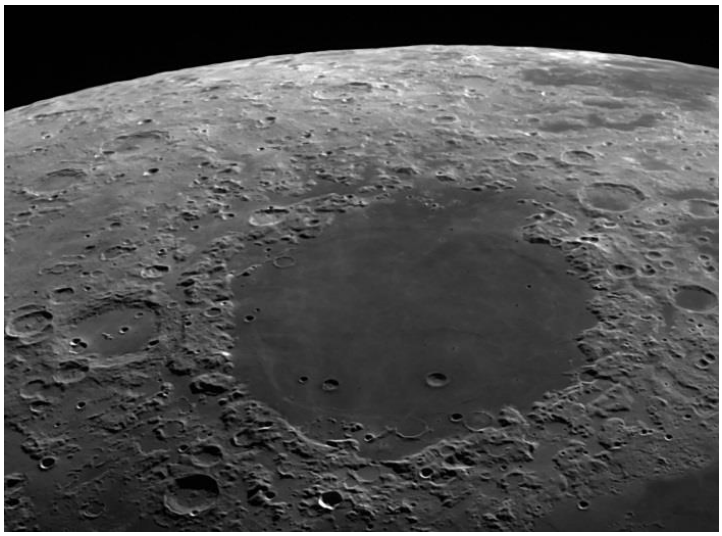
The Earth's moon is the only other world that humans have visited, and although it is small and airless it has a fascinating geological history.

The Moon

Lunar Geology

One look at the moon and one can easily see two distinct types of surfaces. First you have the dark, smooth areas, these are the lowlands. Second, you have the lunar highlands which are lighter in color and heavily battered by uncountable craters, one on top of another. Even with the naked eye, we can see these regions on Earth's moon, but in a photograph they are dramatic. The key to understanding Earth's moon lies in understanding why the lowlands, on average 3 km lower than the highlands, are so free of craters.

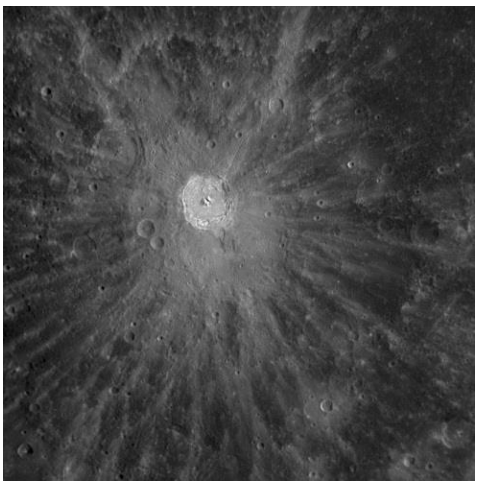
Obvious in this image are the two distinct regions on the moon. The dark areas are the lowlands and the light areas are the highlands.



The key to understanding Earth's moon lies in understanding why the lowlands, are so free of craters.

Lunar Craters

The lunar craters are impact features formed when meteorites struck the lunar surface at high velocity. These craters range from hundreds of miles in diameter down to microscopic pits. From studies of Earth's meteorite craters, we know that such impacts are rare now, so we must conclude that most craters of Earth's moon date from early in its history during the heavy bombardment at the end of planet building. Although seeing a new crater appear on the moon would be exceedingly rare, meteorites continue to fall, and craters must continue to form. This bombardment of the lunar surface has covered the surface with a layer of crushed rock called **ejecta** and the youngest craters are bright and marked by radial **rays** of fresh ejecta



The ejecta forms radial rays coming from a fairly recent crater.

Moon Rocks

Twelve Apollo astronauts visited both the highlands and the lowlands on Earth's moon between 1969 and 1972. One of the most important tasks they performed was bringing back samples of moon rocks. Most of the rocks they found were **basalts** typical of hardened lava, and some were **vesicular basalt**, which contains holes formed by bubbles in the molten rock. These bubbles form when the rock flows out onto the surface, and the lower pressure allows gases dissolved in the rock to form bubbles. The same thing happens when we open a bottle of carbonated beverage and bubbles form. The presence of vesicular basalts shows that much of the surface of Earth's moon has been covered by successive lava flows, and the flat plains of the lunar lowlands, known as **maria** (singular mare), Latin for “seas " are actually ancient lava flows. The highlands, in contrast, are rich in **anorthosite**, a light-colored rock of low density that would be among the first to solidify and float to the top of molten rock. Many of the rocks all over Earth's moon are **breccias**, rocks made up of fragments of broken rock cemented together under pressure. The breccias tell us how extensively the lunar surface has been shattered by meteorites. Nowhere did the astronauts find what they could call bedrock; the entire surface of Earth's moon is fractured by meteorite impacts.

Basalt

Anorthosite

Breccia

Vesicular basalt

As the astronauts bobbed across the lunar surface, their boots kicked up the powdery dust that covers everything on Earth's moon. This lunar dust is produced by the continuous bombardment of the lunar surface by micrometeorites, which slowly grind exposed rocks into fine gray grit about the consistency of talcum powder.

The fine dust caused by micrometeorites can easily be discerned in this image.

Overall Lunar Surface

The color of moon rocks is a dark gray, but Earth's moon looks quite bright in the night sky. In fact, the **albedo**, of Earth's moon, the fraction of the light that it reflects, is only 0.06. In other words, it reflects only 6 percent of the light that hits it. Earth, thanks mostly to its bright clouds, has an average albedo of 0.39. Thus, our moon looks bright in the night sky only in contrast. It is in reality, a cold, airless gray world.

As can be seen in this image, the moon reflects much less light than does the Earth. The moon's albedo is .06 compared to .39 for Earth.

Image URLs

https://upload.wikimedia.org/wikipedia/commons/6/67/Earth's_Moon.jpg
http://lroc.sese.asu.edu/news/uploads/lrocwac643nm_nearside_1200p.png
https://messier42.files.wordpress.com/2011/12/20111129_moonir0012_17h57_pp.jpg
https://www.psi.edu/sites/default/files/images/staff/EPO/kuiper_crater.jpg
http://upload.wikimedia.org/wikipedia/commons/f/fc/Granite-Basalt_contact.jpg
http://farm3.staticflickr.com/2552/3686988169_146af9e0d5_o.jpg
http://cdn2.bigcommerce.com/server2900/db9c4/products/542/images/1740/anorthosite2__56292.1321403894.1280.1280.jpg
http://4.bp.blogspot.com/-JXA3eCwl2xk/TmFb6AJ83aI/AAAAAAAAEbM/XYxaKvEmcOk/s1600/lunar-rock-sample-no-creature-spider-Apollo%2B18-16-Real-Moon.jpg
http://slideplayer.com/slide/5061917/16/images/17/Planet+Earth%E2%80%99s+Albedo:+30%25.jpg

Guided Reading Questions: (10 pts.)

Use the above text and class notes to answer the following questions

The Moon

1. What are the two different areas on the moon?

2. Which area has more craters?

3. What is ejecta?

4. How many astronauts have visited to moon?

5. What is the most common type of rock found on the moon?

6. What is vesicular basalt? How does it form?

7. The highlands are comprised mostly of what kind of rock?

8. What is breccia?

9. What causes the powdery dust that covers the moon surface?

10. What is albedo? What is the moon's albedo? What is the Earth's albedo?

Lesson Notes:
The Moon
Lunar Geology

- two main geographic regions
- lowlands
  - 3 km lower than highlands
  - relatively free of craters
  - darker
- highlands
  - many craters
  - lighter

Lunar Craters

- lunar craters are impact features
  - caused by impacting meteoroids
- diameters from hundreds of miles down to microscopic
- most occurred during the heavy bombardment in the early solar system

Ejecta

- The continual bombardment of the lunar surface has created a layer of fine dust called ejecta
- Since there is no erosive forces on the moon, this ejecta simply piles up year after year

Lunar Rocks
Three Main Types

- Basalts
- Anorthosites
- Breccias

Basalt

- found in the lowlands (maria)
- basalt is simply hardened lava, therefore it is an igneous rock
- vesicular basalts
  - basalt rock with lots of bubbles
  - indicates loss of volatile compounds (gasses)

Anorthosite

- Make up the highlands
- Low density rocks that would have solidified and floated to top of magma

Breccia

- clasts cemented together under pressure
- indicates lots of impacts from meteors
  - impacts would create heat that would glue the pieces of shattered rock together

Lunar Surface

- covered with fine dust (impacts from micrometeorites)
- rather gray
- albedo (amount of light reflected)
  - moon : .06 (6 %)
  - Earth : .39 (39 %)

Vocabulary:
anorthrosite - a particular type of rock found on the moon, especially in the highlands
basalt – a igneous rock, found on the moon, especially in the lowlands **(maria)**
vesicular – full of bubbles

Data File Three - The Moon

Average distance from Earth	384,400 km 238,855 miles (center to center)
Eccentricity of orbit	0.055
Maximum distance from Earth	405,500 km 251,966 miles
Minimum distance from Earth	363,300 km 225744 miles
Inclination of orbit to ecliptic	$5^o9'$
Average orbital velocity	1.022 km/sec 0.635041358 miles/s
Orbital period (sidereal)	27.321661 days
Orbital period (synodic)	29.5305882 days
Inclination of equator to orbit	$6^o41'$
Equatorial diameter	3476 km 2159 miles
Mass	7.35×10^{21} kg ($0.0123\ M_{earth}$)
Average density	3.36 g/cm^3 (3.35 g/cm^3 uncompressed)
Surface gravity	0.167 Earth gravity
Escape velocity	2.38 km/sec ($0.21\ V_{earth}$)
Surface temperature	170^o to 130^oC (274^o to 266^oF)
Average albedo	0.07
Oblateness	0.0034