



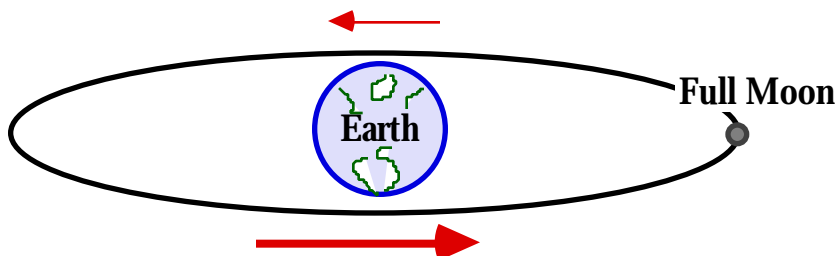
## The Great Moon Adventure Teacher's Guide

### SHOW DESCRIPTION:

*The Great Moon Adventure* is a planetarium program that examines our understanding and discoveries of the Moon. We will begin with an examination of how the Moon moves through the skies, phases, eclipses, and physical-features visible through a small telescope and/or binoculars. The second half of the program will examine the **Apollo Moon Missions** with emphasis on the first Moon landing by Neil Armstrong and Buzz Aldrin. It features a narration by Buzz Aldrin of his personal experiences on the Moon's surface. Finally, we will examine the recent findings of water near the Moon's poles by the **Lunar Prospector** space probe.

## One Month = One Moonth!

From Full Moon to Full Moon = 29 Days and 12 hours.



## 20 QUESTIONS:

1. Why does the Moon change *phases* or shape?
2. How long does it take the Earth to go through one complete set of phases (full Moon to full Moon)?
3. What unit of time is directly related to one orbit of the Moon around the Earth?
4. What keeps the Moon in orbit around the Earth?
5. How are craters formed?
6. Can the Space Shuttle go to the Moon?
7. How much gravity does the Moon have?
8. Why does the Moon have more craters than the Earth?
9. How many astronauts have walked on the Moon?
10. Who was the first person to step on the Moon?
11. What were his words as he first stepped on the Moon?
12. Who was the second man on the Moon?
13. Is the far side of the Moon always dark?
14. Why are the dark areas on the Moon called *mare*, which means ocean?
15. Where was water recently found on the Moon's surface?
16. Why is finding water on the Moon important?
17. Which rocket was used to send astronauts to the Moon?
18. List the Moon's major *phases* in order from *new Moon* to *new Moon*.
19. What is the *terminator line*?
20. Why are the astronaut's footprints still on the Moon today, even though they were made between 1969 and 1972?

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(Answers are found on page 7.)



## WORDS AND NAMES TO LEARN AND UNDERSTAND

**APOLLO MISSION:** The name given to the series of spacecraft that made the voyages to the Moon in the late 1960's and early 1970's.

**CLEMENTINE PROBE:** A space probe that was launched on January 25, 1994. It completed the first digital mapping of the Moon's surface. Using special filters and cameras, it was able to look at the Moon in many different kinds of light, even light that we cannot see with our eyes! This enables us to make the best map of the Moon ever.

**EARTHSHINE:** When the Moon is in its *crescent phase*, the dark area can be seen if you look at it carefully. That means that it is being illuminated from somewhere other than the direct Sun. The light that is illuminating it is called *Earthshine*. It is Sunlight that is reflecting off the Earth and then bouncing up and hitting the Moon. It provides just enough light so that you can see the dark area that is not being lit by the Sun directly.

**ECLIPSE:** A phenomena that occurs when the Moon goes directly in front of the Sun. For this to happen the Sun, Moon, and Earth must be in an exact straight line. If the Moon is in the middle, it blocks the Sun's light and creates a SOLAR ECLIPSE. If the Earth is in the middle, Earth blocks the Sun's light from hitting the Moon and creates a LUNAR ECLIPSE. The Sun is never in the middle of this line-up!

**HIGHLANDS:** The area on the Moon's surface that appears white from the Earth. They are made up of hills, mountains, valleys, craters, and generally rugged terrain. The rocks in the highlands are much older than the rocks in the *maria*.

**LUNAR PROSPECTOR:** A space probe that was launched on January 6, 1998. It initially orbited the Moon at an altitude of just 60 miles and was designed to study the geology of the Moon. It discovered water deep in craters near the Moon's poles.

**MARIA:** The plural term for MARE. The maria on the Moon are what appear as dark areas on the Moon's surface. They are not craters, they are level areas created by ancient lava flows. The term "*mare*" actually means "ocean" or "sea" because hundreds of years ago that's what many people thought the dark areas on the Moon were--lunar oceans.

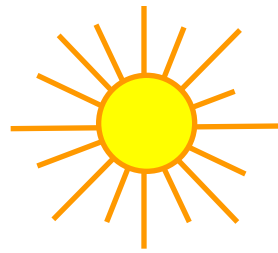
**PHASES:** The various appearances of the lit side of the Moon as it orbits the Earth. The Moon goes through one complete set of phases for each orbit around the Earth. The phases of the Moon listed in order are: *New Moon, Waxing Crescent, First Quarter, Waxing Gibbous, Full Moon, Waning Gibbous, Third Quarter, Waning Crescent, New Moon.*

**SATURN V ROCKET:** The largest rocket ever built by the United States. It was used to launch the *Apollo* spacecraft to the Moon. It stood 365 feet tall, nearly 200 feet taller than the Space Shuttle!

**TERMINATOR LINE:** The line between the lit and the dark areas on the Moon. If you were on the Moon at the terminator line, you would be watching either the Sun set or the Sun rise. This line is important because this is where shadows are longest, which highlights the contours on the Moon's surface. This is the most rewarding and interesting place to look at the Moon with a telescope or binoculars. And because the Moon is orbiting the Earth, the terminator line crosses a different region of the Moon's surface each day.

## A MOON DISTANCE PUZZLE:

Did you ever notice that the Moon and the Sun appear to be exactly the same size in the sky? Yet we all know that the Sun is much larger than the Moon. Actually the Sun's diameter is 400 times greater than the Moon's diameter. The Moon appears to be the same size because of a rare coincidence: The Moon is exactly 400 times closer to us than the Sun. That makes the two objects appear to be the same size in the sky.



Sun @  
40th  
floor

Many of us have a difficult time understanding how close the Moon is to us compared to the Sun, so here's a puzzle for you to contemplate. The information that you need to solve this puzzle is found in the above paragraph.

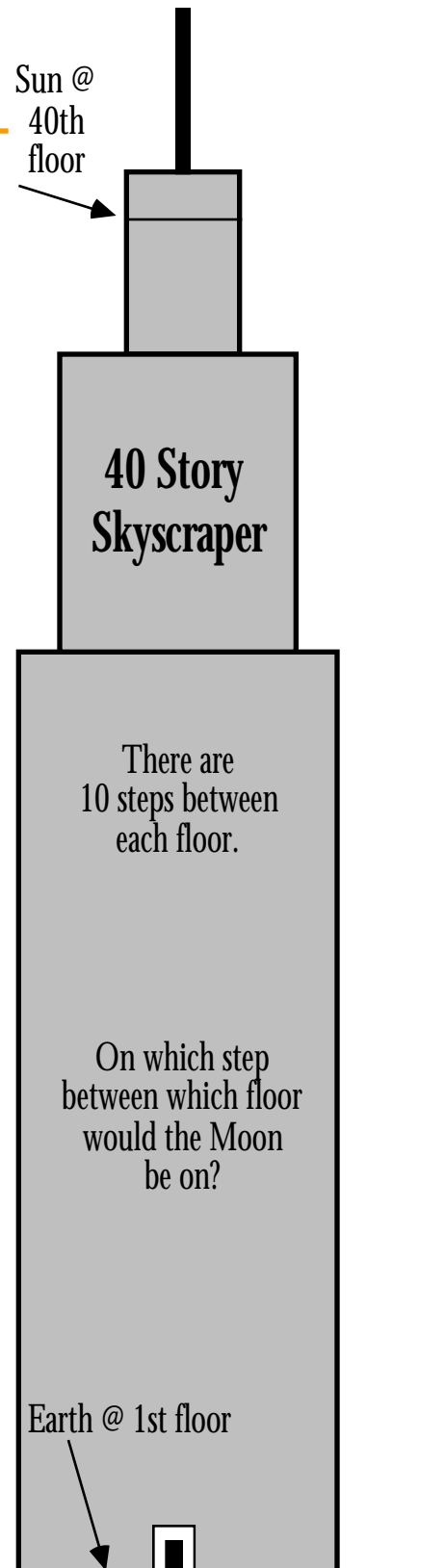
Imagine that the we were going to make a scale model of the distance between the Earth, Sun and Moon using a 40 story building. The Earth is the ground floor and the Sun is the top floor. There are 10 steps between each floor. On which step, between which floors, would you place the Moon to have the correct scale model of distance.

(Hint: Figure out how many steps there are by multiplying the number of steps between each floor by the number of floors.)

Fill in the blanks:

The Moon would be on:  
step number \_\_\_\_\_,  
above floor number \_\_\_\_\_.

(Answer on page 7.)



# The Face of the Moon

## Maria or Seas:

- Mare Australe.....The Southern Sea
- Mare Crisium.....The Sea of Crises
- Mare Fecunditatis.....The Sea of Fertility
- Mare Frigoris.....The Sea of Cold
- Mare Humorum.....The Sea of Humors
- Mare Imbrium.....The Sea of Showers
- Mare Marginis.....The Sea of Margins
- Mare Nectaris.....The Sea of Nectar
- Mare Nubium.....The Sea of Clouds
- Oceanus Procellarum.....The Ocean of Storms
- Mare Serenitatis.....The Sea of Serenity
- Mare Tranquillitatis.....The Sea of Tranquility
- Mare Vaporum.....The Sea of Vapours

## Craters:

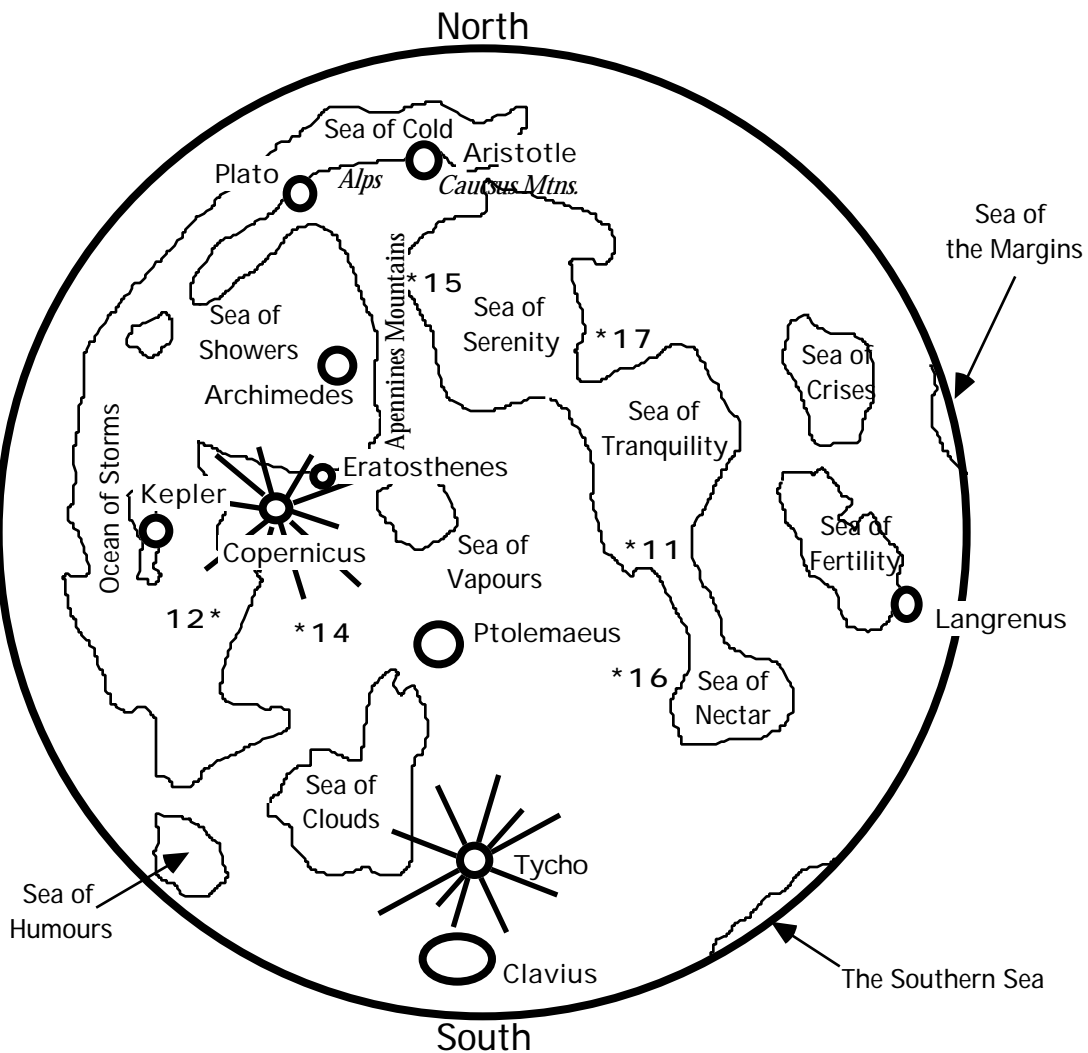
- Archimede
- Aristotle
- Clavius
- Copernicus
- Eratosthenes
- Kepler
- Langrenus
- Plato
- Ptolemaeus

## Mountains Ranges:

- Alps*
- Apennines*
- Caucasus*



\* Apollo Landing Sites





## Astronaut Footprints

The astronauts left many footprints on the surface of the Moon. This picture is of the first step taken on the Moon's surface. Notice how sharp and clean the edges are. It looks like Neil Armstrong just made that print (actually he had when the picture was taken!), but if we were to go back there today, the footprint would look exactly the same.

Why would it look just the same after more than thirty years? Do footprints on the Earth last for thirty years or more? Why?

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**ANSWERS TO QUESTIONS:**

???????

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PAGE 2. 20 QUESTIONS:

1. The Moon changes shape because of two things. First, the Sun only lights up half the Moon at a time--the half that faces the Sun. Second, the Moon revolves around the Earth, which makes us see different parts of the sunlit areas of the Moon's surface.
2. 29.5 days.
3. The Month which used to be a "Moonth".
4. Gravity.
5. Meteoroids, which are rocks that hit planets and moons. They can be very large (miles in diameter) or very small (specks of dust).
6. No. The space shuttle does not have enough power to fly that far away.
7. 1/6th the gravity of Earth. To find out what you would weigh on the Moon, simply divide your weight by six.
8. The Moon has no air or weather. On Earth, most meteorites burn up falling through the air due to friction. Even if they do last until they hit the ground and create a crater, the Earth's weather eventually erodes the crater away. On the Moon with neither air nor weather, no meteors burn up, they all hit the surface, and the only thing to destroy old craters is the impact of a new one on top of the old one.
9. 12 astronauts have walked on the Moon's surface.
10. Neil Armstrong.
11. "One small step for man, one giant leap for mankind."
12. Buzz Aldrin.
13. No. The far side of the Moon receives just as much light as the near side.
14. The mare were called that because long ago people thought those areas might actually be oceans of water. Even though we now know there is no water in the maria, we still use the term.
15. Evidence of water was recently discovered frozen deep in craters at both the north and south poles of the Moon. There may be as much as six-billion metric tons of water ice in these two regions. This was discovered by the *Lunar Prospector Probe*.
16. Finding water on the Moon is very important for possible future Moon stations or even colonies, because it means that water would not have to be brought there from Earth which is very expensive. Water is needed not only for people, plants, and animals to live, but it can also be used for rocket fuel for launching space ships to other planets.
17. The Saturn V rocket was used to send all the Apollo astronauts to the Moon.
18. New Moon, Waxing Crescent, First Quarter, Waxing Gibbous, Full Moon, Waning Gibbous, Third Quarter, Waning Crescent, New Moon.
19. The line between daylight and darkness on the Moon (or any other planet for that matter!).
20. The astronauts footprints will forever be on the Moon because there is no air, wind, rain, or weather of any kind to wear it away. The only things that might destroy the footprints would be if a meteoroid should hit the Moon in the same spot as a footprint, or in we go back to the Moon and mess them up!

PAGE 4. A MOON DISTANCE PUZZLE:

THE MOON WOULD BE ON: STEP NUMBER 1, ABOVE FLOOR NUMBER 1. There are ten steps between each floor and forty floors in all. 40 floors X 10 steps = 400 steps total. Since the Sun is 400 times farther away than the Moon, the Moon must therefore belong on just the **very first step!**

# Lunar Word Prospecting

Find the lunar words hidden in the puzzle below. The words may be found either horizontally, vertically, or diagonally.

Moonbase Mare Highlands  
Phases Crescent Rover  
Neil Armstrong Sea  
NASA Spacesuit Gravity  
First Quarter Astronaut



Luna Lunar Module Apollo  
Eclipse Saturn V Rocket  
Crater Ejecta Month  
Moonrock Earth Satellite  
Full Moon Orbit

M S E N O R U T M V E M O O N R O C K N  
T A P J B A L K M O O N B A S E E Z F D  
O T S A E N L S A Q N L T P A C O E U M  
B U H T X C A G R E U T S O B D I S L E  
G R B I U B T S E A M D H L G H G E L E  
R N E S G R N A A K J P O L U S C E M F  
A V U P L H P Z L U N A R O V E R H O S  
V R G A T E L U N A R M O D U L E C O A  
I O R C D C R A T E R A O Y E N S N N T  
T C I E J L F X N L A H K R C R C E I E  
Y K J S D I D A S D E R H G B N E E M L  
X E V U C P H A S E S B T Y A I N R H L  
E T H I A S T R O N A U T H J C T G P I  
X O M T N E I L A R M S T R O N G I K T  
G F I R S T Q U A R T E R R S K E P V E



## Lost on the Moon Activity

Read the following passage to your students and have them complete the exercise. After they have made their choices, discuss their answers in comparison to NASA's suggested answers. Then have them complete the same exercise but pretend they are on the Earth instead of the Moon.

Image yourself in the following situation. You and two friends are astronauts. You are supposed to meet with a mother ship on the lighted side of the Moon. Because of some very bad mechanical problems, your lunar lander has forced you to crash land 200 miles away from your rendezvous point. The crash landing has ruined most of the equipment aboard.

Since your life depends on making it to the mother ship, you must make the trip on foot. Only the most important things can be carried with you. Below is a list of fifteen things that were still in one piece after the crash. It is your job to rank these items. Number them from 1 to 15. Place number 1 next to the most important item you would take, number 2 next to the second most important item, and so on through number 15, the least important.

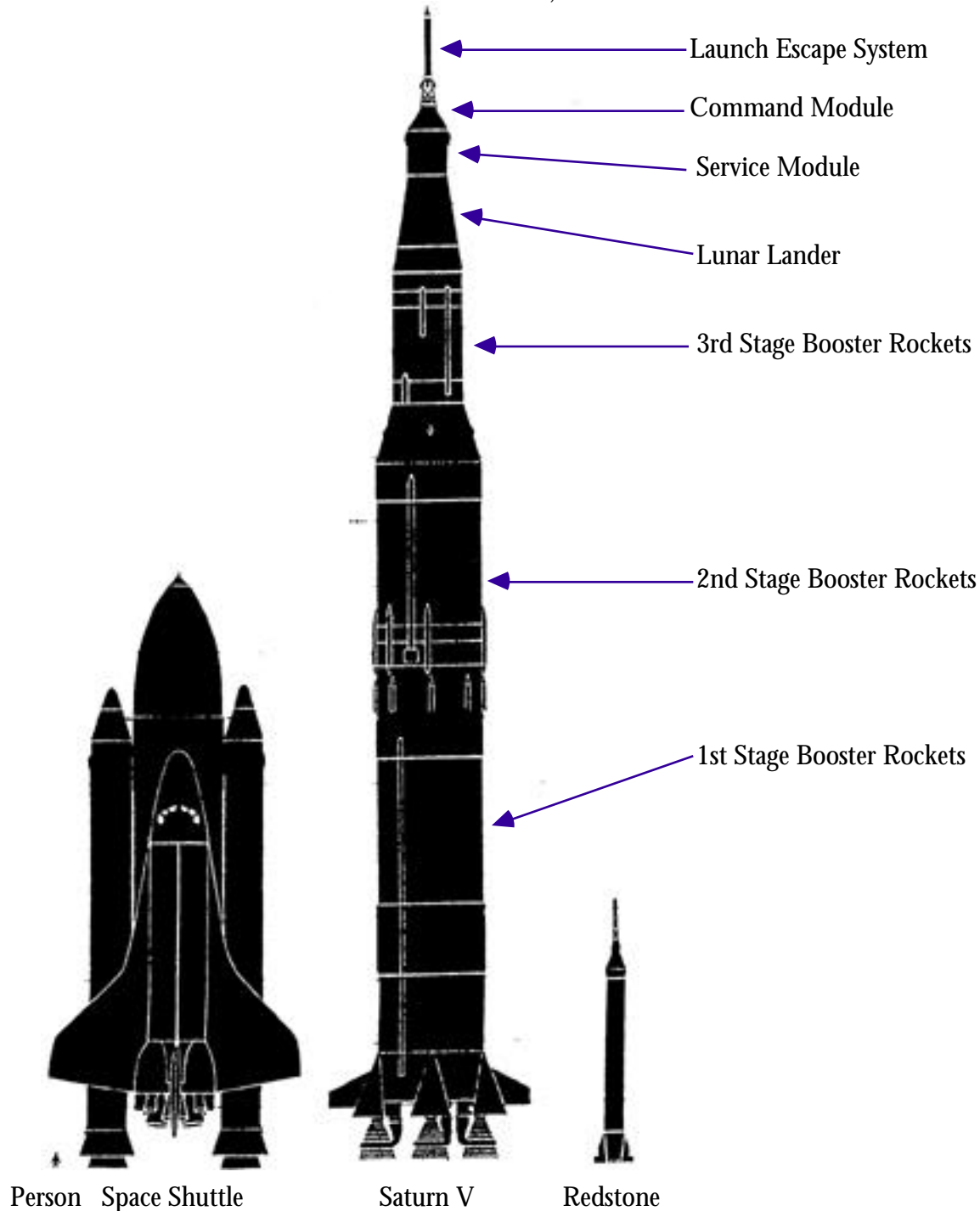
- |                                    |                         |
|------------------------------------|-------------------------|
| _____A box of matches              | _____A map of the Moon  |
| _____Food                          | _____A life raft        |
| _____50 feet of rope               | _____A compass          |
| _____A parachute                   | _____5 gallons of water |
| _____A heater                      | _____Signal flares      |
| _____Two guns                      | _____First -aid kit     |
| _____A case of dried milk          | _____A radio            |
| _____Two 100 pound tanks of oxygen |                         |

Now imagine that the same thing has happened to you on some remote part of Earth. How would your choices change?

NASA ordered them like this, but remember there are no "right" answers: 1. Oxygen tanks. 2. Water. 3. Moon map. 4. Food. 5. Radio. 6. Rope. 7. First-aid kit. 8. Parachute. 9. Life Raft. 10. Signal flares. 11. Two guns. 12. Dried milk. 13. Heater. 14. Compass. 15. Box of matches.

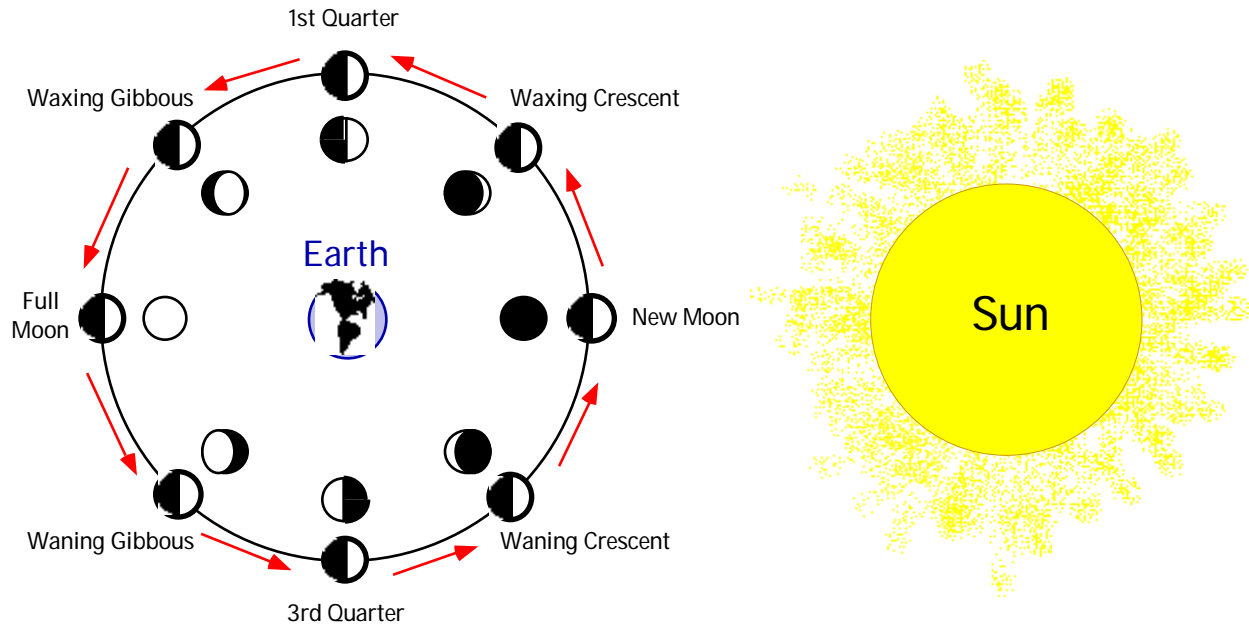
# Saturn V Rocket

The Saturn V launch vehicle was used in the Apollo trips to the Moon and to place Skylab Space Station in orbit. At nearly 365 feet tall, it included the two Apollo spacecraft and three stages of launch rockets. The first Saturn V flight was on November 9, 1967 and was called Apollo 4. The sixth launch of a Saturn V rocket was for Apollo 11, the first manned spaceflight to the Moon. Astronauts landed upon the surface on July 20th, 1969. There were a total of 13 missions involving this huge multiple stage rocket. Below compare the size of the Saturn V, to today's Space Shuttle, and the earliest manned rocket in the United States, the Redstone Rocket.



## The Phases of the Moon

The circles within the orbit show what the Moon looks like from Earth at that phase.  
Waxing means “getting bigger.” Waning means “getting smaller.”



1. What phase comes after a “1st Quarter Moon”? \_\_\_\_\_
2. What fruit most commonly resembles a Crescent Moon? \_\_\_\_\_
3. If the Moon is “waxing” is it’s phase getting: BIGGER or SMALLER ?
4. What phase comes just after the Full Moon? \_\_\_\_\_
5. What does the Moon look like at the “New Moon Phase”? \_\_\_\_\_
6. Is a “Waning Crescent” getting: BIGGER or SMALLER ?
7. Which phase of the Moon reflects the most light towards Earth? \_\_\_\_\_
8. What is the common unit of time that relates to one full set of phases? \_\_\_\_\_

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Nine Planets: <http://seds.lpl.arizona.edu/nineplanets/nineplanets/nineplanets.html>

Lunar Prospector: <http://lunar.arc.nasa.gov/>

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Solar Eclipse Stories: [http://live.exploratorium.edu/eclipse/alt\\_index.html](http://live.exploratorium.edu/eclipse/alt_index.html)

A NASA search engine for all NASA sites: <http://www.nasa.gov/search/>

NASA's Home Page: <http://www.nasa.gov/>

Teacher's Guide to the Moon: <http://lunar.arc.nasa.gov/education/tg/teach1.html>

