

Summary Notes - Topic 2: The Lunar Disc



2.1 The Shape of the Moon

- The Moon is an **oblate spheroid** but appears almost spherical. It is Earth's only natural satellite.
- The Moon's surface is covered in impact craters, maria (seas), highlands (terrae), and mountains.
- It is approximately 380,000 km from the Earth.



2.2 The Mean Diameter of the Moon

- The Moon has a mean diameter of **3,500 km**.
- This is about **27% the diameter of Earth**.

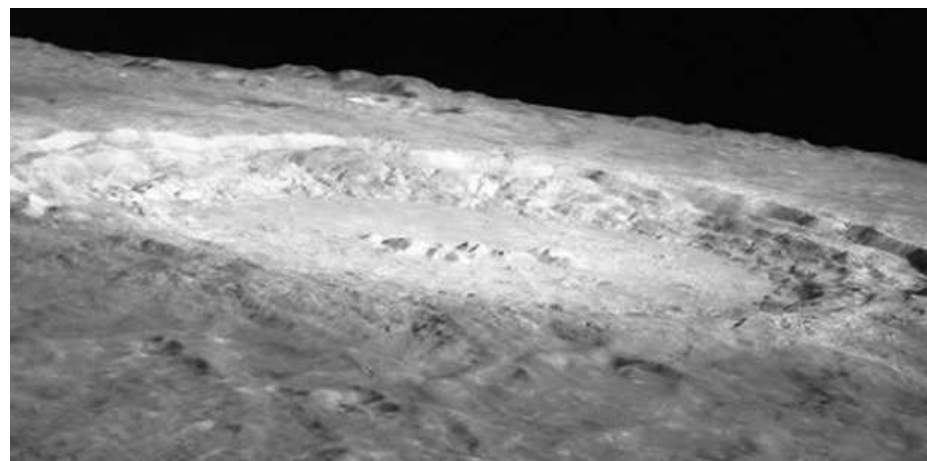
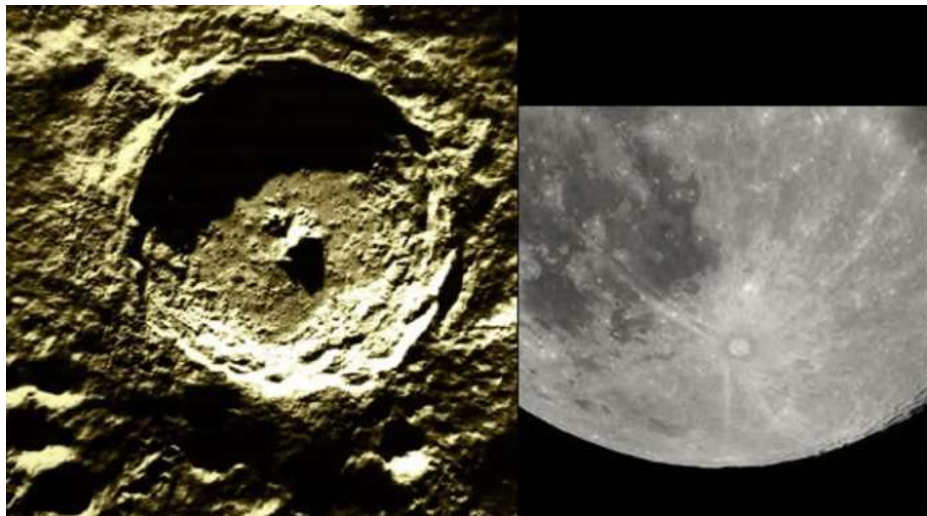
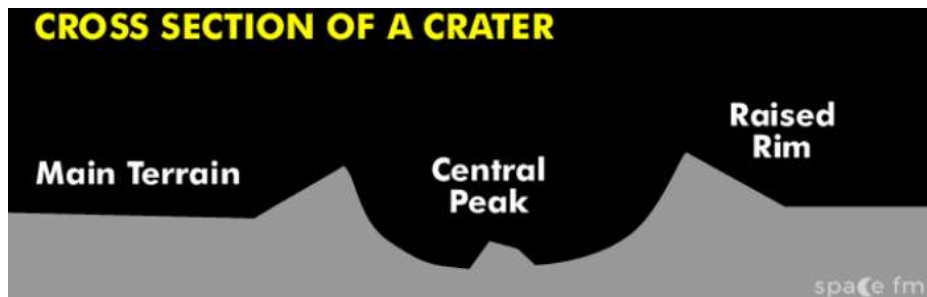


2.3 & 2.4 Lunar Surface Formations

Principal Naked-Eye Lunar Features:

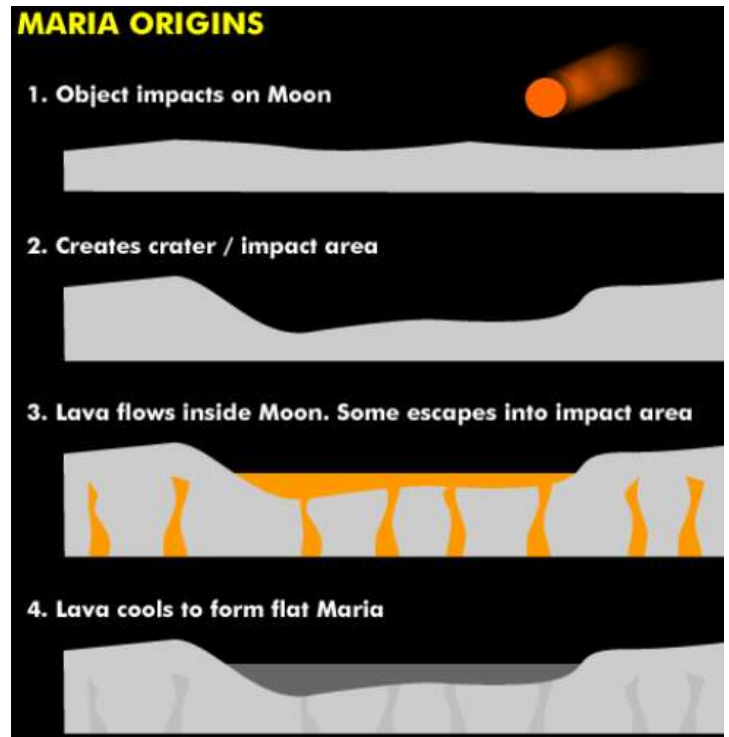
1. Craters:

- Formed when various solid bodies from our solar system, called meteoroids collided with the lunar surface. Some are so large they must have been caused by larger objects, called asteroids . One of the largest craters on the Moon is named after the Polish astronomer Copernicus and is 93km in diameter – London is roughly 40km in diameter for comparison.

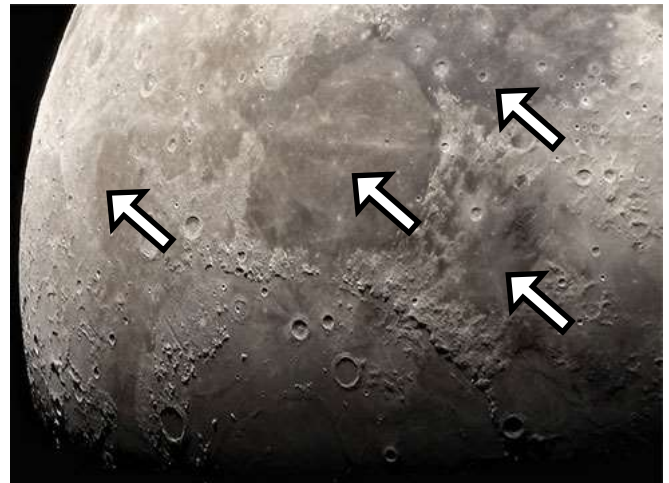


2. Maria (Seas):

- Mare (pronounced Mah-ree) is the latin word for sea and the plural is maria (pronounced Mah-ree-a). They were named so because people thought that the Moon used to have seas just like the Earth does. Today we know from geological samples taken from the Moon that they are made of basaltic iron-rich rock. This material came from under the crust of the Moon when it was relatively young, after some heavy bombardment which pierced the crust, letting the molten rock out. When that molten material cooled down, it got that darker shade that we see today.

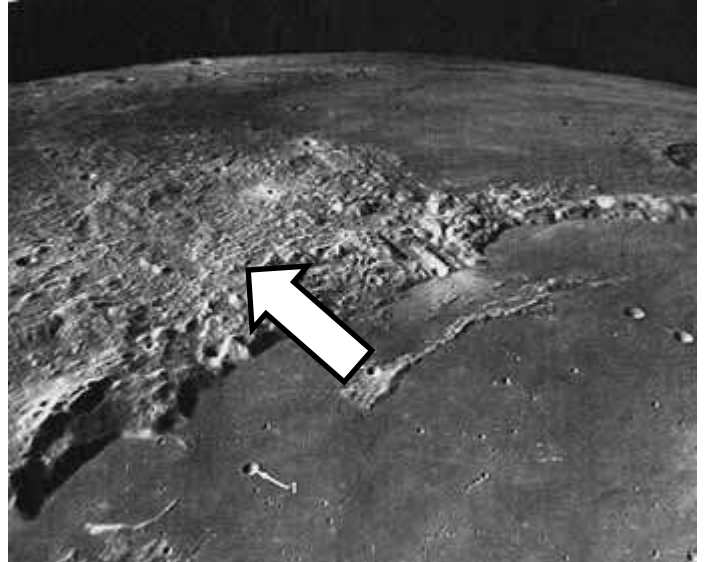


- Examples: **Sea of Tranquility, Ocean of Storms, Sea of Crises.**



3. **Terrae (Highlands):**

Terra is the Latin word for Earth, and the plural is terrae. Terrae are, in a way, the opposite of Maria. They are mountainous regions, which are highly cratered. They are composed of a different material than maria, called anorthosite, which is why they have a lighter colour. Terrae were naturally formed as the originally molten Lunar surface cooled down, forming contours, just like it did on the Earth.



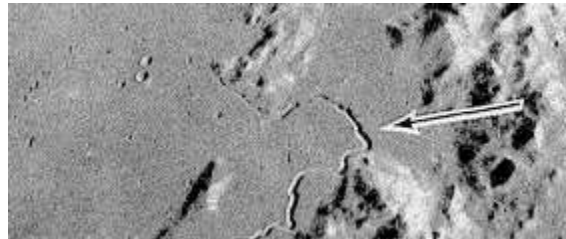
4. **Mountains:**

- Our mountains on Earth were formed by the movement of tectonic plates or volcanic action. Lunar Mountains are thought to have been formed by impacts that released magma under the early lunar surface.
- Example: **Apennine Mountains.**



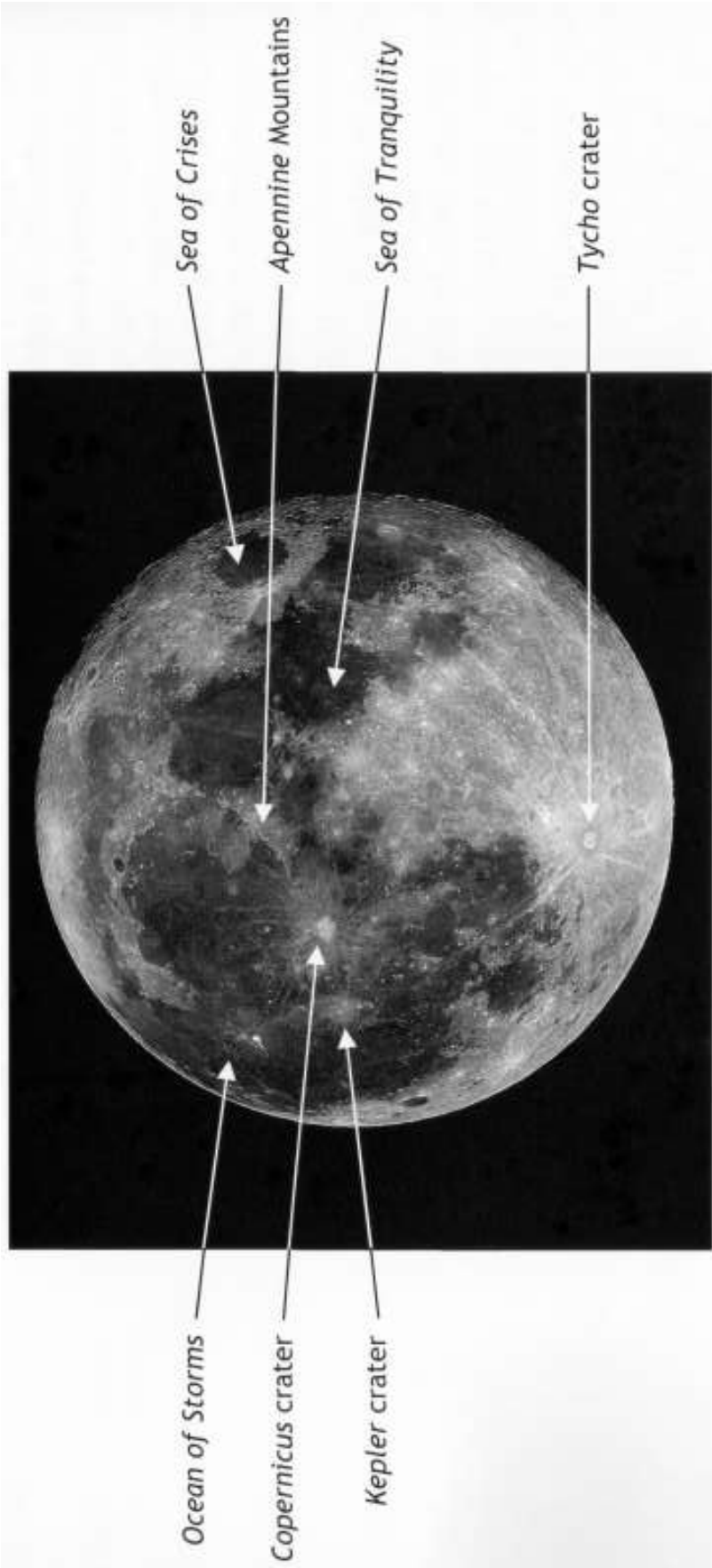
5. Valleys and Rilles:

- Valleys are long depressions on the Moon's surface. They are difficult to find with the naked eye. Although they can reach hundreds of kilometres long, they are usually only a few kilometres wide. Valleys are unusual because other features such as craters or rays (ejecta from impacts) intersect them. They are thought to have formed by ancient lava flows, collapsed lava tubes or geological faults. They are sometimes labelled as rilles - cracks or clefts on the lunar surface notably near maria. They are geological faults caused by collapsed lava tubes. When lava flowed on the Moon, the top and sides of these tubes solidified first while lava flowed underneath. When this lava moved away or solidified, the top or roof of the tube collapsed, leaving these rilles.



2.5 Identifying Lunar Features

- **Sea of Tranquility (Mare Tranquillitatis)**
 - Location: Between Mare Serenitatis and Mare Fecunditatis.
 - Size: 870 km
 - Features: Its borders are not clear; it is surrounded by some smaller mountain groups as well as small maria called bays. Best known for being the landing site of the first manned landing, Apollo 11.
- **Ocean of Storms (Oceanus Procellarum)**
 - **Location:** On the western side of the Moon
 - **Size:** 2,500 km
 - **Features:** Largest of lunar mare. Around its edges are small maria 'bays'. Its name comes from a myth that after its appearance comes bad weather on Earth.
- **Sea of Crises (Mare Crisium)**
 - **Location:** North East
 - **Size:** 555 km
 - **Features:** Circular flat mare to the north of the Sea of Tranquility with few craters within it. Wrinkle ridges are located near its edges.
- **Tycho (Crater)**
 - **Location:** South
 - **Size:** 86km diameter, 4.8km depth
 - **Features:** 100 million years old so quite young for a lunar crater. Best seen at full moon where rays of ejecta can be seen emanating from it.
- **Copernicus (Crater)**
 - **Location:** Centre-West
 - **Size:** 86km diameter, 4.8km depth,
 - **Features:** Prominent and easy to find for astronomers as brighter than surrounding landscape slightly hexagonal in shape. Prominent central peak.
- **Kepler (Crater)**
 - **Location:** To the west of Copernicus
 - **Size:** 32km diameter, 2.6km depth
 - **Features:** Landslide material and debris from the crater wall has been observed.
- **Apennine Mountain Range (Montes Appeninus)**
 - **Location:** Centre-North
 - **Size:** Approximate length: 600km 5.4km at highest point
 - **Features:** An arcing chain of mountains formed 3.9 million years ago, home to numerous craters nestled between mountains.



Sea of Crises

Apennine Mountains

Sea of Tranquility

Tycho crater

Ocean of Storms

Copernicus crater

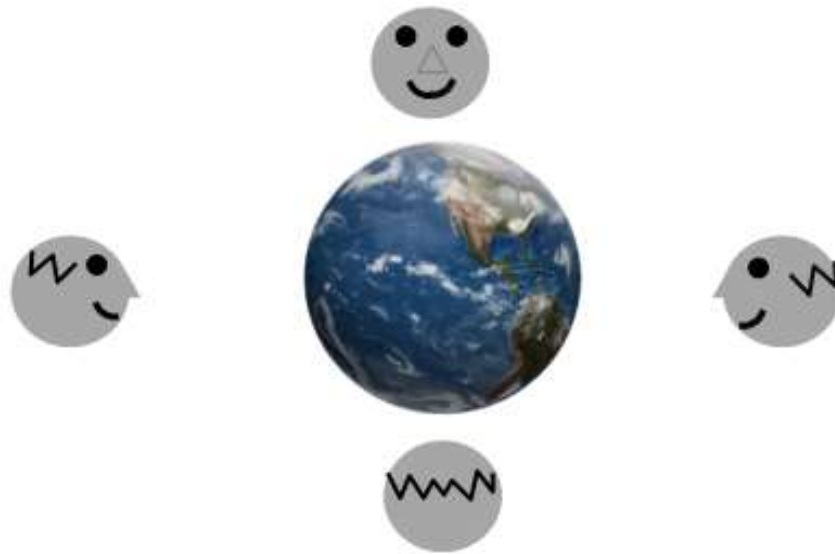
Kepler crater

2.6 Rotation and Revolution of the Moon

- **Orbital period: 27.3 days** (time taken to orbit Earth).
- **Rotation period: 27.3 days** (time taken to spin once on its axis).

2.7 Synchronous Orbit of the Moon

- The Moon is **tidally locked** to Earth.
- The orbit and rotation period of the Moon are identical - 27.3 days. The Moon has a synchronous (or captured) rotation which means it keeps the same side or face towards the body it orbits. This means that from Earth only one side or hemisphere can be seen. The Moon has a day and night and receives sunlight on every area of its surface; an exception to this are deep craters at the poles which remain in permanent darkness.



2.8 Lunar Libration

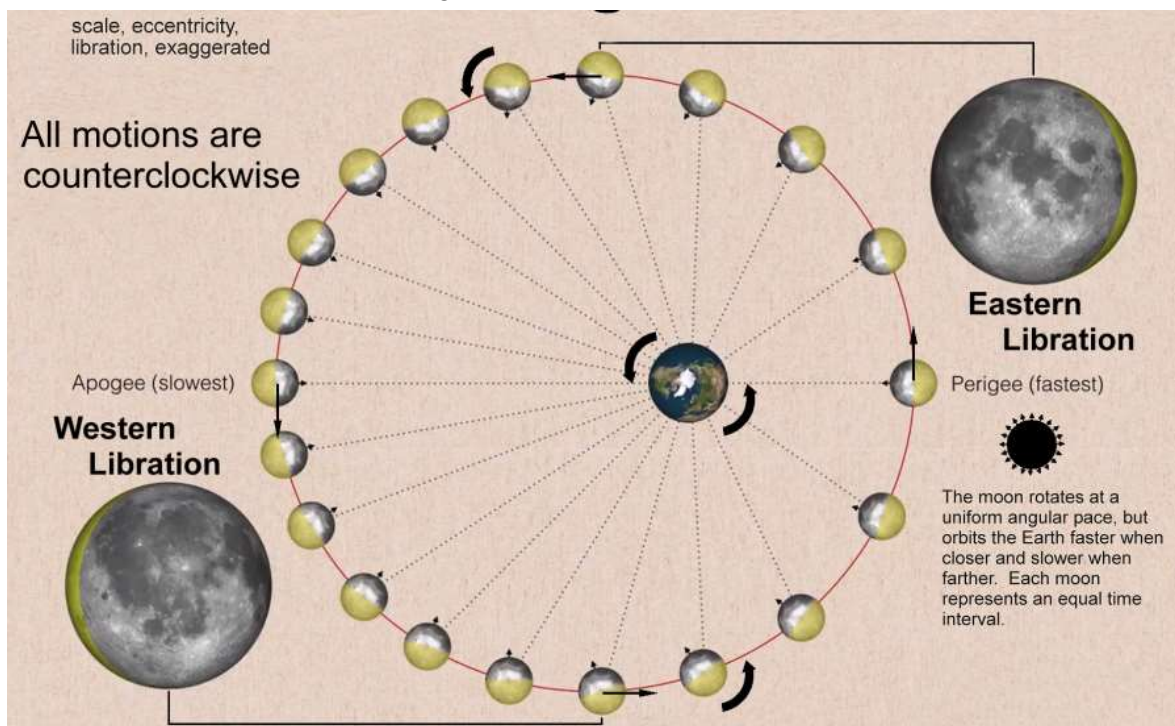
- At any moment we can only see 50% of the Moon's surface whether illuminated or not. It is not possible to see any more at any one time. We also know the Moon has a synchronous rotation and the same face is permanently turned towards us. Yet astronomers state that they can view 59% of the Moon's surface. This is possible by a process called **libration**. During the lunar cycle we can view a different part of the surface not visible during other phases. At times a crater or mountain that might appear on the edge of the Moon's disk (we call this the limb) might another time appear away from the limb. Sometimes we see a little more around the north, east, south, and west of the lunar surface. This explains how we can see 59% of the Moon's surface. We cannot see the remaining 41% from Earth, only spacecraft sent into lunar orbit can do this.

There are several reasons why this takes place.

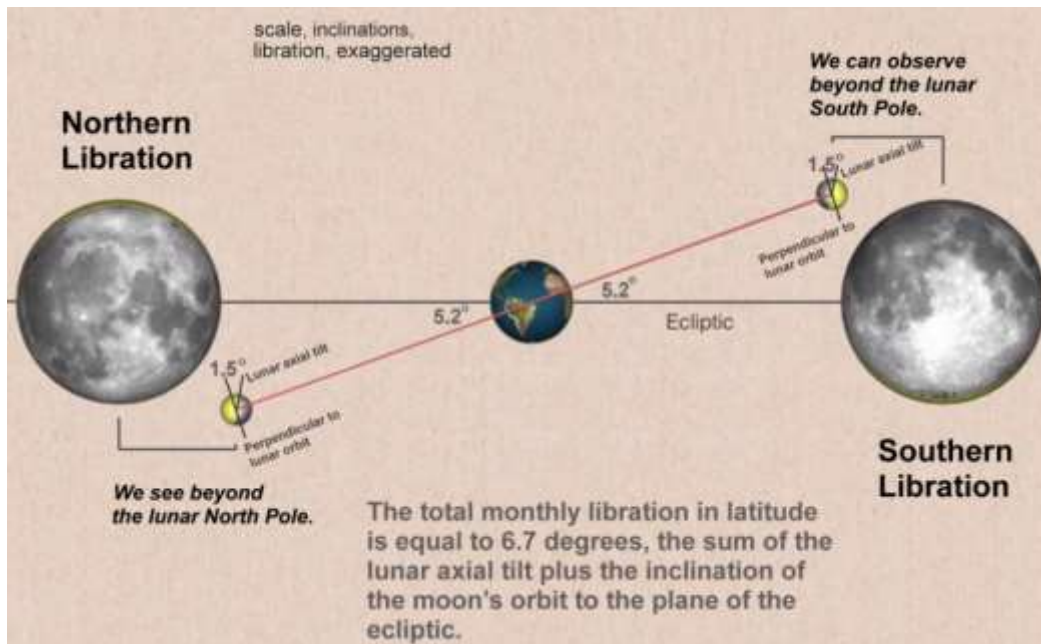
1. The elliptical orbit of the Moon around the Earth.
2. The plane of the Moon's orbit.
3. Our own observing position.
4. The Moon also has a precession effect so that it wobbles slightly.

- **Types of libration:**

1. **Libration in longitude:** The Moon's orbit around Earth is elliptical, so it sometimes moves faster and sometimes slower in its orbit. However, its rotation on its axis is steady. This mismatch means we can see a little way around the eastern and western edges at different times.



2. **Libration in latitude:** The Moon's axis is tilted by about 6.7° to the plane of its orbit. As a result, during different parts of its orbit we can "look over" its north or south poles slightly, revealing more of its surface.



3. **Diurnal libration:** Because observers on Earth see the Moon from slightly different angles at moonrise and moonset, this daily change lets us glimpse a little beyond its eastern and western edges.

