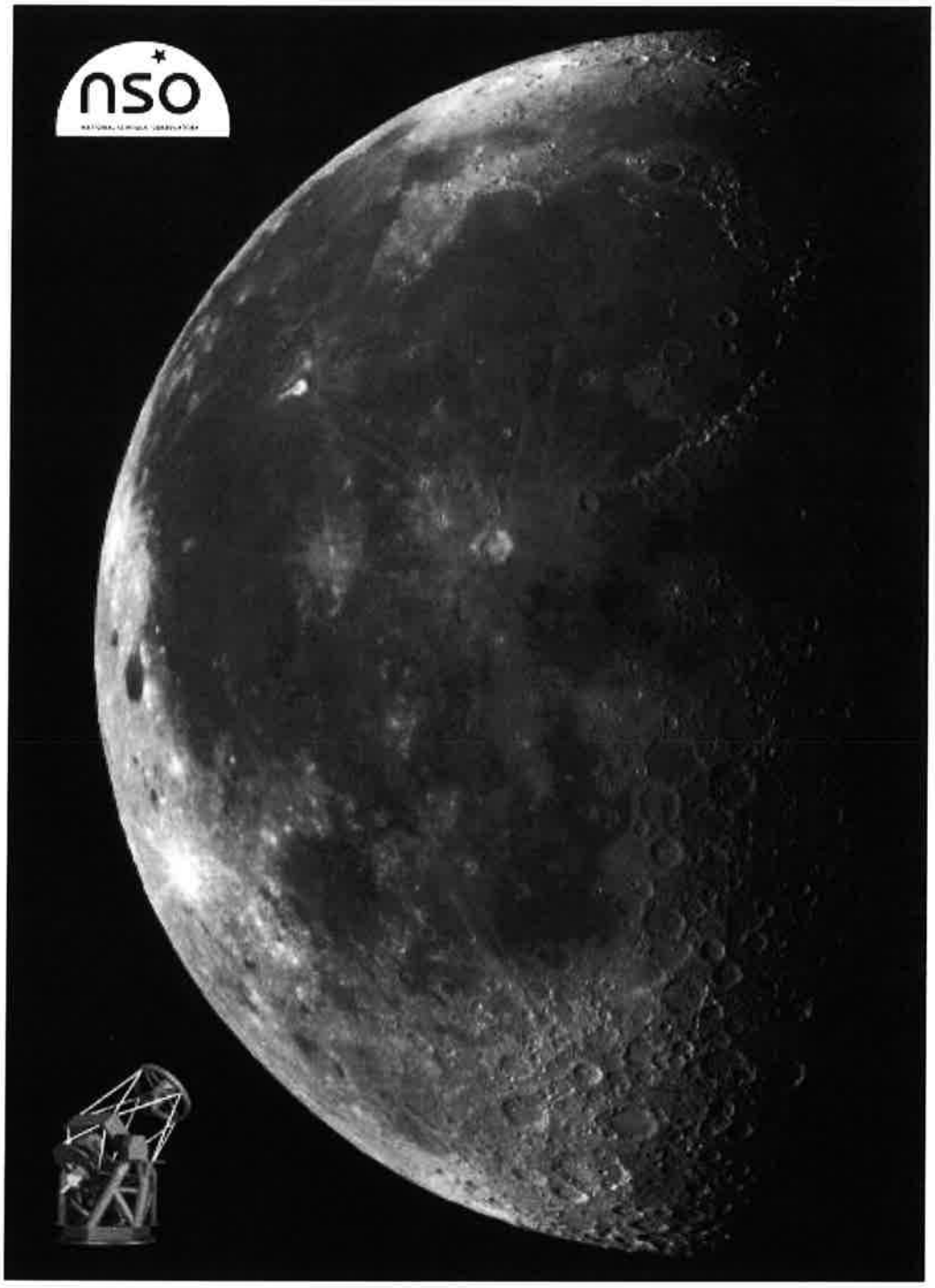
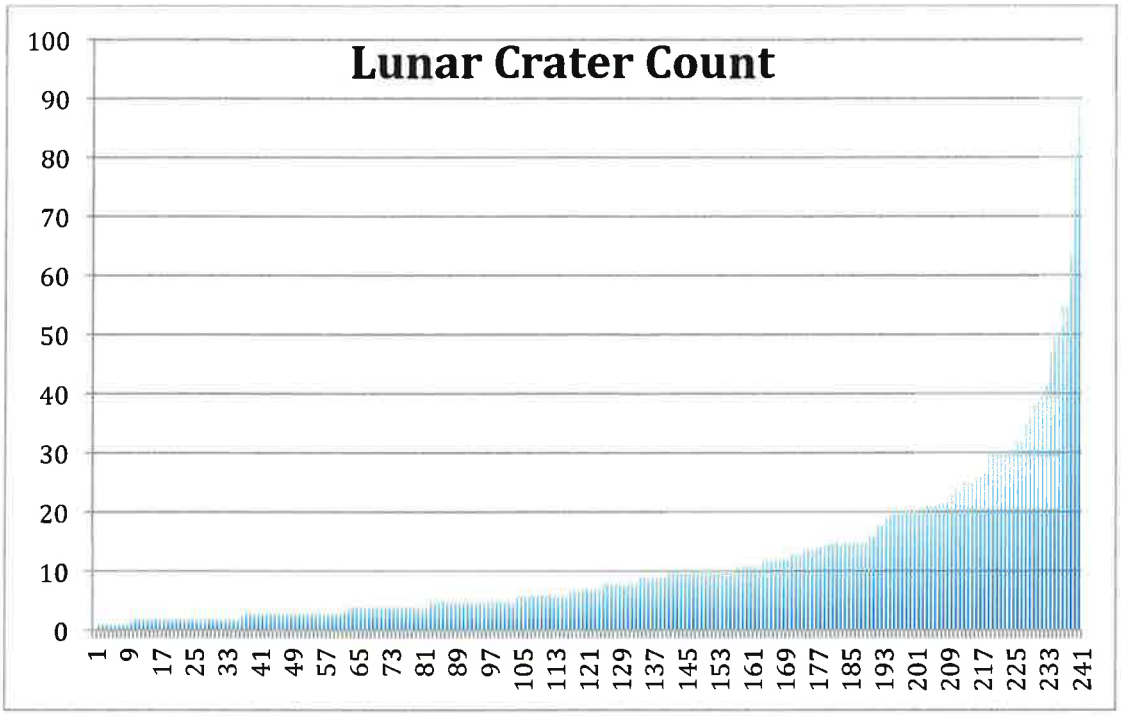
# Abingdon Schools GCSE Astronomy Group
# Lunar Information Booklet
# 2016






This chart shows all the lunar craters counted on the NSO half moon mosaic by the Abingdon Schools GCSE Astronomy class of 2016.

The true radius of the Moon is approximately 1700km

The radius of the NSO Moon mosaic is approximately 770mm

Work out a scaling factor and estimate the true size of the largest and smallest craters measured:

Extension Task – write a discussion of the distribution of crater sizes e.g. is there a typical size? Are small craters or large craters more common? Looking at the NSO image, where is the concentration of craters largest?

# Dimensions

The diameter of the Moon is 3,474,000 metres (3,474 kilometres), it has a radius of 1,737,500 metres (1,737.5 kilometres) and a circumference of 10,917,000 metres (10,917 kilometres).

The Moon has a mass of $7.35 \times 10^{22}$kg

The Moon's average distance from Earth is 384,400 km so light takes just over 1s to travel between them.

The Moon takes 27 days to orbit the Earth

# Gravity and Atmosphere of the Moon

- Gravity 1.662 $m/s^2$
- The moon's gravity pulls on the Earth, making the tides rise and fall
- The moon is 1/4 of the size of the Earth, so the Moon's gravity is much smaller than the Earth's gravity, 83.3% smaller.
- Due to the smaller gravitational pull, your weight (in N) would be much less on the Moon.

- There was thought that there was no atmosphere on the Moon as we can still see the damage caused billions of years ago because it has not been eroded
- However our moon does have an atmosphere consisting of some gases such as sodium and potassium and helium, argon, and possibly neon, ammonia, methane and carbon dioxide.
- NASA think that there are several sources for gases in the moon's atmosphere. These include high energy photons and solar wind particles knocking atoms from the lunar surface, chemical reactions between the solar wind and lunar surface material, evaporation of surface material, material released from the impacts of comets and meteoroids, and out-gassing from the moon's interior.

# Craters

(Milly, Oli and Alasdair)

## Formation

- Most craters are formed when meteorites, comets or asteroids crash into a surface - impact craters
- Impacters (the objects that form craters) aren't normally spherical - the circular shape comes from the ejection of the material during impact
- Craters can be simple or complex - simple craters are plain bowl-shapes, while complex craters have had time to develop central peaks, rings and terraces as a result of the weight of their walls acting towards the centre
- The word 'crater' comes from the Greek word 'κρατήρ', meaning a bowl-shaped mixing vessel

## Key Parts

- Floor - the base, rounded or flat and below the level of the surrounding ground
- Central peaks – formed when a crater's walls (interior sides) collapse in on themselves, pushing material in the centre up into a mound
- Rim – the edge of the crater is higher than the ground level as material is pushed up during the excavation
- Ejecta – Debris of rock material thrown out of the crater area during an impact event, radiating out from the centre; can either be individual rocks or small rocks over a wide area
- Rays – Bright streaks extending away from the crater sometimes for great distances, composed of ejecta material.

## Lunar Craters

- There are thousands of craters on the moon but only about 180 visible on Earth, since the Earth's surface regenerates through erosion (weather and plant life), tectonics (old crust slowly being replaced by new at the ocean rifts) and in some areas volcanism (where the crust is covered by lava flows).
- The largest lunar crater is the South Pole-Aitken Basin
- Its diameter is 2,500 km (the distance from London to Athens)
- Its depth is 6km (deeper than Challenger Deep in the Marianas Trench, the deepest point on the Earth)
- It is 4.3 billion years old, formed a few hundred million years after the moon's formation;
    - Its origin is unknown, as it doesn't exhibit all of the characteristics of a high-velocity impact crater (there is no material from deep in the moon's mantle at the lowest points of the basin)
    - More likely, a huge impactor hit at low velocity at a glancing angle, not deep enough to dig deep into the moon's surface

# Rilles and Wrinkles Ridges

**RILLES** are cracks or clefts on the lunar surface, notably near the maria (seas). They are geological faults caused by collapsed lava tubes.

**FORMATION: (LEFT Image)**
Rilles are narrow depressions in the moon that can be straight, smoothly curved or sinuous (meandering). They are formed from collapsed ,extinct lava flows and appear quite channel like.

**WRINKLE RIDGES** are ridges of maria (seas), usually hundreds of kilometers in length. They are thought to have been lava tunnels that have contracted and cooled.

**FORMATION: (RIGHT Image)**
Wrinkle ridges are formed by lava on the lunar surface (this lava also created the seas.) The lava contracted and cracked when it cooled. They can be straight, smoothly curved or sinuous (meandering).

# RILLES

a fissure or narrow channel on the moon's surface.

# RILLES

- German for trench or groove
- They are narrow, channel-like depressions in the moon's lunar seas.
- They can be straight, curved or sinusoidal (wavy)
- Caused by lava flows

# WRINKLE RIDGES

- Wrinkle ridges are ridges of maria usually hundreds of kilometres long.
- Only around 200 metres high – so not considered mountains.
- Thought to have caused by the buckling of the lunar surface , as a result of forces compressing the cooling ad contracting lava.

Wrinkle ridges, south of crater Humason

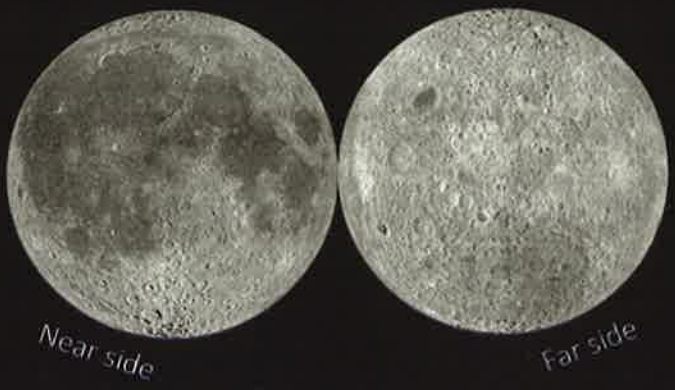
# EXTRA DETAIL ABOUT DIFFERENT TYPES!

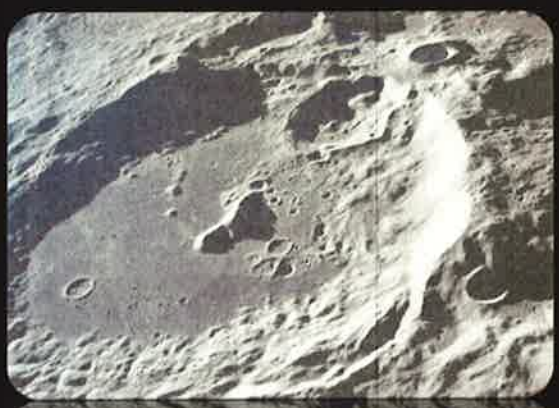
- Sinuous (wavy) rilles **meander in a curved path like a river**, and are commonly thought to be the remains of **collapsed lava tubes or extinct lava flows**. They usually begin at an extinct volcano, then meander and sometimes split as they are followed across the surface. Vallis Schröteri in Oceanus Procellarum is the largest sinuous rille.
- Arcuate rilles have a smooth curve and are found on the **edges of the dark lunar maria**. They are believed to **form when the lava flows that created a mare cool, contract, and sink**. These are found all over the moon, examples can be seen near the south-western border of Mare Tranquillitatis and on the south-eastern border of Mare Humorum.
- Straight rilles follow long, linear paths and are believed to be grabens, **sections of the crust that have sunk between two parallel faults**. These can be readily identified when they pass through craters or mountain ranges. Vallis Alpes is by far the largest graben rille, indeed it is regarded as too large to be called a rille and is itself bisected by a straight rille; Rupes Recta in Mare Nubium is a clearer example.

# Far Side of the Moon

## Features

The far side of the moon is more ragged and less smooth than the near side. It has one of the largest craters in the Solar System, the South Pole-Aitken basin (shown below). In fact, this side of the moon has a multitude of impact craters - only 1% of the surface of the far side is covered by maria compared to 31.2% on the near side. The far side is also colder, dipping to minus 243°F, and experiences more dramatic temperature changes.



## Potential

Because the far side of the Moon is shielded from radio transmissions from the Earth, it is considered a good location for placing radio telescopes. The craters there also form natural foundations for any potential telescopes. However, before this can happen, we have a long way to go. For example, there are some problems that would need to be overcome, such as the fine lunar dust can contaminate equipment and the materials used for the radio dishes must also be shielded from the effects of solar flares.

## Observation

The far side of the moon was first observed in October 1959, by the Soviet Union's small probe called Luna 3. Though this probe was somewhat simple by today's standards, it was ambitious in its goal. It achieved the first image of the far side of the moon, pictured below. Since then, there have been multiple missions to image the far side of the moon, and the latest is the Lunar Reconnaissance Orbiter, whose high-resolution cameras are so advanced that they can make out features smaller than a meter across.

Neil Armstrong, Buzz Aldrin and Michel Collins have actually ventured to the moon and Michel Collins saw the far side of the moon in the Apollo 11 when he was the loneliest person in the solar system

# The Giant-Impact Hypothesis

The Giant-Impact Hypothesis is, as of yet, the most popular theory of the Moon's formation. Widely accepted, it details the creation of the Moon following the collision of Earth with a foreign object roughly the size of Mars, known at "Theia".

Evidence supporting the theory:

- It was ascertained that certain isotopes present in the Earth exist on the Moon.
- Research suggests that similar situations have occurred in other systems.
- The Earth's spin correlates with the Moon's orbit.
- The Moon has a comparatively larger size than other natural satellites in the Solar System.

Evidence against the theory:

- Why was only one moon formed?
- The Roche limit: When an object reaches a certain proximity to a planetary body, the strength of the gravitational field of the body tears apart that object.