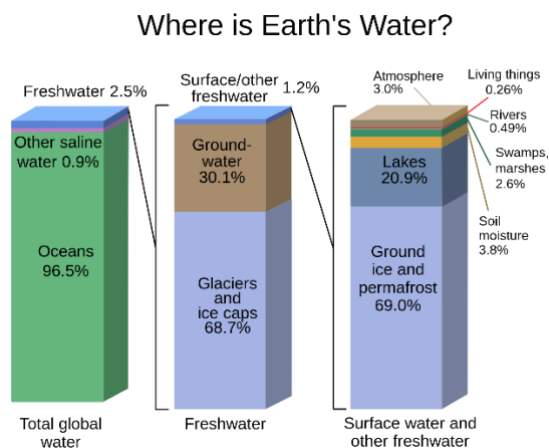


## Icy moons - Terrestrial Cryosphere Quiz (85 min):

### Part 1: Terrestrial Cryosphere (24 min)

- How thick is the thickest ice sheet on the Earth? (3 min)  
**4,897 meters (+/- 100 m answers are allowed).** *The thickest ice in the world forms part of the Antarctic Ice Sheet where it sits over a region known as the Astrolabe Subglacial Basin to the south of the Adélie Coast. Here, the ice sheet has been measured to be 4,897 meters (16,066 feet) thick*
- Where does the word 'Arctic' come from and what does it mean? (3 min)  
**Arctic = Arktos = Great Bear constellation.** *Arctic comes from the word 'Arktos' meaning the Great Bear (Ursa Major) and Small Bear (Ursa Minor) constellations seen in the northern hemisphere*
- In the Arctic Circle, which island is the largest in the Svalbard Archipelago and the home of a doomsday seed bank? (3 min)  
**Spitzbergen.** *Spitzbergen was discovered by the famous Dutch explorer Willem Barents in 1596. The Norwegian government administers Spitzbergen. It set up a seed bank to store as many seeds of the world's plant species as possible. Spitzbergen is so far north that from November to January it is in complete darkness.*
- Which pole has the highest altitude? (3 min)  
**South Pole.** *Because the North Pole is located in the Arctic Sea most of the region is sea level. The South Pole has numerous mountains. The Amundsen-Scott Base on the South Pole has a altitude of 2,835 meters (9,300 ft). That is higher than most cities in the world.*
- What time zone is the South Pole in? (3 min)  
**All.** *Since the South Pole is the place where all time zones come together, it lies in all time zones, or none. Walking around the South Pole you would have to reset your watch every step you take. It must be fun being able to cross the date line twice a minute.*  
*For convenience sake, the people in Amundsen-Scott base (and others) use New Zealand time, because supply flights come from Christchurch, New Zealand.*
- How much frozen vs liquid water is there on Earth (in percent)? (3 min)  
**1.7% per the cited Wiki source**



- Which three lakes have been accessed in Antarctica in the 2012/2013 season in the 'race for subglacial access'? (3 min)  
*Lake Vostok, led by a Russian team; Lake Ellsworth, led by the British; and Lake Whillans, led by the USA*
- It is hypothesized that Earth itself was once globally glaciated. *When would this have been and how is the period named? (3min)*  
*650 mya during the Cryogenian period. The Snowball Earth is a geohistorical hypothesis that proposes during one or more of Earth's icehouse climates, the planet's surface became entirely or nearly entirely frozen with no liquid oceanic or surface water exposed to the atmosphere. The most academically referred period of such global glaciation is believed to have occurred sometime before 650 mya during the Cryogenian period.*

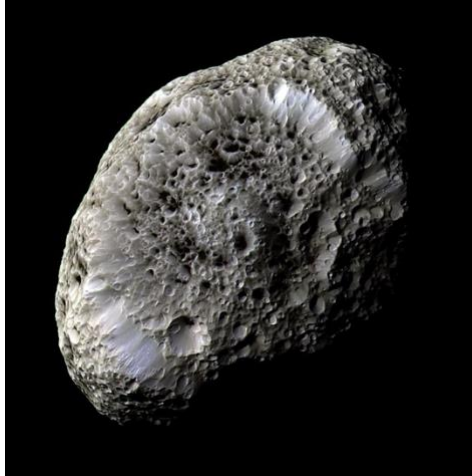
## Part 2: Icy Moons (23 min)

- Most moons have their own orbits, relatively far away from any other moons. These two moons are in almost the same orbit, close to Saturn's rings. What are their names (3 min)  
*Epimetheus and Janus -- orbit Saturn so close together that it seems as though their different orbital speeds should make them crash into each other. But due to the complex interplay of their mutual gravitational attraction and their very slightly different distances from Saturn, they never get closer than about 15,000 kilometers (9,000 miles) from each other. Instead of crashing, they exchange orbital positions in a gravitational do-si-do once every four years, in a dance that takes 100 days to play out. Cassini was able to observe the swap once during its primary mission, on January 21, 2006 at 02:24:57 UTC.*
- Which is the coldest moon in the Solar system and how cold is the temperature on its surface? (3 min)  
*Triton (-240°C or 33 K, +/-10 K answers are allowed). Triton's icy surface reflects so much of what little sunlight reaches it that the moon is one of the coldest objects in the solar system, about -400 degrees Fahrenheit (-240 degrees Celsius)*
- The discovery of which life-sparking energy source and molecule at Saturn's moon Enceladus was published in a Nature Astronomy study in 2024? (3 min)  
*Hydrogen cyanide. The discovery of hydrogen cyanide was particularly exciting, because it's the starting point for most theories on the origin of life. Life as we know it requires building blocks, such as amino acids, and hydrogen cyanide is one of the most important and versatile molecules needed to form amino acids. Because its molecules can be stacked together in many different ways, hydrogen cyanide can be seen as the Swiss army knife of amino acid precursors.*
- Match the moons with their planet. Planets: Jupiter, Saturn, Uranus, Neptune, Pluto  
Moons: (1) Daphnis, (2) Titania, (3) Nereid, (4) Telesto, (5) Amalthea, (6) Hippocamp, (7) Hydra, (8) Nix, (9) Thebe, (10) Sycorax (8 min)  
*Jupiter: Amalthea, Thebe  
Saturn: Telesto, Daphnis  
Uranus: Titania, Sycorax*

*Neptune: Hippocamp, Nereid*

*Pluto: Hydra, Nix*

- This moon looks like a giant sponge. It is one of the largest irregular shaped moons in the Solar System. What is the name of it? (3 min)



**Hyperion.** *Hyperion was the first irregular shaped moon to be discovered in 1848. It is also one of the largest irregular shaped moons in the Solar System. It has an average diameter of approximately 270 km (168 mi). Neptune's moon, Proteus, is thought to be larger, but it's debatable.*

*Instead of rotating around a common axis, Hyperion seems to tumble around like a giant potato. This tumbling makes Hyperion's orbit very erratic.*

- Some surface phenomenon / morphological features on one of the icy moons are named after cities and countries in 'One Thousand and One Nights'. Do you know the moon and what are the official names of these morphological features? (3 min)

**Enceladus. Feature names: Alexandria Sulcus, Cairo Sulcus, Baghdad Sulcus, and Damascus Sulcus.** *The tiger stripes of Enceladus consist of four sub-parallel, linear depressions in the south polar region of the Saturnian moon. Observations from Cassini's Composite Infrared Spectrometer (CIRS) instrument showed the tiger stripes to have elevated surface temperatures, indicative of present-day cryovolcanism on Enceladus centered on the tiger stripes. Enceladean sulci (subparallel furrows and ridges), like Samarkand Sulci and Harran Sulci, have been named after cities or countries referred to in The Arabian Nights. Accordingly, in November 2006, the tiger stripes were assigned the official names Alexandria Sulcus, Cairo Sulcus, Baghdad Sulcus and Damascus Sulcus (Camphor Sulcus is a smaller feature that branches off Alexandria Sulcus).[5] Baghdad and Damascus sulci are the most active, while Alexandria Sulcus is the least active.*

### **Part 3: Literature and Movies (23 min)**

- Most moons are named for mythical characters. Most moons of Uranus, however, are named after characters that appear in, or are mentioned in, the works of two famous writers. What are the names of these writers? (3 min)

**Shakespeare and Alexander Pope.** *Although the first two Uranian moons were discovered in 1787, they were not named until 1852, a year after two more moons had been discovered. The responsibility for naming was taken by John Herschel, son of the discoverer of Uranus. Herschel, instead of assigning names from Greek mythology,*

named the moons after magical spirits in English literature: the fairies Oberon and Titania from William Shakespeare's *A Midsummer Night's Dream*, and the sylph Ariel and gnome Umbriel from Alexander Pope's *The Rape of the Lock* (Ariel is also a sprite in Shakespeare's *The Tempest*). The reasoning was presumably that Uranus, as god of the sky and air, would be attended by spirits of the air. Subsequent names, rather than continuing the airy spirits theme (only Puck and Mab continued the trend), have focused on Herschel's source material. In 1949, the fifth moon, Miranda, was named by its discoverer Gerard Kuiper after a thoroughly mortal character in Shakespeare's *The Tempest*. The current IAU practice is to name moons after characters from Shakespeare's plays and *The Rape of the Lock* (although at present only Ariel, Umbriel, and Belinda have names drawn from the latter; all the rest are from Shakespeare). The outer retrograde moons are all named after characters from one play, *The Tempest*; the sole known outer prograde moon, Margaret, is named from *Much Ado About Nothing*.

- This moon was named after the daughter of the lead character in "The Tempest". What is the name of this moon? (3 min)

**Miranda.** In 1949, the fifth moon, Miranda, was named by its discoverer Gerard Kuiper after a thoroughly mortal character in Shakespeare's *The Tempest*.

- Match titles and authors to the following book covers (8 min):

**Titles:** (1) 3001: The final odyssey, (2) Farmer in the Sky, (3) Triton, (4) The Cassini division, (5) Titan, (6) The Ice Orphan of Ganymede, (7) The Moons of Jupiter, (8) The frozen sky

**Authors:** (1) Leonardo Ramirez, (2) Alice Munro, (3) Jeff Carlson, (4) Arthur C. Clarke, (5) Robert A. Heinlein, (6) Ben Bova, (7) Samuel R. Delany, (8) Ken MacLeod



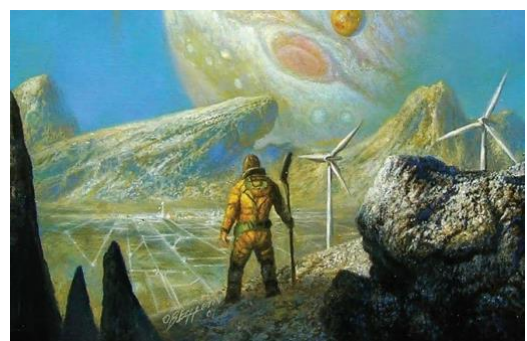
Arthur C Clarke, 3001: The final odyssey.



Leonardo Ramirez, The Ice Orphan of Ganymede.



Alice Munro, The Moons of Jupiter.



Robert A. Heinlein, Farmer in the Sky





Samuel R. Delany, Triton



Jeff Carlson, The frozen sky



Ken MacLeod, The Cassini division



Ben Bova, Titan

- Which moon resembles the Death Star from Star Wars? (3 min)

**Mimas.** Mimas was discovered by British astronomer William Herschel on September 17, 1789. The diameter of Mimas is approximately 396 km (246 mi). The most distinguishing feature of Mimas is a large impact crater discovered in 1980 by the Voyager spacecraft. The crater was named Herschel after Mimas' discoverer.

*The Herschel crater causes Mimas to resemble the Death Star from "Star Wars". It is coincidental as the first "Star Wars" film was released in 1977, three years before the crater was discovered.*

- In which 2013 movie was life discovered on one of the icy moons? (3min)

**Europa report.** Europa Report is a 2013 American science fiction film directed by Sebastián Cordero and written by Philip Gelatt. It stars Christian Camargo, Anamaria Marinca, Michael Nyqvist, Daniel Wu, Karolina Wydra, and Sharlto Copley. A found footage film, it recounts the fictional story of the first crewed mission to Europa, one of the four Galilean moons of Jupiter. Despite a disastrous technical failure that causes the loss of all communications with Earth, and a series of further crises, the crew continues its mission to Europa and finds mounting evidence of life on the moon.

- In the TV Series "The Expanse", hundreds of years in the future, humanity has colonized the Solar System. The three largest powers are the United Nations of Earth and Luna, the Martian Congressional Republic on Mars, and the Outer Planets Alliance (OPA), a loose political confederation of colonies scattered across the asteroid belt and the moons of Jupiter and Saturn. On which icy moon of Saturn is there a research station? (3 min)

***Phoebe.** The station was established by a joint research group between Protogen and the Martian Naval Scientific Service. In addition to the researchers, Mars provided naval support staff, raising the station population to a few hundred people.*

#### **Part 4: History (15 min)**

- In what year did Galileo Galilei publish his discovery of moons orbiting Jupiter? (3 min)

***1610 (+/- 10yrs answers are allowed).** Galileo Galilei lived from 1564 until 1642 and was a big influence in the Renaissance. According to Wikipedia, Galileo has earned a few pretty significant monikers: the "father of modern observational astronomy", the "father of modern physics", the "father of science", and the "father of modern science".*

*Finding moons orbiting Jupiter essentially disproved geocentrism (all planetary bodies orbiting the Earth), and Galileo became a proponent of the heliocentric model (the planets orbit the sun, and moons orbit the planets). It didn't sit well with many people, and especially not with the Church.*

- Galileo did not name the four moons after Zeus' lovers from Greek mythology. Rather, hoping to garner favour from a prospective patron, he initially called them Cosmica Sidera (or Cosimo's stars). To which family did Cosimo belong? (3 min)

***de' Medici (just Medici is also allowed).** Galileo was the tutor of Cosimo de' Medici between 1605 and 1608, when Cosimo was a teenager (he was born in 1590). His father's death in 1609 vaulted Cosimo to the position of Grand Duke of Tuscany, a position he held for 11 years.*

*Galileo made his discovery only a year into Cosimo's reign, and he wanted to curry favour with his former pupil to hopefully gain a patron. The Grand Duke's secretary, however, thought it might be better to honour the whole family, so Galileo settled on the name Medicea Sidera (the Medician stars) instead.*

- Who named the Galilean moons? (3 min)

***Simon Marius after the suggestion of Johannes Kepler.** The names that eventually prevailed were chosen by Simon Marius, who discovered the moons independently at the same time as Galileo: he named them at the suggestion of Johannes Kepler after lovers of the god Zeus (the Greek equivalent of Jupiter), in his *Mundus Jovialis*, published in 1614.*

*Galileo steadfastly refused to use Marius' names and invented as a result the numbering scheme that is still used nowadays, in parallel with proper moon names. The numbers run from Jupiter outward, thus I, II, III and IV for Io, Europa, Ganymede, and Callisto respectively.] Galileo used this system in his notebooks but never actually published it. The numbered names (Jupiter x) were used until the mid-20th century when other inner moons were discovered, and Marius' names became widely used.*

- When did the Ann Bancroft (the first known woman to reach both poles) reach the North Pole? What about South Pole? (3 min)

***North Pole: 1986 (+/- 2yr answers are allowed).***

**South Pole: 1993 (+/- 2yr answers are allowed).**

*In 1986, in a dog-sled expedition, Will Steger of Ely, Minnesota, and his team of four, including a woman—Ann Bancroft of Scandia, Minnesota—reached the North Pole sledge hauling.*

*In 1993, Ann Bancroft, recognized as the first known woman to reach the North Pole, led a four-women group, the American Women's Expedition (AWE), in reaching the South Pole on foot, an historic achievement that won for her the distinction of being the first known woman to have reached both Poles.*

- When was the first station built at the South Pole and what is its name? (3 min)  
**1957, Amundsen-Scott South Pole Station (+/- 1yr answers are allowed).** *The first station, built to support researchers during the International Geophysical Year, was begun in November 1956 and completed in February 1957. The station's name honors Roald Amundsen and Robert F. Scott, who attained the South Pole in 1911 and 1912.*